APPOLO STUDY CENTRE CHENNAI

APPOLO STUDY CENTRE

TEST – 4 GEOGRAPHY

Part – I

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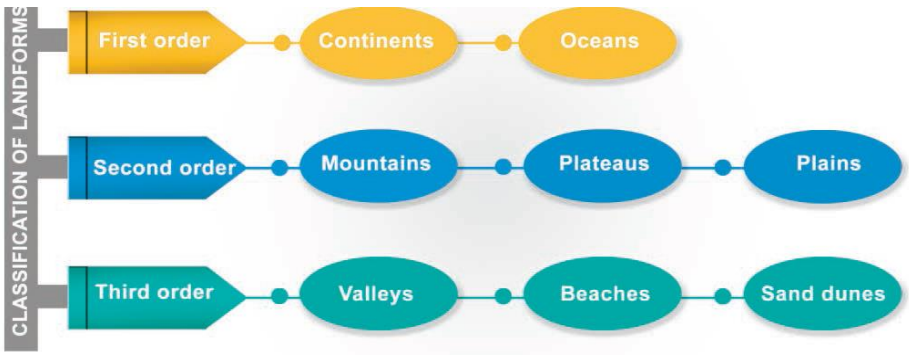
6th Term I
Unit - 2 Land and Oceans

- This is Pangea, the Super Continent, and the Sea around is Panthalasa. It was 200 million years ago, when these landmasses moved away from each other to gain the present position as continents and oceans."

- The Earth is covered by water which occupies 71 percent and land that occupies 29 percent of the Earth's surface. The surface of the Earth is not even, because it has lofty mountains, deep oceans and other landforms. These landforms can be classified as



First order landforms

- Continents and oceans are grouped as first order landforms. The vast land masses on Earth are called Continents and huge water bodies are called Oceans. There are seven continents. They are Asia, Africa, North America, South America, Antarctica, Europe and Australia. Asia is the largest continent, whereas Australia is the smallest one.

Land classification - Sangam period

- Kurinji - Mountain and its environs
- Mullai - Forest and its surroundings
- Marutham - Agricultural land and its adjoining areas.
- Neithal - Sea and its environs
- Palai - Desert region

- Apart from continents, there are five oceans located on the Earth's surface. They are the Pacific, Atlantic, Indian, Southern and Arctic Ocean. Among these oceans, the Pacific Ocean is the largest and the Arctic Ocean is the smallest.

Isthumus : A narrow strip of land which connects two large landmasses or separates two large waterbodies.

Second order landforms

- The second order landforms are categorised as mountains, plateaus and plains.

Mountains

- A landform that rises 600 metre above its surroundings and has steep slopes is called a mountain. Mountains are found in isolation or in groups. If the mountains extend for a larger area continuously, it is called a mountain range. These ranges stretch for hundreds or thousands of kilometre. The Himalayas of Asia, the Rocky Mountains of North America and the Andes of South America are such examples. The Andes mountain in South America is the longest mountain range (7,000 km) in the world. The highest point of a mountain is known as peak. Mt. Everest is the highest peak (8,848 m) in the world.

- Mountains are the sources of rivers. They provide shelter to flora and fauna. Here, tourism is an important activity. During summer, people go to mountain regions to enjoy the pleasing cool weather. Udhagamandalam, Kodaikanal, Kolli hills, Yercaud and Yelagiri are some of the hill stations found in Tamil Nadu.

Plateaus

- Plateaus are the elevated portions of the Earth that have flat surfaces bounded by steep slopes. The elevation of plateaus may be a few hundred metre or several thousand metre. Tibetan Plateau is the highest plateau in the world. So, it is called

as the 'Roof of the world'. The flat topped part of the plateau is called Tableland. The plateaus are generally rich in minerals. The Chotanagpur Plateau is one of the mineral rich plateaus in India. Therefore, mining is one of the major activities of the people living here. The Deccan Plateau in peninsular India is of volcanic origin.

Dharmapuri Plateau, Coimbatore Plateau and Madurai Plateau are found in Tamil Nadu.

Plains

- Plains are a flat and relatively low-lying lands. Plains are usually less than 200 metre above sea level. Sometimes they may be rolling or undulating. Most plains are formed by rivers and their tributaries and distributaries. These plains are used extensively for agriculture due to the availability of water and fertile soil. Theyare most suitable for human inhabitation. Hence, they are the highly populated regions of the world. The oldest civilisations like the Mesopotamian and the Indus civilisations developed in river plains. The Indo-Gangetic plain in North India is one of the largest plains in the world. The plains formed by river Cauvery and Vaigai are important plains found in Tamil Nadu. Coastal plains are the low lying lands adjacent to oceans and seas.

The plains have been the cradle of civilisations from the earliest times. **For example:** the Indus in India, the Nile valley in Egypt are some of the early civilisations which developed and flourished.

Third order landforms

- Third order landforms are formed on mountains, plateaus and plains mainly by erosional and depositional activities of rivers, glaciers, winds and waves. Valleys,beaches and sand dunes are some examples of third order landforms.

Erosion is the process of removal of surface material from the Earth's crust. The eroded materials are transported and deposited on the low lying areas. This process is called as Deposition

Oceans

- The Earth looks blue when we see it from space. This is because, two-thirds of it is covered by water. The water is found in oceans and seas. Oceans are vast expanse of water. Seas are water bodies partially or fully enclosed by land. As you have studied previously, there are five main oceans in the world.

The Pacific Ocean

- The Pacific Ocean is the largest and deepest ocean on the Earth. It covers about one-third of the Earth's total area and spreads for about 168.72 million

sq.km. It is bounded by Asia and Australia in its west and North America and South America in its east. It stretches from the Arctic Ocean in the north to the Southern Ocean in the south.

If Mount Everest, which is the highest point (8,848 metres) was plugged into the Mariana Trench, still there would be 2,146 metres of water left.
The depth in meters from mean sea level is denoted as m-

- This ocean's shape is roughly triangular with its apex in the north at the Bering Strait which connects the Pacific Ocean with the Arctic Ocean. The Bering Sea, the China Sea, the Sea of Japan, Tasman Sea and the Philippine Sea are some of the marginal seas of the Pacific Ocean. Indonesia, Philippines, Japan, Hawaii, New Zealand are some of the islands located in this Ocean. The deepest point Mariana Trench is 10,994 m- and is located in the Pacific Ocean. A chain of volcanoes is located around the Pacific Ocean called the Pacific Ring of Fire.

The Spanish navigator Ferdinand Magellan named the ocean Pacific, meaning calm or tranquil.

The Atlantic Ocean

- The Atlantic Ocean is the second largest ocean on the Earth. It covers one sixth of the Earth's total area and spreads for about 85.13 million sq.km . It is bounded by North America and South America in the west and Europe and Africa in the east. Like the Pacific, it stretches from the Arctic Ocean in the north to the Southern Ocean in the south. The shape of the Atlantic Ocean resembles the letter 'S'. The Strait of Gibraltar connects theAtlantic Ocean with the Mediterranean Sea. The Atlantic Ocean is the busiest shipping route between the Eastern and Western hemispheres. The deepest point is the Milwaukee Deep in the Puerto Rica Trench. It has a depth of about 8600 m-. The Caribbean Sea, the Gulf of Mexico, the North Sea, the Gulf of Guinea and theMediterranean Sea are important marginal seas of the Atlantic Ocean. St. Helena, Newfoundland, Iceland and Falkland are some of the islands found in this ocean.

The Indian Ocean

- The Indian Ocean is the third largest ocean on the Earth's surface. It covers an area of about 70.56 million sq.km. It is named after India. It is triangular in shape and bounded by Africa in the west, Asia in the north and Australia in the east. The Andaman and Nicobar Islands, Lakshadweep, Maldives, Sri Lanka, Mauritius and the Reunion Islands are some of the islands located in the Indian Ocean. Malacca strait connects the Indian Ocean and the Pacific Ocean.

Palk Strait connects the Bay of Bengal and Palk Bay.

- The Bay of Bengal, the Arabian Sea, the Persian Gulf and the Red Sea are some of the important marginal seas of the Indian Ocean. The Java trench (7,725 m-) is the deepest point in the Indian Ocean.

- 6° Channel separates Indira Point and Indonesia
- 8° Channel separates Maldives and Minicoy islands
- 9° Channel separates Lakshadweep Islands and Minicoy islands
- 10° Channel separates Andaman and Nicobar Islands

The Southern Ocean

- The Southern Ocean surrounds the continent of Antarctica and is enclosed by the 60°S latitude. It covers an area of 21.96 million sq.km. It is bordered by the southern parts of the Pacific, the Atlantic and the Indian Oceans. The Ross Sea, the Weddell Sea and the Davis Sea are the marginal seas of this Ocean. Farewell Island, Bowman Island and Hearst Island are some of the islands located in this ocean. The water inthis ocean is very cold. Much of it is covered by sea ice. The deepest point in this ocean is South Sandwich Trench with a depth of 7,235 m-.

The Arctic Ocean

- The Arctic Ocean is the smallest ocean. It covers an area of 15.56 million sq.km. It lies within the Arctic Circle. It remains frozen for most of the year. The Norwegian Sea, the Greenland Sea, the East Siberian Sea and the Barents Sea are some of the marginal seas of this ocean. Greenland, New Siberian Island and Novaya Zemlya Island are some of the islands located in the Arctic Ocean. The North Pole is situated in the middle of the Arctic Ocean. The Eurasian Basin is the deepestpoint in the Arctic Ocean, which is about 5,449 m- in depth.

6th Term -3
Unit-1 Asia and Europe

ASIA

- Asia is the largest and the most populous continent in the world. It covers about 30 percent of the world's land area and about 60 percent of the world's population. Most of the land of Asia lies in the northern hemisphere. It has different types of physical and cultural features. Lofty mountains, plateaus, plains, islands and peninsulas are the major physiographic features of Asia. Many perennial rivers flow through different parts of Asia. These river valleys are the cradles of ancient civilizations (Indus valley, Mesopotamian and Chinese civilizations). Let us know more about our home continent.

Location and Area

- Asia extends from 10˚11' South to 81˚12' North latitudes and from 26˚2' East to 169˚40' West, longitudes. It spreads for an area of 44 million km2.

Boundaries

- Asia is surrounded by the Arctic Ocean in the north, Pacific Ocean in the east, Indian Ocean in the south and the Ural Mountains, Caucasus Mountains, Red Sea, Mediterranean Sea, Caspian Sea and Black Sea in the west. The Suez Canal separates Asia from Africa. The narrow Bering Strait separates Asia from North America.

Political Divisions

- There are forty eight countries in Asia. The countries are grouped into several realms based on landscape and political status such as 1.East Asia 2.Southeast Asia 3.South Asia 4.Southwest and 5.Central Asia

Physiographic Divisions

- Asia is the land of long mountain ranges, snow-capped high mountains, vast plateaus, extensive plains, river valleys and sea coasts. These diverse physical features encourage the people of this continent to involve in diverse economic activities. The physiography of Asia can be divided into five major groups. They are;

1. The Northern lowlands
2. The Central High Mountains
3. The Southern Plateaus

4. The Great Plains and

5. The Island Groups

1. **The Northern Lowlands**: The most extensive lowland in Asia is the Siberian plain. It extends from the Ural Mountains in the west to the Verkhoyansk Range in the east.

2. **The Central Highlands:** The central highlands stretches from Turkey to the Bering Strait. There are two knots found in Asia. They are 1. The Pamir Knot 2.The Armenian Knot.

- The Hindukush range, the Sulaiman range, the Himalayan range and the Tian Shan range radiate from the Pamir Knot. The Hindukush range continues westward as the Elburz, whereas the Sulaiman range continues south west as the Zagros range. The Elburz and the Zagros converge at the Armenian knot. The Taurus and the Pontine ranges radiate from the Armenian knot. The other important mountain ranges are the great Khingan, the Altai, the Verkoyansk and the Arakan yoma. The Himalayan mountain range is the highest mountain range in the world Mt. Everest (8848 m) is the highest peak in Asia, as well as the world. The lowest point in the world is located in Dead Sea in Asia. Intermundane plateaus are found in these mountain ranges. The important plateaus are 1. The plateau of Anatolia (Pontine to Taurus) 2. The plateau of Iran (Elburz to Zagros mt) 3. The plateau of Tibet (Kunlun to Himalayas)

The Southern Plateaus: The southern plateaus are relatively lower than the northern plateaus. The four important southern plateaus are the Arabian Plateau (Saudi Arabia), Deccan Plateau (India), Shan Plateau (Myanmar) and the Yunnan Plateau (China). Among these plateaus, the Arabian Plateau is the largest Plateau.

The Great Plains: The great plains are formed by the major rivers of Asia. They are the West Siberian plain (Ob and Yenisey), Manchurian Plain (Amur), Great Plain of China (Yangtze and Sikiang), Indo-Gangetic Plain (Indus and Ganga), Mesopotamian plain (Tigris and Euphrates) and the Irrawaddy plain (Irrawaddy).

The Island Groups

- Numerous islands are found in the Pacific coast of Southeast Asia. Kuril, Taiwan, Singapore and Borneo are the important island groups.

The Philippines, Japan islands and Indonesia are the major archipelagos in Asia. Smaller archipelagos are also located in the Indian Ocean such as the islands of Maldives and Lakshadweep in the Arabian Sea. Bahrain is in the Persian Gulf. Sri Lanka is an island, which is located in the Bay of Bengal.

Drainage

- The rivers of Asia originate mostly from the central highlands. The Ob, Yenise and Lena are the major rivers that flow towards the north and drain into the Arctic Ocean. These rivers remain frozen during winter. On the other hand, South Asia has many perennial rivers (e.g.) Brahmaputra, Indus, Ganga and Irrawaddy which originate from the snow covered high mountains that do not freeze during winter. The Euphrates and Tigris flow in West Asia. The Amur, Huang He, Yangtze and Mekong rivers flow in the south and south eastern parts of Asia. Yangtze is the longest river in Asia.

S. No	Name of the River	Origin	Outflow	Length in KM
1.	Yangtze	Tibetan plateau	East China sea	6,350
2.	Huang He	Tibetan plateau	Gulf of Pohai	5,464
3.	Mekong	Tibetan plateau	South China sea	4,350
4.	Yenisei	Tannuala Mountain	Arctic Ocean	4,090
5.	Ob	Altai Mountain	Gulf of Ob	3,650
6.	Brahmaputra	Himalayas	Bay of Bengal	2,900
7.	Indus	Himalayas	Arabian Sea	3,610
8.	Amur	Confluence of Shika and Argun rivers	Tatar Strait	2,824
9.	Ganga	Himalayas	Bay of Bengal	2,525
10.	Irrawaddy	North Myanmar	Bay of Bengal	2,170

Climate

- Asia exhibits a variety of climate. The northern part of Asia experiences severe long winter and cool summer. (Winter -37°C and Summer 10°C). Precipitation is in the form of snow (250 mm to 300 mm).The north eastern part of Asia experiences cold winter and warm summer and a moderate rainfall of 50 mm to 250 mm. The south, south east and eastern parts of Asia are strongly influenced by monsoon winds. Summer is hot and humid while winter is cool and dry. The summer monsoon winds bring heavy rainfall to India, Bangladesh, Indo-China, Philippines and Southern China (1500 mm to 2500 mm). In India, Mawsynram (11871 mm) receives the highest rainfall. So, this place is called the wettest place in the world. The areas found in and around the equator have uniform climate throughout the year. There is no winter. The average temperature is 27°C and the mean rainfall is 1270 mm.

- The west and central parts of Asia have hot, dry climate. The temperature is very high during the day and very low during the night. Rainfall varies from 25 mm to 200 mm. The West coastal fringe of Asia (along the Mediterranean Sea) receives rainfall in winter and is warm in summer. Deserts are found along the western part of Asia. The major hot deserts are the Arabian (Saudi Arabia) and

Thar (India and Pakistan) deserts. The cold deserts of Asia are Gobi and Taklamakan. The largest desert in Asia is the Arabian Desert.

Natural Vegetation

- Natural vegetation depends upon rainfall, temperature and soil. As Asia stretches from the equator to poles, all types of vegetation are found here. Some rare species are found in Asia. (Orang- Utan, Komodo Dragon, Giant panda). The Asian flora and fauna are listed below:

S. No	Climate	Location	Flora	Fauna
1.	High Temperature, High rainfall	Indonesia, Malaysia, Singapore Sri Lanka	Evergreen trees- Mahogany, Rubber, Rosewood, Sal	Rhinoceros, tiger, Babirusa, Orangutan, Komoda Dragon
2.	Summer rainfall, Dry winter	India, Vietnam, Cambodia, Thailand, Southern China	Deciduous trees – Teak, Sandal Wood, Bamboo	Tiger, Elephant, Indian Cobra, viper
3.	Extreme temperatures	Arabian desert, North, North West India	Cactus, Dates (Oasis), Thorny shrubs, Babul tree	Bactrian Camel, The Sand grouse, desert oryx
4.	Dry winter, Warm summer	East China, Japan, North and South Korea	Cherry, Apricot, Plum	Giant Panda, Japanese macaque
5.	Warm Summer and winter rainfall	Israel, Lebanon, Turkey, Syria	Figs, Olives, Citrus fruits	Lynx, Jackrabbit
6.	Long and dry winter, short and cool summer	Siberia, Himalayas	Coniferous trees– Pine, Fir, Spruce	Siberian Tiger, Brown bear, Wolf
7.	Permanent snow cover	Beyond the snow line	Lichen, mosses Grass	Polar bear, Lemming, Reindeer, Arctic fox

Resource Base and Economic Activities of Asia

Mineral Resources

- Asia has a variety of mineral deposits. It holds an important place in the production of Iron, Coal, Manganese, Bauxite, Zinc, Tungsten, Petroleum, Tin etc. Oil and Natural Gas found in the west Asian countries. One third of the world's oil is produced in Asia. Among the west Asian countries, Iran has a considerable wealth of mineral resources. The important minerals found in Asia are:

- ✓ **Iron Ore:** Asia has the largest deposits of iron ore in the world. China and India are the important iron ore deposit countries ofAsia. Turkey,Philippines, Malaysia, Thailand, Myanmar etc.,are a few othercountries that have iron ore deposits.

- ✓ **Coal:** Coal is a fossil fuel. Asia has the largest deposits of coal intheworld. China and India are the largest producers of coalin Asia.

- ✓ **Petroleum:** Petroleum is a mineral oil. The largest petroleum reserves arefound in South West Asia. The important petroleumproducing countries are Saudi Arabia, Kuwait, Iran, Bahrain,Qatar and UAE. South China, Malaysia, Brunei, Indonesia,India, Russia are the other important petroleum producingcountries in Asia.

- Bauxite is found in India and Indonesia. India is the largest producer of Mica in the world. Tin is found in Myanmar, Thailand, Malaysia and Indonesia.

Agriculture

- Only about 18 percent of the total area is cultivable in Asia. Agriculture is the chief occupation of the people here. The river valleys in the South, South East and East Asia have rich alluvial soil. Agriculture is intensively practised in the riverine plains of Asia. However, some areas are not suitable for agricultural practices. **India** has the largest area of arable lands in Asia. Most of the west Asian countries cultivate their crops where the ground water level is nearer to the surface. Iraq practices agricultural activities based on the availability of rainfall and supply of water from Euphrates and Tigris rivers.

- Rice and Wheat are the staple food crops in Asia. China and India are the leading producers of rice in the world. Other important rice producing countries are Myanmar, Japan, Bangladesh and Thailand. Monsoon Asia is suitable for rice cultivation because of the abundant rainfall, fertile plains and availability of labour. Thailand is called the Rice bowl of South East Asia.Wheat is grown in the temperate regions of Asia. Russia, India, China and Pakistan are the leading producers of wheat in Asia. Millets like Bajra, Jower, Ragi and Sorgham are grown in the drier parts of Asia. These are widely cultivated in India, Pakistan and a few gulf countries. Apart from these, pulses, spices and oil seeds are also cultivated in various parts of Asia.

- Jute and cotton are the important natural fibres cultivated in Asia. One third of the world's cotton is produced by Asia. The major cotton producing countries are India, China, Russia and Kazakhstan. India, Pakistan, China and Bangladesh are the leading producers of jute. The tropical wet and dry climate is suitable for sugarcane cultivation in Asia. India, Indonesia and Philippines are the major producers of sugarcane. Coffee, Tea, Rubber, Palm trees and Cocoa are the

important plantation crops. India, Sri Lanka, Thailand, Vietnam, Malaysia and Indonesia are importantan producers of plantation crops. Malaysia and Thailand are the leading producers of natural rubber. Dates are produced in west Asia, among the countries Iran is the largest producer of dates in the world.

1. **Fishing:** Fishing is an important economic activity in Asia. It is prevalent in open seas as well as inland water bodies. China and Japan are the leading fishing nations. In Cambodia, Tonle Sap lake is one of the world's richest sources of fresh water fishing. Bay of Bengal is the major fishing ground for India, Sri Lanka, Myanmar and Bangladesh. Fishing is the mainstay of the national economy in Maldives. Pearl fishing (Bahrein) is popular in the eastern coast of Arabia.

2. **Industrial Regions:** In China, Manchurian, Shanghai- Wuhan, Peking—Shenyang, Guangdone- Hongkong regions are the major industrial regions. In Japan, the major regions are Tokyo, Yokohama and Osaka-Kyoto regions. In India, Mumbai, Ahmedabad, Coimbatore, Bengaluru and Chottanagpur are the important industrial regions.

3. **Transport:** Transport is the backbone of the economic development of a region. Many Asian countries are developing their transport network for their economic progress. Roadway is the most common mode of transport in Asia.

4. **Roadways:** The Asian Highway connects Tokyo in the east to Turkey in the west, Russia in the north to Indonesia in the south and the total length of road is 1,41,000 km. It passes through 32 countries. The Asian Highway 1(AH 1) is the longest highway among the Asian Highway Network (20557 km). It connects Tokyo to Turkey. The Asian Highway 43 (AH 43) runs from Agra in India to Matara in Sri Lanka (3024 km).

5. **Railways:** The Trans - Siberian Railways (9258 km) is the longest rail route in the world. It is a transcontinental railway line which connects Leningrad and Vladivostok. The Trans Asian Railway links Singapore and Istanbul in Turkey. The Shinkansen, bullet train is the world famous super express train that runs between Osaka and Tokyo in Japan at a speed of 352 km/h. The Indian railway network is the second largest railway network in Asia.

6. **Waterways:** The Cape of Good Hope route connects Europe to South Asia. The Trans Pacific route connects the ports of eastern Asia to the ports of western American countries. The Suez Canal route passes through the heart of the world trade route and connects Europe with South and Southeast Asia. Tokyo, Shanghai, Singapore, Hong Kong, Chennai, Mumbai, Karachi and Dubai are the important seaports in Asia.

Cultural Mosaic of Asia

1. **Population:** Asia is the most populated continent in the world. Approximately six-tenth of the world's population lives in Asia. The population is unevenly distributed because of various physical features. China and India alone covers three fifth of Asia's population. Apart from these two countries, Bangladesh, Indonesia, Japan, Pakistan and Philippines have more than 100 million populations. The population density in Asia is 143 persons per Km2. India, Japan, Bangladesh and Singapore have high population density. River plains and industrial regions have high density of population, whereas low density is found in the interior parts of Asia.

2. **Religion & Language:** Hinduism, Islam, Buddhism Christianity and Sikhism are the major creeds in Asia. The minor creeds Zoroastrianism, Jainism, Shintoism, Confucianism and Taoism are also practised in Asia. Mandarin, English, Indonesian, Japanese, Arabic, Korea, Vietnamese and Hindi are the most widely spoken languages in Asia.

3. **Art and Architecture:** Asia is the home land of three civilizations.(Mesopotamian, Indus valley and Chinese civilizations).These three contributed to the architectural works at an early stage. Among the seven wonders of the world, two are located in Asia (The Tajmahal in India, The Great wall of China).The people of Yemen built a mud skyscraper thousands of years ago. Ankorwat in Cambodia, Buddhist Temple in East and Southeast Asia, Mosques in west Asia and the temples and forts in India are fine examples of Asian architecture.

4. **Food:** Rice, Wheat, Maize and Barley are the staple food in Asia. Dairy products, fruits and nuts are also consumed. In East Asia, bread and noodles are the staple food where rice is not available. Tea, Coffee and green tea are the chief beverages. In West Asia, meat, herbs and olive oil are the prime ingredients in their food.

5. **Dance and Music:** In Asia, Yangee, Dragon Dance, Kabaki are popular in East Asia RamThai in Thailand, Bhangra, Kathak and Bharathanatyam in India are also important dances in Asia. Sufi music and Arabic classical music are common in west Asia. Tinikling is the national dance of Philippines.

6. **Festivals:** The mid-autumn festival / moon festival in China, Taiwan and Vietnam. Holi and Mahara Sankaranthi / Pongal in major parts of India and Sukkoth in Israel are the important harvest festivals of Asia. The snow sculpture festival, Chinese New Year, Thaipusam, Diwali, Taiwan Lantern festival, Songkran, winter light festival are also some of the famous festivals in Asia.

7. **Land of contrasts:** Asia is the biggest continent. It has different types of land features such as mountain, plateau, plain, valley, bay, island etc. It also has different climatic conditions from the equator to polar region. Apart from this, many races, languages, religions and cultures are followed by people who live in Asia. So, Asia is called 'the land of contrasts'.

NOTE

- There are 12 landlocked countries in Asia. Among these, only one is doubly landlocked which means it is surrounded entirely by other landlocked countries.That is UZBEKISTAN. It is surrounded by 5 countries(Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan)
- 'Knot' refers to the convergence of mountain ranges.
- Tibet is called the 'Roof of the world' and it is also known as the third pole because of its cold weather, largest reserve of freshwater and inhospitable environment.
- The Three Gorges dam has been constructed across the river Yangtze. It is the largest power station dam in the world. It fulfills ten percent of power needs of China.
- A Desert is a large area that gets very low rainfall and very few plants and animals. There are two types of deserts found in Asia, Hot and cold deserts.
- Rub'al Khali desert is the largest, continuous sandy desert in the world.It is found in the south-eastern part of Saudi Arabia.
- **Banaue rice terrace:**The Banaue rice terraces were built 2000 year ago by the Ifugaos people in the Philippines. It is located approximately about 1524 m above sea level.
- **Ankorwat**: It is a world heritage site. It was built by king Suriya Varma II in 1100 AD(CE) at Cambodia. 'Ankorwat' means 'the city of temples' in Khmer language. It is the largest Hindu Temple in the world.

Europe

- Europe is the sixth largest continent in size and the third largest in population in the world. It has diverse landforms and people. It is the birth place of western civilizations (Roman and Greek), democracy and Industrial Revolution. It is the most developed continent in the world. Let us explore the continent.

Location and size

- Europe spreads from 34^{o} 51' North latitude to 81^{o} 47' North latitude and from 24^{o}33' West longitude to 69^{o} 03' East longitude. The Prime Meridian 0^{o} longitude passes through Greenwich in England.

Europe is found in the northern hemisphere and it covers an area of 10.5 million sq.km. It is surrounded by the Arctic Ocean in the North, the Black Sea and

Mediterranean Sea in the south, the Atlantic Ocean in the west and the Ural mountains in the east. So it looks like a giant peninsula.

Physical Divisions

- Europe has diversified physical features such as mountains, plains, plateaus, peninsulas, bays, islands and river basins. It can be divided into four physical divisions.

1. The North Western Highlands
2. The Central Plateaus/High land
3. The Alpine Mountain system
4. The North European plains

1. **The North Western highlands:** This region includes the mountains and plateaus of Norway, Sweden, Finland, Scotland and Iceland. This region has themost beautiful fjord coast. It was created by glaciations in the past. This region has a lot of lakes, which serve as reservoirs for producing hydroelectricity. Norway and Sweden are the largest producers of hydroelectricity in the world.

2. **The Central Plateaus:** The plateaus are found in east west direction across central Europe. Many rivers in Europe such as, the Danube, the Volga and the Tagus originate from this plateau. The important plateaus of this region are The Pennines (England), The Meseta (Spain), The Central Massif and Jura (France). The Black forest (Germany) in these region has rich mineral resources. The Pennines is called the backbone of England.

3. **The Alpine Mountain System**: The alpine mountain system consists of a chain of young fold mountains found in the southern part of Europe. The important mountain ranges are the Sierra Nevada, the Pyrenees, the Alps, the Apennines, the Dinaric Alps, the Caucasus and the Carpathian. The Pyrenees forms a natural boundary between Spain and France. Thehighest peak in Europe is Mt. Elburz (5645 m) in the Caucasus range. The Mont Blanc (4,807 m) found in the Alps is the second highest peak in the Alpine System.There are several active volcanoes found in the Alpine mountain system. Mt. Etna, Mt. Vesuvius and Mt. Stromboli are the important volcanoes found in Europe. Earthquakes are common in this region. The Stromboli is called the 'light house of the Mediterranean'.

4. **The North European plain**: The north European plain stretches from the Atlantic Ocean in the west to the Ural Mountains in the east. On the north, it

is surrounded by the Baltic Sea and on the South by the alpine mountain. It is narrow in the West and wide towards the East. Major European rivers such as the Seine, the Rhine, the Danube and the Don criss-cross this region and deposit their alluvium. The Andalusian Plain, The Hungarian Plain and the Wallachian Plain are also found in this region. It has rich deposits of coal and iron ore. The north European plain is densely populated region and cities like Paris, Moscow and Berlin are located here.

S. No	Rivers	Length (km)	Source	Out flow
1.	Volga	3,692	Valdes plateau	Caspian Sea
2.	Danube	2,860	Black forest	Black Sea
3.	Dnieper	2,145	Valdai Hills	Black Sea
4.	Rhine	1,230	Alps (Switzerland)	North Sea
5.	Rhone	813	Swiss Alps	Mediterranean Sea
6.	Po	652	Cottian Alps	Adriatic Sea
7.	Thames	346	Kemble	North Sea

Drainage

- The rivers play an important role in the development of Europe. These rivers are used to irrigate farmland and also help to produce electricity.Most of the rivers originate in the Alps and the central plateau of Europe. These rivers are useful for inland navigation in central and Eastern Europe. The Volga is the longest river in Europe. The river Danube passes through nine countries in Europe.

Climate

- The climate of Europe varies from the subtropical to the polar climate. The Mediterranean climate of the south has warm summer and rainy winter. The western and northwestern parts have a mild, generally humid climate, influenced by the North Atlantic Drift. In central and eastern Europe, the climate is humid continental-type. In the northeast, subarctic and tundra climates are found. The whole of Europe is subject to the moderating influence of prevailing westerly winds from the Atlantic Ocean.

Natural vegetation: The natural vegetation of Europe can be classified as follows:
1. Tundra, 2. Taiga or Coniferous, 3.Mixed Forest, 4. Mediterranean Forest , 5. Grassland

- The Arctic and northern Scandinavian highland have Tundra type of vegetation made up of lichens and mosses.Coniferous or Taiga vegetation's are found to the south of the Tundra region in Norway, Sweden, Finland, Germany, Poland and Austria. Pine, fir, spruce and larch are the important tree varieties of taiga forest.

The mixed forest comprising of birch, beech, poplar, oak and maple trees found in the western part of Europe particularly in western France, Belgium, Denmark, Britain etc. Mediterranean trees like cypress, cork, oak, olive and cedar are found along the borders of the Mediterranean Sea. Eastern Europe is covered by grasslands (Steppe).

Resources Base and Economic Activities of Europe

- Availability of resources, efficient educated work force, research, contact with other nations and innovations have transformed Europe into a modern and economically developed continent in the world. Europe is an industrially developed continent in the world. It has great diversity in its topography, climate and soil. These interact to produce varied patterns of agricultural activities such as Mediterranean agriculture, Dairy farming, mixed livestock and crop farming and horticulture (Truck Farming) Wheat is the dominant crop throughout Europe. Barley, Oats, sugar beet, rye, potatoes and hay are also common crops. Corn (maize) is an important crop in the lower Danubian lowlands and southwestern European Russia, France and Italy. Rice (northern Italy) and citrus fruits, olive trees (Spain, Sicily) depend on irrigation.

- The northernmost countries grow few cereals (mainly oats) and concentrate on animal husbandry, especially cattle and dairying. Mixed farming and the use of well-tried crop rotations are widely practised. Viticulture is mostly practised in Italy, France and Germany. As for industrial crops, European Russia, Ukraine, and Belarus are large producers of flax and hemp, sugar beets and sunflower seeds. Tobacco is grown in Belarus and is also important in Bulgaria, Italy, and Macedonian Greece. European Russia, Sweden and Finland are the major producers of softwood and hardwood. Fishing is a large industry in Norway, Iceland, Russia, Denmark, the United Kingdom, the Netherlands etc., The Dogger Bank in North Sea is an important fishing ground in Europe.

Industries

- Europe produces a significant portion of the world's steel and iron ore. Shipbuilding, motor-vehicle and aircraft construction are widely distributed all over Europe. Europe is also a large producer of pharmaceutical drugs. A wide range of small-scale industries (i.e., those that produce nondurable goods) is found throughout Europe. Some countries have a reputation for specialty goods, as in the case of English, Italian, and Dutch bicycles, Swedish and Finnish glass, Parisian perfumes and fashion goods and Swiss precision instruments.

Cultural Mosaic of Europe

- Europe is the third most populous continent, after Asia and Africa. The population of Europe was 742 million in 2018, which accounted for 9.73% of the world's population. The population density in Europe is 34 persons / km2. High

population density is often associated with the coalfields of Europe. Other populous areas are sustained by mining, manufacturing, commerce, offering large market, labour forces and productive agriculture. Monaco, Malta, San Marino, and the Netherlands are the most densely populated countries; Iceland and Norway have very low density of population. In general, population is scantiest in the mountain regions, some highlands, arid parts of Spain and the Arctic regions of Russia. Monaco has the highest density of population in Europe (26,105 persons / km2) as well as in the world. Iceland has a very low density of population (3 persons/ km2).

Religion & Language

- Europe is a continent of great linguistic and cultural difference. English, Spanish, Portuguese, French, Italian and Slavic are the broadly spoken languages in Europe. Christianity is the major religion in Europe. A considerable number of Hindus, Muslims and Jews are spread throughout Europe. More than 90 percent of the people belong to the Caucasoid race.

Art and Architecture

- European art and architecture mostly reveals the ordinary human being and is popular all over the world. Acropolis, the Colosseum, the statue of David, The thinker, Eiffel tower, Big Ben, Pisa Tower and Mona Lisa are some of the master pieces of art and architecture in Europe.

Food and Festivals

- Bread, fish, meat, potatoes and dairy products are the staple food in Europe. The Europeans celebrate both religious and holiday festivals. Christmas, Easter, Good Friday, the Saint Day, Redentore, Tomatina and Carnival are the important festivals of Europe. They play Rugby, foot-ball, basket-ball, ice hockey and skiing. Bull fighting in Spain is the world's attractive game.

A Comparison of Asia and Europe

- Asia and Europe are integrated geographically and separated politically. Europe is the giant peninsula of Asia. Both the Himalayas (Asia) and the Alps (Europe) were formed during the same geological period. The Steppe grass lands and coniferous forests are spread over several hundred kilometres from Europe to Asia. Generally, the plains are found in the northern part and the mountains in the southern part in both the continents. The two continents are the homeland of ancient civilizations. From the ancient period, these two continents had trade relationship through the silk route and the spice route. Despite the various geographical similarities, these two continents have striking differences.

NOTE

- Europe is called as the 'Peninsula of Peninsulas'.
- **European Union:** The European Union (EU) is an economic and political union of 28 member countries for their welfare. It has own flag and the com
- **The Netherlands:** About 25 percent of the Netherlands lies below sea level. So they have built dikes. They have reclaimed new land from the sea with the help of dikes. These reclaimed lands are called polders. mon currency, the Euro (€).
- **Fjord:** A fjord is a narrow and deep sea inlet between steep cliffs. It helps in the following ways.
  - ✓ It reduces the speed of wind, irrespective of its direction.
  - ✓ The force of sea waves are also controlled.

  Hence, areas with fjords are best suited for natural harbours.
- **Black forest**: The lush and dark coloured fig and pine trees give black colour to this region.
- **The Matterhorn**: The pyramid-shaped Matterhorn Mountain is located in the Swiss Alps a height of 4478 m. It is popular for its shape.
- **Climate Divider:** The Alps Mountain separates the Mediterranean climate from the cold climate of the north.
- **North Atlantic Drift** is a warm ocean current which brings warmth to the western Europe. The westerly wind further transports warmth across Europe.

Asia	Europe
1. It is the largest continent, both by area and population.	1. It is the smallest continent by area and the most developed.
2. It extends from 10° 11′ 81° 12′ N latitudes. That is from the equatorial region to the polar region.	2. It extends from 34°51′N to 81° 47′N latitudes. That is, from the sub-tropical region to the polar region.
3. It is located on the eastern hemisphere	3. It is located at the centre of the earth.
4. The Bering Strait separates Asia and North America.	4. The Strait of Gibraltar separates Europe from Asia
5. The Arabian, Indo China, India and Korea are the important peninsulas in Asia.	5. The Scandinavian, Iberian, Italian and Balkan are the important peninsulas in Europe.
6. The important parallels such as the Equator, Tropic of Cancer, Arctic Circle pass through it.	6. Only the Arctic Circle passes through it.
7. All kinds of climatic conditions are found here. It also enjoys the distinctive monsoon type of climate Southern Asia receives summer	7. It lies largely in the temperate zone. It enjoys the distinctive Mediterranean type of climate. Southern Europe receives winter

rainfall.	rainfall.
8. Both hot and cold deserts are located here.	8. There are no deserts here.
9. It has a variety of mineral deposits.	9. Mineral resources are limited, except for coal & iron.
10. Plantation crops such as tea, rubber and dates are largely cultivated in Asia.	10. Citrus fruits, olives and grapes are cultivated mostly in Asia.
11. A majority of people in Asia are involved in primary activities.	11. A majority of people in Europe are involved in secondary and tertiary

5. Globe

Directions

- The directions on the ground are always shown with respect to the North. If we know the North, then it is easy to find the other directions, namely South, East and West. These are the four cardinal directions. We know that the Sun rises in the East and sets in the West. If we stand facing the sun in the morning, then we face the east. The west is towards our back. The left hand points towards the north and the right hand points towards the south. We should always keep this in mind.

Globe

- We live on the planet Earth, which is found third from the Sun. Since the Earth is huge and we live on a very small area, we are not able to see the Earth as a whole. But, when we travel to space, we can see the Earth as a whole. So, in order to see the shape of the Earth as a whole and to know its unique features, a three dimensional model of the Earth was created with a specific scale. The Earth which is spherical, is flat at the poles and bulges at the Equator. The Earth cannot be compared with any other geometrical shape as it has a very unique shape. Hence, its shape is called a geoid (earth shaped). The Earth moves around the Sun. It also rotates from the West to East on its axis at an inclination of 23 ½°. The globe is also inclined at an angle of 23 ½°. The axis is an imaginary line. It is not actually found on the Earth.

Lines on the Globe: There are imaginary lines which are drawn on the globe horizontally and vertically to find a location and calculate distance and time. These imaginary lines are called lines of latitudes and longitudes.

Latitudes

The imaginary lines which are drawn horizontally on East - West direction on the Earth are called the lines or parallels of latitudes. The 0° line of latitude which divides the Earth into two halves is known as the Equator. From the Equator, parallel lines are drawn towards the North and South poles at equal intervals. The latitudinal extent between 1° lineof latitude on Earth is 111 km. Since the Earth is geoid shaped, the length of the lines of latitude decreases from the Equator towards the South and North Poles. The 90° North and South Poles are not found as lines, but as points.

- The lines of latitude that are drawn horizontally between the Equator and the North Pole are called 'Northern latitudes' and those which are found between the Equator and the South Pole are called 'Southern Latitudes'. The lines of latitude consist of 89 parallels in the Northern Hemisphere and 89 parallels in the Southern

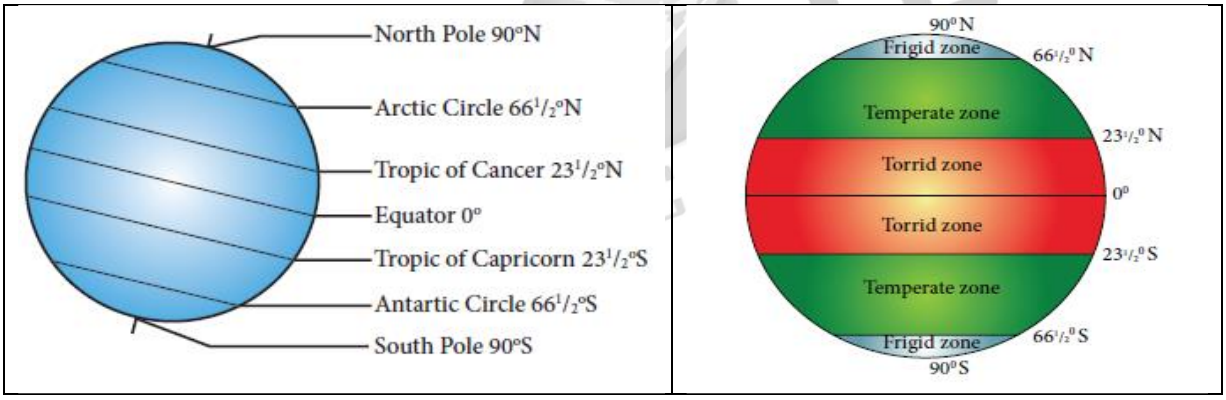
Hemisphere, one at the Equator and the two poles are found as points. Totally, there are 181 parallels found on earth.

- ✓ **Northern Hemisphere:** The area of the Earth found between the Equator (00) and the North Pole (90°N) is called the Northern Hemisphere.

- ✓ **Southern Hemisphere:** The area of the Earth from the equator (0°) to the South Pole (90°S) is called the Southern Hemisphere. The location of any country or place is based on this division of the hemispheres.

- ✓ **Important lines of latitude:** The earth rotates on its axis at an inclination of 23½°. It also revolves around the sun while rotating. Based on the angle at which the sun's rays fall on the earth, certain lines of latitude gain significance.

- The Sun's rays do not fall equally on all parts of the earth. They fall vertically over the Equator and slanting towards the poles. Thus, all the places on earth do not have the same amount of temperature. Based on the amount of heat received from the Sun, the lines of latitude help in dividing the earth into different climatic zones.



Torrid Zone: The region from the Equator towards the Tropic of Cancer (23½°N) and the Tropic of Capricorn (23½°S) is called the Torrid Zone. The Sun's rays fall vertically over this region and the average temperature is very high. Hence this region is known as the Torrid Zone.

Temperate Zone: From the Tropic of Cancer (23½°N) to the Arctic Circle (66½°N) and from the Tropic of Capricorn (23½°S) to the Antarctic Circle (66½°S), the Sun's rays fall slantingly. Moderate temperature prevails in this region. Hence, this region is called Temperate Zone.

Frigid Zone : From the Arctic Circle (66½°N) to the North Pole (900N) and from the Antarctic Circle (66½°S) to the South Pole (90°S), the Sun's rays fall further inclined, through out the year. The temperature is very low. Hence, this region is known as Frigid Zone.

Longitudes

- The imaginary lines drawn vertically connecting the North Pole and the South Pole are called lines or meridians of longitude. These lines of longitude are seen as semi circles. The 0° line of longitude is called the Prime Meridian. There are 180 lines of longitude towards the East and West from the Prime Meridian. So, there are totally 360 lines of longitude. These lines converge at the poles. The 180° W and 180° E line of longitude are the same line.The lines of longitude that are found between the Prime Meridian and the 180° East line of longitude are called 'Eastern Longitudes' and the lines of longitude that are found between the Prime Meridian (0°) and the 180° West line of longitude are called 'Western Longitudes'. Two opposite meridians form a great circle

✓ **Eastern Hemisphere:** The part of the Earth between the 0° line of longitude and the 180° East line of longitude is known as the Eastern Hemisphere.

✓ **Western Hemisphere:** The part of the Earth from 0° line of longitude to 180° West line of longitude is called as Western Hemisphere.

Significant Lines of Longitude

Greenwich Meridian

- The Royal Astronomical Observatory is located at Greenwich near London in England. According to the International Meridian Conference held in 1884 in Washington DC in the U.S.A. all nations agreed on choosing the Greenwich Meridian as the international standard meridian (0°). This line of longitude is called the Prime Meridian and it is also known as the Greenwich Meridian because it passes through Greenwich.

International Date Line

- The 180o line of longitude has been fixed as the International Date Line, drawn on the Pacific Ocean between Alaska and Russia through Bering Strait. If a person crosses this line from the West to East, he loses a day. On the other hand, when he crosses from the East to West, he gains a day. Based on this, the date is fixed for different countries or regions of the world.

Earth Grid: The imaginary lines of latitude and longitude form a grid like pattern on the surface of the earth, known as the 'Earth grid' or 'Geographic grid'. To locate a place exactly on earth, the latitudinal and longitudinal extensions are required.

Longitude and Time: As many as 360 lines of longitude are drawn to connect the North and South Poles around the Earth 180° on the Eastern Hemisphere

and 180° on the Western Hemisphere. Time is calculated on the basis of the lines of longitude.

Local Time

- When the sun is overhead on a particular line of longitude, it is 12 noon at all the places located on that line of longitude. This is called local time. The Sun is overhead on a line of longitude only once in a day. So the local time differs for every line of longitude. When the Sun is overhead the Greenwich Meridian at 12 noon, it is the local time of that place. The world time is calculated by this standard line of longitude. It is known as the Greenwich Mean Time (GMT). For example, if the time is 12 noon at Greenwich Meridian, it is 12:04 p.m. at 1°E line of longitude and 11:56 a.m. at 1°W line of longitude. So, as one moves towards the east from any meridian the time increases. And if one moves towards the west from any meridian, time decreases.

Standard Time

- Local time is calculated when the sun is overhead at noon. Many lines of longitude may pass through a country. Countries may or may not observe a common time. The standard time of a country or a part of it is calculated keeping a particular meridian as a standard one. The meridians are selected in multiples of 15° or 7 ½°. It is done in such a way that the variation of standard time from the Greenwich is expressed either as 1 hour or ½ an hour.

Indian Standard Time

- The longitudinal extent of India is from 68°7′ E to 97°25′ E. As many as twenty nine lines of longitude pass through India. Having 29 standard time is not logical. Hence 82½° E line of longitude is observed as the Prime Meridian to calculate the Indian Standard Time (IST). The world has 24 time zones. Some countries have a great longitudinal extent. So they have more than one standard time. Example: Russia has 7 time zones.

NOTE

- The surface area of the Earth is 510.1 million square kilometres.
- Ptolemy, a Greco – Roman mathematician, astronomer and geographer, was the first person to draw the lines of latitude and longitude on a map. In his book, 'Geographia' a detailed description about the Earth's surface, its size and circumference and many locations based on the lines of latitude and longitude are given.
- The first globe was created by the Greeks in the year 150 AD(CE).
- The Indian astronomer Aryabhatta - I has mentioned in his book. 'Aryabhatta Sidhantha'. 'The stars in the sky seem to move towards the West because of the

Earth's roation on its axis'.

- ❖ The Equator is the longest of all lines of latitude. Hence, it is also known as 'The Great Circle'.
- ❖ 0°N and S – 23½°N and S lines of latitudes are called – Low latitudes
- ❖ 23½°N and S – 66½°N and S lines of latitudes are called – Middle Latitudes
- ❖ 66½°N and S – 90°N and S lines of latitudes are called – High Latitudes
- ❖ Some lines of latitude are also called by the following names in Tamil.

  - ✓ Latitude - ahalangu(அகலாங்கு)
  - ✓ Longitude - nettangu(நெட்டாங்கு)
  - ✓ Equator - nilanaduvarai(நிலநடுவரை)
  - ✓ Tropic of Cancer -kadagavarai (கடகவரை)
  - ✓ Tropic of Capricorn - magaravarai(மகரவரை)

- ❖ The lines of longitude are found as semi circles covering 111 km at the Equator, 79 km at 45° latitude and no space between the lines at the poles.

- ❖ The International Date Line is not straight. If the line is drawn straight, two places in the same country would have different dates. So the International Date Line is found zigzag in certain places to avoid confusion.

Fact

- ❖ The Earth takes one day to rotate on its axis.
  - ✓ 1 day = 24 hours
  - ✓ 1 hour = 60 minutes
  - ✓ 24 hours = 24 x 60 = 1440 minutes
  - ✓ The angle of the earth = 360 °
  - ✓ 360 ° = 360 Longitudes
  - ✓ 360 ° = 1440 minutes
  - ✓ So 1 ° = 1440 360 = 4 minutes
  - ✓ In 4 minutes = 1°rotation
  - ✓ In 60 minutes = 60 4 = 15° rotation
  - ✓ So, in an hour (60 minutes) the earth rotates 15°

- ❖ The word meridian is derived from the Latin word 'Meridianus'. It means mid-day. (Medius – Middle, dies – day). So, meridian means the position of the Sun found overhead at a place at noon.
- ❖ a.m. means 'anti Meridiem' (anti – before) – Before Noon.
- ❖ p.m. means 'post Meridiem' (Post – after/later) – After noon.
- ❖ The 82½° E line of longitude passes through Mirzapur near Allahabad in Uttar Pradesh. This is located at an equal distance from Ghuar Mota in Gujarat and Kibithu in Arunachal Pradesh.

7th Term I

Unit II – Landforms

Introduction

- We have learnt that the surface of the earth is not the same everywhere. The earth has an infinite variety of landforms named mountains, plateaus, plains, valley etc., Some parts of the lithosphere may be rugged and some flat. These landforms are a result of two processes – the endogenic process and the exogenic process. The endogenic process (internal process) leads to the upliftment and sinking of the earth's surface at several places.The exogenic process (external process) is the continuous wearing down and rebuilding of the land surface.

- Gradation is the process of levelling of highlands through erosion and filling up of lowlands through deposition.

Landforms

- The landscape is being continuously worn away by two processes – weathering and erosion. Weathering is the breaking and falling apart into small pieces of the rocks on the earth's surface. Erosion is the wearing away of the landscape by different agents like water, wind, ice and sea waves. The eroded material is carried away by water, wind, etc. and eventually deposited. This process of erosion and deposition create different landforms on the surface of the earth.

River

- The water flowing from its source to river mouth, along a definite course is called a River. Rivers generally originate from a mountain or hill.

- The place of origin of the river is known as its Source. The place where it joins a lake or sea or an ocean is known as the River mouth.

- The running water in the river erodes the landscape, which creates a steep-sided valley like the letter 'V' known as 'V' shaped valley.

Tributary: A stream or river that flows into and joins a main river.
Distributary: A stream that branches off and flows away from a main stream.

- Falling of river water over a vertical step in the river bed is called waterfall. It is formed when the soft rocks are removed by erosion. E.g. Coutrallam falls across the river Chittar in Tamil Nadu.

The highest waterfall is Angel Falls of Venezuela in South America. The other

waterfalls are Niagara Falls located on the border between Canada and USA in North America and Victoria Falls on the borders of Zambia and Zimbabwe in Africa.

- Plunge pool is a hollow feature at the base of a waterfall which is formed by cavitation. Alluvial fan is a deposition of sediment occurs at which the river enters a plain or the foot-hills.

- As the river enters the plain it twists and turns forming large bends known as Meanders. Eg. Meanders along the River Vellar near Sethiyathope in Cuddalore District, Tamil Nadu.

- Due to continuous erosion and deposition along the sides of the meander, the ends of the meander loop comes closer and closer. In due course of time the meander loop cuts off from the river and forms a cut-off lake, also called an Ox-bow lake.

The term 'Meander' has been named on the basis of Meander River of Asia Minor (Turkey), it flows through numerous curves and turns.

- At times the river overflows its banks. This leads to the flooding of the neighbouring areas. As the river floods, it deposits layers of fine soil and other material called sediments along its banks. This leads to the formation of a flat fertile floodplain. The raised banks are called levees.

- As the river approaches the sea, the speed of the flowing water decreases and the river begins to break up into a number of streams called distributaries. The velocity of the river becomes so slow that it begins to deposit its load. Each distributary forms its own mouth. The

collection of sediments from all the mouths form Delta. Deltas are excellentproductive lands. They have more minerals which favour cultivation. E.g. Cauvery delta, Ganges delta, Mississippi delta**.**

Glacier

- A large body of ice moving slowly down a slope or valley due to gravity is called a glacier. Glaciers are grouped into Mountain or Valley Glaciers and Continental Glaciers.

Continental Glacier: The glacier covering vast areas of a continent with thick ice sheets. E.g. Antarctica, Greenland

- Mountain or Valley Glacier is a stream of ice, flowing along a valley. It usually follows former river courses and are bounded by steep sides. E.g. The Himalayas and the Alps.

- Glaciers erode the landscape by levelling soil and stones to expose the solid rock below. Cirque is a glacially eroded rock basin, with a steep side wall and steep head wall, surrounding an armchair-shaped depression. E.g. Corrie – Scotland (United Kingdom), Kar – Germany.

- As the ice melts, they get filled up the cirque with water and become beautiful lakes in the mountains called as Tarn Lake. When two adjacent cirques erode towards each other, the previously rounded landscape is transformed into a narrow rocky, steep – sided ridge called Aretes.

- U' Shaped Valley is found beneath the glaciers which is deepened and widened by the lateral and vertical erosion. The material carried by the glacier such as rocks - big and small, sand and silt get deposited. These deposits form glacial moraines.

Wind

- Have you ever visited a desert? Try to collect some pictures of sand dunes. An active agent of erosion and deposition in the deserts is

wind. In deserts you can see rocks in the shape of a mushroom, commonly called mushroom rocks.

- Winds erode the lower section of the rock more than the upper part. Therefore, such rocks have narrower base and wider top. An isolated residual hill, standing like a pillar with rounded tops are called Inselbergs. E.g. Inselberg in the Kalahari Desert of South Africa.

- When the wind blows, it lifts and transports sand from one place to another. When it stops blowing the sand falls and gets deposited in low hill – like structures. These are called sand dunes. The crescent shaped sand dunes are called Barchans.

- When the grains of sand are very fine and light, the wind can carry it over very long distances. When such sand is deposited in large areas, it is called Loess. Large deposits of loess are found in China.

Northern China loess deposits are brought from the Gobi Desert.

Coast

- A part of the land adjoining or near the sea is called the Sea coast. The boundary of a coast, where land meets water is called the Coast line. The coastal areas are subject to change due to wave erosion and wave deposition.

- The erosion and deposition of the sea waves give rise to coastal landforms. Sea Cliffs are steep rock faces formed, when the sea waves dash against them. Sea waves continuously strike at the rocks. Cracks develop. Over time they become larger and wider. Thus, hollow like caves are formed on the rocks. They are called Sea Caves.

- As the cavities of sea caves become bigger and bigger only the roof of the caves remains, thus forming Sea Arches. Further, erosion breaks the roof and only walls are left. These walllike features are called Stacks.

- The sea waves deposit sediments of sand and gravel along the shores forming Beaches.Sand bar is an elongated deposition of sand or mud found in the sea, almost parallel to the coast.

The first longest beach in the world is the Miami beach in South Florida in U.S.A. The second longest beach in the world is the Marina beach in Chennai

- Lagoon is a shallow stretch of water partially or completely separated from the sea. E.g. Chilka lake in Odisha, Pulicat lake in Tamil Nadu and Andhra Pradesh and Vembanad lake in Kerala are the famous lagoons in India.

8th Term I

Unit – 3 Hydrologic cycle

Introduction

- Water is one of the most important elements on earth. All plants and animals need water for survival. Apart from drinking, water is required for domestic, agriculture, industrial purposes etc. Water is very essential for carrying out almost all economic activities. So, water is an indispensible element without which life form on the earth is not possible

Water on the Earth

- About 71% of the earth's surface is covered by water. The quantity of water present on the earth is about 326 million cubic miles. It is hard to visualise this massive quantity of water. Most of the water on the earth is saline and is found in seas and oceans. The salt water constitutes about 97.2% and the fresh water is only about 2.8%. Out of this 2.8%, about 2.2% is available as surface water and the remaining 0.6% as groundwater. From this 2.2% of surface water, 2.15% is available in the form of glaciers and icecaps, 0.01% in lakes and streams and the remaining 0.04% is in other forms. Only about 0.25% of the total ground water of 0.6% can be economically extracted with the present drilling technology. Water resources are useful or potentially useful to humans. Water in India is available in three sources. They are precipitation, surface water and groundwater.

Hydrologic Cycle or Water Cycle

- Hydrology is the science which deals with the various aspects of water such as its occurrence, distribution, movement and properties on the planet earth. Availability of water on the earth is not uniform. Some places are very rich in water resources while some other places are poor in water resources.

Estimated Volume of Water on the Earth's Surface

Water Source	Volume of water (Cubic Miles)	Percentage to Total Water
Oceans, Seas, & Bays	321,000,000	96.54
Ice caps, Glaciers, & Permanent Snow	5,773,000	1.74
Groundwater	5,614,000	1.69
Soil Moisture	3,959	0.001
Ground Ice & Permafrost	71,970	0.022
Lakes	42,320	0.013
Atmosphere	3,095	0.001

Swamp Water	2,752	0.0008
Rivers	509	0.0002
Biological Water	269	0.0001

- Hydrologic cycle is a global sun-driven process where water is transported from oceans to atmosphere, from atmosphere to land and from land back to oceans. The water cycle can be considered as a closed system for the earth, as the quantity of water involved in the cycle is invariable, though its distribution varies over space and time.

- Evaporation takes place from the surface water and transpiration from the plants. Water vapour gets condensed at higher altitudes by condensation nuclei and form clouds (resulting in droplet growth). The clouds melt and sometimes burst resulting in precipitation of different forms. A part of water from precipitation flows over the land is called runoff and the other part infiltrates into the soil which builds up the groundwater.

- Hydrologic cycle is a circulation of water. It is a continuous process and takes place naturally. The three important phases of the hydrologic cycle are: 1) Evapotranspiration, 2) Precipitation and 3) Runoff.

Components of Hydrologic Cycle

- There are six main components in hydrologic cycle. They are: 1) Evapotranspiration, 2) Condensation, 3) Precipitation, 4) Infiltration, 5) Percolation, and 6) Runoff.

Evapotranspiration

- It is defined as the total loss of water from the earth through evaporation from the surface water bodies and the transpiration from vegetation. In cropped area, it is difficult to determine the evaporation and transpiration separately. Therefore it is collectively called as evapotranspiration.

Evaporation

- Evaporation refers to the process in which the liquid form of water changes into gaseous form. Water boils at 100°C (212°F) temperature but, it actually begins to evaporate at 0°C (32°F); and the process takes place very slowly. Temperature is the prime element which affects the rate of evaporation. There is a positive relationship between these two variables. Areal extent of surface water, wind and the atmospheric humidity are the other variables which affect the rate of evaporation.

- Many studies reveal that the oceans, seas, lakes and rivers provide

nearly 90 % of the moisture in the atmosphere through evaporation and the remaining 10 % is contributed by plants through transpiration.

- On a global scale, the amount of water gets evaporated is about the same as the amount of water delivered to earth as precipitation. This process varies geographically, as the evaporation is more prevalent over the oceans than precipitation, while over the land, precipitation routinely exceeds evaporation. The rate of evaporation is low during the periods of calm winds than during windy times. When the air is calm, evaporated water tends to stay close to the water body. During windy, the water vapour is driven away and is replaced by dry air which facilitates additional evaporation.

The rate of evaporation increases with
- Increase in wind speed
- Increase in temperature
- Decrease in humidity and
- Increase in areal extent of surface water bodies.

Transpiration

- Transpiration refers to the process by which the water content in the plants are released into the atmosphere in the form of water vapour. Much of the water taken up by plants is released through transpiration. The rate of transpiration is also affected by the temperature, wind and humidity. The soil water content and the ability of the soil to conduct water to the roots, the nature of the plant parts including barks and leaves also determine the transpiration rate. In case of agriculture, the crop characteristics, its environment and cultivation practices also affect the transpiration process.

Condensation

- It refers to the process in which the gaseous form of water changes into liquid form. Condensation generally occurs in the atmosphere when warm air rises, cools and loses its capacity to hold water vapour. As a result, excess water vapour condenses to form cloud droplets. Condensation is responsible for the formation of clouds. These clouds produce precipitation which is the primary route for water to return to the earth's surface in the water cycle. Condensation is the opposite of evaporation.

Forms of Condensation

- Dew, Fog and Clouds are the three major forms of condensation

a) **Dew:** It is a water droplet formed by the condensation of water vapour on a relatively cold surface of an object. It forms when the temperature of an object drops below the dew point temperature.

Frost: The ice crystals formed by deposition of water vapour on a relatively cold surface of an object is known as frost. It forms when the temperature of an object drops below the freezing point of temperature.

b) Fog: Fog is the suspended tiny water droplets or ice crystals in an air layer next to the earth's surface that reduces the visibility to 1,000 m or lower. For aviation purposes, the criterion for fog is 10 km or less.

Mist: Mist is the tiny droplets of water hanging in the air. These droplets form when the water vapour in the air is rapidly cooled, causing it to change from invisible gas to tiny visible water droplets. Mist is less dense than fog.

c) Clouds: Clouds consist of tiny water droplets/ice particles which are so small and light in weight. Clouds are formed by microscopic drops of water or by small ice crystals. The size of the droplets generally range from a couple of microns to 100 microns. This is the limit beyond which cloud drops become rain drops.

- Condensation occurs when the air get saturated.
- Warm air can hold more water vapour than the cool air.
- Saturation occurs when the temperature drops down.

Precipitation

- Precipitation refers to all forms of water that fall from clouds and reaches the earth's surface. For the occurrence of precipitation, cloud droplets or ice crystals must grow heavy enough to fall through the air. When the droplets grow large in size, they tend to fall. While moving down, by collecting some small droplets, they become heavy enough to fall out of the cloud as raindrops.

Forms of Precipitation

- The form of precipitation in a region depends on the kind of weather or the climate of the region. The precipitation in the warmer parts of the world is always in the form of rain or drizzle. In colder regions, precipitation may fall as snow or ice. Common types of precipitation include rain, sleet, freezing rain, hail and snow.

Rain: The most common kind of precipitation is rain. The precipitation in the form of water droplets is called rain. The precipitation in which the size of rain drops are <0.5 mm in diameter is known as drizzle and the rain drops with >0.5 mm in diameter is known as rain. Generally drizzle takes place from stratus clouds.

Sleet: The precipitation which takes place in the form of mixture of water droplets and tiny particles of ice(5mm in diameter) is known as sleet. Sometimes raindrops fall through a layer of air below 0°C, the freezing point of water. As they fall, the

raindrops freeze into solid particles of ice. So, the mixture of water droplets and ice particles would fall on the earth surface.

Freezing Rain: At other times raindrops falling through cold air near the ground do not freeze in the air. Instead, the raindrops freeze when they touch a cold surface. This is called freezing rain and the drops of water are usually greater than 0.5 mm in diameter.

Hail: The precipitation which consists of round pellets of ice which are larger than 5 mm in diameter is called hail or hailstones. Hail forms only in cumulonimbus clouds during thunderstorms. A hailstone starts as an ice pellet inside a cold region of a cloud. Strong updrafts in the cloud carry the hailstone up and down through the cold region many times.

Snow: Often water vapour in a cloud is converted directly into snow pieces due to lowering of temperature. It appears like apowdery mass of ice. The precipitation in the form of powdery mass of ice is known as snowfall. It is common in the polar and high mountainous regions.

Infiltration

- Water entering the soil at the surface of the ground is termed as infiltration. Infiltration allows the soil temporarily to store water, making it available for plants use and organisms in the soil. Infiltration is an important process where rain water soaks into the ground, through the soil and underlying rock layers. Some of this water ultimately returns to the surface through springs or low spots down hills. Some of the water remains underground and is called groundwater. The rate of infiltration is influenced by the physical characteristics of the soil, vegetative cover, moisture content of the soil, soil temperature and rainfall intensity. The terms infiltration and percolation are often used interchangeably.

- Percolation is the downward movement of infiltrated water through soil and rock layers. Infiltration occurs near the surface of the soil and delivers water from the surface into the soil and plant root zones. Percolation moves the infiltrated water through the soil profile and rock layers which leads to the formation of ground water or become a part of sub-surface run-off process. Thus, the percolation process represents the flow of water from unsaturated zone to the saturated zone.

Runoff

- Runoff is the water that is pulled by gravity across land's surface. It replenishes groundwater and surface water as it percolates into an aquifer (it is an underground layer of water-bearing rock) or moves into

- a river, stream or watershed. It comes from unabsorbed water from rain, snowmelt,irrigation or other sources, comprising a significant element in the water cycle as well as the water supply when it drains into a watershed.

- Runoff is also a major contributor to the erosion which carves out canyons, gorges and related landforms. The amount of runoff that can happen depends on the amount of rainfall, porosity of soil, vegetation and slope. Only about 35% of precipitation ends up in the sea or ocean and the other 65% is absorbed into the soil.

Types of Runoff

- Based on the time interval between the instance of rainfall and generation of runoff, the runoff may be classified into following three types

i) Surface Runoff: It is the portion of rainfall, which enters the stream immediately after the rainfall. It occurs, when the rainfall is longer, heavier and exceeds the rate of infiltration. In this condition the excess water makes a head over the ground surface, which tends to move from one place to another following land gradient and is known as overland flow. When the overland flow joins the streams, channels or oceans, it is termed as surface runoff or surface flow.

ii) Sub-Surface Runoff: The water that has entered the subsoil and moves laterally without joining the water-table to the streams, rivers or oceans is known as sub-surface runoff. The sub-surface runoff is usually referred as interflow.

iii) Base Flow: It is a flow of underground water from a saturated ground water zone to a water channel. It usually appears at a downstream location where the channel elevation is lower than the groundwater table. Groundwater provides the stream flow during dry periods of small or no precipitation.

Units of the Measurement pertaining to Hydrology

- Evaporation /interception - inches (or) cm
- Infiltration - inches (or) cm / hour
- Precipitation - inches (or) mm (or) cm
- Run off - inches (or) mm (or) cm
- Run off rate - cubic feet per second
- Run off volume - acre feet (or) cubic feet
- Storage - cubic feet (or) acre feet

9thStd
Unit-1
Lithosphere – I Endogenetic Processes

Pathway

- The Earth is a unique planet of the Solar family. The Earth is composed of four spheres namely, the lithosphere, the atmosphere, the hydrosphere and the biosphere. This lesson focuses on the internal processes of the Earth. The sequence of lessons generally follows the spheres of the Earth system in a comprehensive manner.

Spheres of the Earth

- Earth's surface is a vast area of510 million sq.km, where four spheres of the Earth interact. The abiotic spheres are the lithosphere, atmosphere and hydrosphere. The biotic sphere is the biosphere. Together, these spheres constitute the planet, Earth. This topic 'lithosphere' has been bifurcated for the sake of convenience. It is divided into Endogenetic processes (Internal processes) and Exogenetic processes (External processes). This lesson deals with the Endogentic processes in detail, the next lesson will deal with the Exogenetic processes.

Spheres of Earth

- The outer surface and inner core of the Earth are totally different in their nature and structure. The structure of the Earth's interior is divided into three layers namely the crust, the mantle and the core.

Crust

- Crust is the outer layer of the Earth, where we live. It is the skin of our Earth, which ranges between 5 to 30 km. It is the solid and rigid layer of the Earth. The thickness of the crust is greater below the continents than the ocean floor. The crust is classified as continental crust and oceanic crust. The major elements of crust are Silica (Si) and Aluminium (Al) and thus, it is termed as SIAL.

Mantle

- The interior part beneath the crust is called mantle, which is about 2,900 km thick. The major elements of the mantle are Silica (Si) and Magnesium (Mg) and hence it is also termed as SIMA. In the upper part of the mantle, the rock remains solid, whereas in the lower part of the mantle, rocks are in molten form. This molten rock inside the Earth is called 'magma'.

Core

- The core is the innermost and hottest layer of the Earth which lies below the mantle. It is composed mainly of Nickel (Ni) and Iron (Fe). Hence it is called NIFE. The core is divided into Solid inner core and Liquid outer core. The presence of large quantities of iron in the core is responsiblefor the Earth's gravitational force. As the Earth rotates on its axis, the liquid outer core spins over the solid inner core and generates the Earth's magnetic field. This is responsible for the functioning of the magnetic compass. Due to high pressure, the materials in the inner core are unable to move and hence remain solid.

DATA ON THE EARTH'S INTERIOR				
Layers	**Thickness (km)**	**Top**	**Bottom density (g/cm3)**	**Types of rocks found**
Crust	30	2.2	- 2.9	Silicic Rocks Andesite, Basalt at base, Aluminum
Upper mantle	720	3.4 -	4.4	Peridodite, Eclogite, Olivine, Spinel, Garnet, Pyroxene Perovskite, Oxides
Lower Mantle	2,171	4.4	-	Magnesium and silicon oxides
Outer core	2,259	9.9	- 12.2	Iron oxides, Sulphur, Nickel Alloy
Inner core	1,22,	12.8	-	Iron oxides, Sulphur, Nickel Alloy
Total Thickness	**6,401**			

Rocks: The crust is a storehouse of rocks. An aggregate of minerals on the Earth's crust is called 'rock'. It may be hard and compact like 'granite' or soft as 'clay' or loose as 'sand'.

Types of Rock: Based on formation, rocks are classified as: 1. Igneous, 2. Sedimentary and 3. Metamorphic.

1. **Igneous Rocks:** The word 'igneous' is derived from the Latin word Ignis meaning 'Fire'. The interior of the Earth contains very hot molten material called 'Magma'. When the magma reaches the Earth's surface, it is referred to as 'Lava'. The lava on the surface cools down and gets solidified as rocks called igneous rocks. Granite and basalt are examples of such rocks. Igneous rocks are also called Primary or Mother rocksbecause all other rocks are directly or indirectly formed from them.

2. **Sedimentary Rocks:** These sedimentary rocks are named after the latin word 'sediment' meaning ' settle. Rivers, glaciers and winds carry bits of rock and soil and deposit them in layers.After a few million years, these deposits harden into compact rocks and are called Sedimentary rocks. The bodies of plants and animals that fall on the deposits get embedded in the layers and form Fossils. Sandstone, limestone, chalk, gypsum, coal and onglomerate are examples of sedimentary rocks.

3. **Metamorphic Rocks:** The term 'metamorphic' is derived from the word 'metamorphosis', which means, 'change of form'. When igneous or sedimentary rocks are subjected to extreme heat and pressure, they undergo a complete change in their form and character .i.e., in course of time, granite may get transformed to gneiss, basalt to schist, limestone to marble and sandstone to quartzite.

Types of Rocks	Examples	Uses
Igneous	Granite Basalt	Construction work Laying roads
Sedimentary	Gypsum Limestone	Manufacturing of wall board, cement, plaster of Paris etc. Construction and purification of Iron in blast furnaces
Metamorphic	Diamond Marble	Jewellery making Sculpture and construction

Rock Cycle: The Rock cycle is a continuous process through which igneous, sedimentary and metamorphic rocks are transformed from one form to another.

Geomorphic Processes

- The formation and deformation of landforms on the surface of the Earth is a continuous activity of two broad processes i.e. internal and external. These processes cause stress and deformation on Earth materials and finally bring changes on the surface of the Earth. These are referred as Geomorphic Processes.

- The forces that act from the Earth's interior towards the Earth's surface are calledInternal processess or Endogenetic processes. These forces build the landscape and create topographic relief.

- The forces that act on the surface of the Earth due to natural agents like running water, glacier, wind, waves etc. are called External processes or Exogenetic processes. These external processes tear the landscape down into relatively low elevated plains.

Internal Processes: The internal processes generate heat and eject materials from deep below the Earth's crust. Internal radioactivity is the principal source of power for this process.

Plate Tectonics:

- The lithosphere is divided into a number of huge slabs of rocks called 'Tectonic plates.' These tectonic plates are divided into major and minor plates. These plates float independently over the mantle. Collisions of these plates produce mountain ranges and other irregular surface features, both on land and the ocean floor. This phenomenon is called 'plate tectonics'. The movement of tectonic plates is due to thermal energy from the mantle. Now we have a better understanding about the plate movements and its relation to Earthquake and volcanic activities.

Types of Plate Boundaries

- **Convergent Boundary:** Here the plate moves toward each other and sometimes, a plate sinks under another. The location where the sinking of a plate occurs is called a subduction zone.

- **Divergent Boundary:** Here the plates pull away from each other as magma pushes up from the mantle.

- **Transform Boundary**: Here the plates slide horizontally past each other.

Movements of Continental Plates

- Due to lateral compressional forces, the plates are forced to move upwards and downwards. This is called 'Folding'. Mountains formed by folding are called fold mountains. the Process of folding creates lofty mountain ranges such as the Himalayas and the Alps The movement of plates also create stress and tension in the rocks, causing them to stretch and crack. This is called 'Faulting'. The great rift valley of East Africa is a notable example for the process of faulting. The process of folding and faulting together with volcanoes and Earthquakes continually reshape the continents and seafloor.

- According to plate tectonics, the plates are in constant motion with an average rate of few centimetres per year. The movement might seem slow, but over millions of years, the plates and the continents riding on them move a long way. For example, about 250 million years ago, the Indian Plate was a part of the Gondwana land, which comprised of modern Africa, Australia, Antarctica, and South America.

- Approximately 140 million years ago, the Indian plate broke away from the ancient super continent 'Gondwana' and began moving north and collided with

Asia. The collision with the Eurasian Plate along the boundary between India and Nepal formed the Orogenic belt that created the Tibetan Plateau and the mighty Himalayan Mountains.

Earthquake

- Earthquakes are generally caused by the sudden vibrations in the Earth's crust, which spreads outward in all directions as waves from the source of disturbance.The point of origin of an Earthquake is called 'Focus' (Hypocenter) which generates a series of elastic waves. 'Epicentre' is a point on the Earth's surface that lies directly above the focus. The impact of the Earthquake is felt the most at the epicentre.

Seismic Waves

- **Earthquakes generate seismic waves:** The nature, force and speed of these seismic waves depend on the nature of the medium through which it passes. Accordingly, there are three major types of waves.

- **Primary or P-waves**are the fastest of all the Earthquake waves and the first to reach the epicentre. These waves pass through solids, liquids and gases, either through push or pull with an average velocity of 5.3km per second to 10.6 km per second.

- **Secondary or S-waves**travel only through solids. These transverse waves shake the ground perpendicular to the direction in which they propagate. The average velocity of these waves is 1Km per second to 8 km per second.

- **Surface Waves (or) L-waves**are similar to P-waves but they travel primarily along the ground surface. These waves travel comparatively slower and are the most destructive waves. The average velocity of these waves are 1 km per second to 5 km per second.

Tsunami

- The word 'Tsunami' is a Japanese term, meaning harbour waves. It is adopted to describe large seismically generated sea waves caused by Earthquakes, submarine explosions and landslides. These waves travel at a great speed (more than 500 km per hour) and the length of the waves exceeds 600 km. These waves reach to a height of more than 15 m near the sea shore and are capable of causing destruction along the coastal area. The 2004 Indian Ocean Earthquake that caused tsunami is the sixth-deadliest natural disaster which travelled at a speed of 600 km per hour with an estimated death toll of 2,80,000. The Earthquake which occurred near Indonesia at 00.58 hours took nearly 7 hours to reach Chennai.

Volcanoes

- A volcano is a vent or an opening on the surface of the Earth crust, through which hot solid, liquid and gaseous materials (Magma) erupt out to the surface from the Earth's interior. Magma rises up and ejects on the surface as Lava. Volcanoes are also formed when plates move apart. Volcanoes generally have the following major components. They are:

i. **Magma chamber**: a large pool of liquid rock found beneath the surface of the Earth

ii. **Vents**: an opening serving as an outlet for air, smoke, fumes, magma etc

iii. **Volcanic cone:** a landform built by the magma ejected from the vent in the shape of a cone.

iv. **Crater:** a bowl shaped depression found at the top of the volcano through which the magma flows out.

Based on the periodicity of eruptions, volcanoes are classified into i. Active volcano, ii. Dormant volcano, iii.Extinct volcano.

i. Active Volcano: Active volcanoes are those which constantly eject volcanic lava, gases and fragmented materials. (eg.) Mount St. Helens in the United States.

ii. Dormant Volcano: Volcanoes that do not show any sign of volcanic activity for a long period of time are known as dormant volcanoes. Sometimes there may be a sudden explosion which may cause unimaginable loss to life and property (e.g.) Mt. Fuji , Japan

iii. Extinct or Dead Volcano: When a volcano permanently stops its volcanic activity, then it is called as extinct or dead volcano (e.g.) Mt. Kilimanjaro, Tanzania

Volcanoes can also be classified based on their structure and composition as composite volcano, shield volcano and dome volcano

- **Composite Volcano:** Composite volcano, also known as strata volcano, is a conical volcano built by many layers of hardened lava, pumice and volcanic ash. These are commonly found in the Pacific Ocean Eg. Mt. Fuji, Japan

- **Volcanic Dome:** A lava dome or volcanic dome is roughly a circular mound formed due to the slow ejection of viscous lava from a volcano. As the lava is rich in silica with intense viscosity, it is prevented from flowing far from its vent. e.g. Paricutin, Mexico

- **Shield Volcano:** Shield volcanoes are formed by intense viscous lava. These are shallow depositions with gently sloping sides. Hence the lava flows out in all directions to create a shield. E.g., Mauna Loa, Hawaii

Distribution of Earthquakes and Volcanoes

- Most Earthquakes and volcanic eruptions do not strike randomly, but occur along the plate boundaries. One such area is the circum-Pacific Ring of Fire, where the Pacific Plate meets many surrounding plates. The Ring of Fire is the most seismically and volcanically active zone in the world. The other distinctive major belts are Mid-Oceanic Ridges and Mid- Continental Belts.

Effect of Volcanoes

Constructive Effects

- Volcanic materials enrich the soil fertility that promotes agricultural activities. The hot volcanic region helps in generating geothermal energy. Many dormant and active volcanoes are the most attractive tourist spots of the world. Most of the volcanic materials are used as building materials.

Destructive Effects

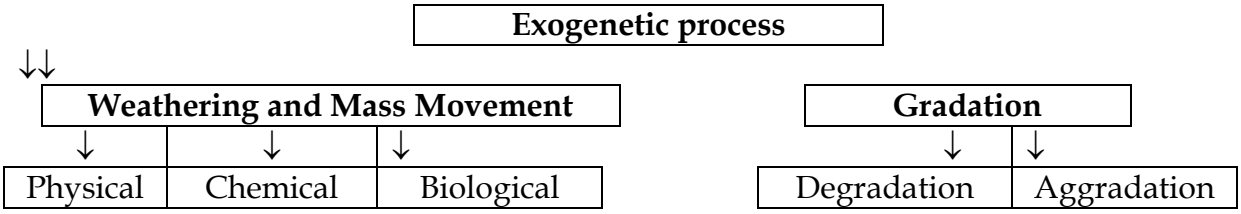
- Volcanic eruption causes Earthquakes, fast floods, mud slide and rock fall. Lava can travel very far and burn, bury, or damage anything in its path. The large amount of dust and ash makes breathing hard and irritable. Volcanic eruptions can alter the weather conditions and disrupt transport (Iceland volcanic eruption) in and around the volcanic region.

- "The Earth can physically be described as a ball of rock (the lithosphere), partly covered by water (the hydrosphere) and wrapped in an envelope of air (the atmosphere). To these three physical zones it is convenient to add a biological zone which includes all the living organisms (the biosphere)."- Arthur Holmes
- The 'Pedosphere' is a part of the lithosphere made up of soil and dirt. It exists at the interface of lithosphere, atmosphere, hydrosphere and biosphere.
- The lithosphere is the solid outer part of the Earth.
- The atmosphere is a thin layer of gases that surrounds the Earth.
- The hydrosphere is the watery part of the Earth's surface including oceans, rivers, lakes and water vapour
- The biosphere is the layer of Earth where life exists.
- The terms 'lithosphere' and 'crust' are not the same. The lithosphere includes the crust and the uppermost part of the mantle.
- All terrestrial planets have lithosphere. The lithospheres of Mercury, Venus, and Mars are much thicker and more rigid than that of the Earth.

- The Deepest Place ever reached by human technology vary from time to time. Till 2011 Kola Super Hole (12,262m) in Murmansk, Russia was the deepest place. But in 2012, Z-44 Chavyo Well (12,376m) broke the record, and is supposed to be 15 times the height of Burj Khalifa in Dubai. The exploration of Earth's interior continues.
- The ancient city of Petra in Jordan is an example of an entire city carved out of rocks. There are many specimens of magnificent rock-cut architecture in India, like the Ajanta and Ellora caves in Maharashtra, the Aihole and Badami temples in Karnataka, the Konark temple in Odisha and Mamallapuram in Tamil Nadu.
- C.F. Richter devised a scale to measure the magnitude of Earthquakes. This scale relates to the energy released at the epicentre and provides an estimation of the severity of an Earthquake. It is an open ended scale. The highest magnitude ever recorded is 9.5 on Richter scale (Bio-Bio, Chile in 1960).
- The instrument which records the Earthquake waves is called 'seismograph' or 'seismometer'. The science that deals with Earthquakes is called 'seismology'.
- On 26 December 2004 a tsunami occurred in the Indian Ocean. It was the result of the Indio- Australian Plate subducting below the Eurasian Plate. It was caused by an Earthquake measuring a magnitude of above 9 in the Richter scale. The Earthquake caused the seafloor to uplift, displacing the seawater above.
- The term 'volcano' is derived from the Latin term VULCAN, which is the name of Roman "God of Fire".

Unit – 2
Lithosphere – II Exogenetic Processes

- The Earth is a dynamic system that undergoes various changes due to internal and external processes. The continuous interaction of these two processes controls the structure of the earth's surface. The external processes are the consequence of solar energy and gravitational forces, whereas the internal processes are an outcome of the earth's internal heat.



Weathering and Mass Movement

- Weathering is the disintegration and decomposition of materials of the earth's crust by their exposure to atmosphere. Movement of huge volumes of weathered rock material down the slope due to gravity is called mass movement or mass wastage. Example: rock slide, land slide, debris fall, mud flow. The nature and magnitude of weathering differs from place to place and region to region. Weathering is affected and controlled by factors such as temperature, rock structure, land slope and vegetation. There are three types of weathering 1. Physical weathering, 2. Chemical weathering and 3. Biological weathering

Physical weathering

- It is the breakdown of rocks without changing their chemical composition, through the action of physical forces. The constant freezing and thawing of rocks during the night and day leads to the expansion and contraction of rocks. Cracks are formed and disintegration occurs eventually. Exfoliation, block disintegration, granular disintegration etc., are the different types of weathering.

✓ **Exfoliation:** The alternate heating and cooling on rounded rock surfaces leads to the peeling of rocks, layer by layer like an onion. This is called exfoliation. Sheeting and shattering are the other forms of exfoliation.

✓ **Granular Disintegration:** Granular disintegration takes place in crystalline rocks where the grains of the rocks become loose and fall out. This is due to the action of temperature and frost.

- ✓ **Block Disintegration:** Repeated expansion and contraction of rocks during day and night respectively causes stress on the joints of the rocks which results in block disintegration.

Chemical Weathering

- Disintegration and decomposition of rocks due to chemical reactions is called Chemical Weathering. This is predominantly high in the hot and humid regions such as the equatorial, tropical and sub tropical zones. Chemical weathering takes place through the processes of oxidation, carbonation, solution, and hydration. The agents of Chemical weathering are Oxygen, Carbon-dioxide and Hydrogen.

- ✓ **Oxidation:** Oxygen in the atmosphere reacts with the iron found in rocks, thus leads to the formation of iron oxide. This process is known as oxidation, which results in the weakening of rocks.

- ✓ **Carbonation:** Carbonation is the mixing of water with the atmospheric carbon-dioxide, forming carbonic acid. Carbonation is important in the formation of caves, in limestone region. When the carbonic acid reacts with the carbonate rocks, the rocks get disintegrated.

- ✓ **Solution:** The process of dissolution of rock substances in water result in the loosening of the rock particles. This inturn breaks down the rocks.

- ✓ **Hydration**: Certain chemicals in the rock enlarge in size in humid conditions. These minerals found in the rock swell and this results in the development of cracks and the rock wears down. This type of weathering is called hydration.

Biological Weathering

- Biological weathering occurs due to the penetration and expansion of plant roots, earthworms, burrowing animals (rabbits, rats) and some human activities.

Gradation: Gradation is the process of levelling of the land by means of natural agents like rivers, ground water, winds, glaciers, and sea waves. These agents produce various gradational relief features in due course of time. Gradation takes place in two ways: degradation and aggradation

- **Degradation or denudation**is the wearing down of the land surface by various natural agents
  .
- **Aggradation**is building up of landforms due to natural agents.

- **Gradation** = Erosion + Transportation + Deposition

Agents of Gradation
Running water (River)

- The work of running water (rivers) is the most extensive among all the other agents of gradation. Rivers originate on higher landforms like, mountains, hills and plateaus that receive water from various sources like the rain, glaciers, springs, lakes, etc.The place where the river originates is called its source and where it joins the sea is known as its mouth. The primary functions of a river are (i) erosion (ii) transportation and (iii) deposition. The work of a river depends on various factors such as volume of water, velocity of the river, slope of land, load of sediment and structure of rock, and load of sediment.

Courses of River:

- Rivers generally originate from mountains and end in a sea or lake. The whole path that a river flows through is called its course. The course of a river is divided into: i. The upper course, ii. The middle course and, iii. The lower course

i. **The Upper Course:** Erosion is the most dominant action of river in the upper course. In this course, a river usually tumbles down the steep mountain slopes. The steep gradient increases the velocity and the river channel performs erosion with great force to widen and deepen its valley. The land features carved by a river in its upper course are V- shaped valleys, gorges, canyons, rapids, pot holes, spurs, and waterfalls.

ii. **The Middle Course:** The River enters the plain in its middle course. The volume of water increases with the confluence of many tributaries and thus increases the load of the river. Thus, the predominant action of a river is transportation. Deposition also occurs due to the sudden decrease in velocity. The river in the middle course develops some typical landforms like alluvial fans, flood plains, meanders, ox-bow lakes etc.,

iii. **The Lower course:** The River, moving downstream across a broad, level plain is loaded with debris, brought down from its upper and middle courses. Large deposits of sediments are found at the level bed and the river, splits into a number of channels called distributaries. The main work of the river here is deposition and it develops typical landforms like delta and estuary.

Erosional Landforms of River

- ✓ **Gorges and Canyons:** When the river flows through a mountainous region made up of hard rocks, it forms a valley with almost vertical sides called gorge. In India, deep gorges have been formed by Brahmaputra and Indus in the Himalayas. A deep gorge with steep sides that

runs for hundreds of kilometres is referred to as canyon e.g. Grand Canyon of the river Colorado in the U.S.A.

- ✓ **Waterfall:** When a river flows in a region where hard rocks lie over soft rocks horizontally, the soft rocks get eroded quickly and the hard rocks projects outwards. Thus, the river falls vertically from a steep slope to form a waterfall. When the water falls with great force, it erodes the rock material beneath and creates a depression called a plunge pool. Shallow fast flowing water in a stream is called a rapid.

- ✓ **V-shaped valley:** A 'V'- shaped valley is formed by the vertical erosion of the river where the valley is deepened and widened.

- ✓ **Pot hole:** Due to the river action, cylindrical holes are drilled vertically in the river bed, with varying depth and diametre. These are called pot holes.

- ✓ **Meander**: As the river loaded with debris flows slowly, it forms sweeping loops and bends. It is referred to as meanders.

- ✓ **Ox bow lake**: Meanders in due course of time become almost a complete circle with narrow necks. This in turn gets abandoned and forms a lake. This is called an Ox-bow lake.

Depositional Landforms of River

- ✓ **Alluvial Fan:** A fan shaped deposition made by the river at the foothills is called an alluvial plain

- ✓ **Flood Plain:** Fine sediments are deposited on river banks when a river floods. These sediments make the region rich and fertile. This is called a flood plain. As the height of the river banks gets increases due to continuous deposition of a flooded river, levees are formed.

- ✓ **Estuary**:Estuary is formed where the rives meets the sea. Deposition of silt by the river is not possible here in the estuaries like delta as if the waves keep on eroding the deposits. Ex. River Narmada and Tapti.

- ✓ **Delta:** A triangular shaped low lying area formed by the river at its mouth is called delta. Deltas have fine deposits of sediments enriched with minerals. Eg. Cauvery Delta, Tamil Nadu.

Groundwater

- Water that percolates through the pores and fissures of rocks gets collected beneath the earth's surface. This is normally referred to as groundwater or sub-surface water. The rate of percolation depends on the nature of the rocks. The rocks

that allow water to percolate are called porous rocks or permeable rocks. The rocks that do not allow water to seep through them are called non-porous rocks or impermeable rocks.The percolated water in course of time returns back to the surface in the form of springs, geysers, hot springs, wells, tanks, artesian wells etc. that are useful for human activities. As an agent of gradation, underground water creates distinct landforms in limestone regions called Karst Topography.

Karst Topography

- Ground water is an active agent in limestone regions. Karst topography is formed due to the dissolution of soluble rocks such as limestone, dolomite and gypsum. Limestone topography of Western Slovenia extends for a distance of 480 km in length and 80 km in width which is termed as Karst in the Slavic language. The world's largest karst area is the Nullarbar located on the Great Australian Coast. Karst regions are also found in Southern France, Spain, Mexico, Jamaica, Western Cuba, Central New Guinea, Sri Lanka and Myanmar. Karst topography also exhibits both erosional and depositional features.

Erosional Landforms of Underground Water

- Most of erosion takes place due to the process of solution. When rain water mixes with carbon-di- oxide and enters into a limestone region, it dissolves and destroys much of the limestone. As a result, landforms such as Terra rossa, Lappies, sinkholes, swallow holes, dolines, uvalas, poljes, caves and caverns are formed.

- ✓ **Terra Rossa (Italian term for Red soil):** Deposition of red clay soil on the surface of the Earth is due to the dissolution of limestone content in rocks. The redness of the soil is due to the presence of iron oxide.

- ✓ **Lappies:** When the joints of limestone rocks are corrugated by groundwater, long furrows are formed and these are called LAPPIES.

- ✓ **Sinkhole:** A funnel shaped depressions formed due to dissolution of limestone rock is called sinkholes. Their average depth ranges between three and nine meters.

Caves and Caverns:

- Caves and caverns are subterranean features of karst topography. Caves are hollows that are formed by the dissolution of limestone rocks when carbon di oxide in air turns into carbonic acid after its reaction with water. They vary in size and shape. Caverns are the caves with irregular floors. Eg. Guptadham caves in Western Bihar.

- All types of deposits in the caves and caverns are collectively called speleothems which includes travertines, tufa, dripstones. Swallow Holes, Uvalas, Dolines, Poljis are other erossional Features of karst regions predominant in other parts of the world.

Depositional Landforms Underground Water

- It is interesting to know that a variety of depositional features are formed on the floor, ceiling and walls of the caves and caverns of the Karst Topography.

Stalactite, Stalagmite and Column

- When the water containing dissolved calcite gradually drips from the ceiling of the caves, water evaporates and the remaining calcite hangs from the ceiling. Thus Stalactites are formed. When the calcite deposits rises upward like a pillar Stalagmites are formed. Sometimes, Stalactites and Stalagmites meet together to form Columns and Pillars.

Glaciers:

- A Glacier is a large mass of ice that moves slowly over the land, from its place of accumulation. It is also known as 'River of ice'. The place of accumulation is called snowfield. The height above which there is a permanent snow cover in the higher altitude or latitude is called snowline. Higher the latitude, lower the snowline from sea level. The gradual transformation of snow into granular ice is called 'firn' or ' neve' and finally it becomes solid glacial ice.

Movement of Glacier

- The large mass of ice creates pressure at its bottom and generates heat. Due to this, the glacier melts a little and starts to move .The rate of movement of a glacier varies from a few centimetres to several hundred meters a day. The movement of glaciers depends on slope, volume of the glacier, thickness, roughness at the bottom (friction) etc., and Temperature. Like the rivers, glaciers also carry out erosion, transportation and deposition.

Types of Glacier

- Glaciers are broadly divided into two types based on the place of occurrence, such as Continental glacier and valley glacier.

Erosional Landforms of glacier

- Glaciers are powerful erosive agents. Some of the important erosional landforms are Cirque, Aretes, Matterhorn, U-shaped valley, Hanging valley, Fiords

etc., Most of these glacial features are predominantly seen in countries like Switzerland, Norway etc.,

- ✓ **Cirque:** The glacier erodes the steep side walls of the mountain and forms a bowl-shaped armchair like depression, it is termed as Cirque
- ✓ **Arete:** Aretes are narrow ridges formed when two cirque walls joined together back to back, and forms narrow knife like ridges.
- ✓ **Matterhorn:** The pyramidal peaks formed when three or more cirques meet together, are referred as Matterhorns.

- ✓ **U-Shaped Valley:** When the glacier moves down along a river valley, the valley further gets eroded deep and wide to form a 'U' shaped valley.

- ✓ **Hanging Valley:** These are valleys eroded by tributary glacier and that hangs over the main valley.

- ✓ **Fjord:** Fjords are glacial valleys that are partly submerged in the sea.

Depositional Landforms of glacier

- After getting eroded, fragments of rocks and boulders along with dirt form glacial debris. Glacial debris gets deposited in the low lying areas and form depositional features like moraines, drumlins, eskers, kames and outwash plains.

- ✓ **Moraine:** Landforms formed by the glacial deposits of valley or continental glaciers are termed as moraines. They are of various shapes and sizes, like ground, terminal and lateral moraines etc.

- ✓ **Drumlin**: Drumlins are deposits of glacial moraines that resemble giant inverted teaspoons or half cut eggs.

- ✓ **Esker:** Long narrow ridges composed of boulders gravel and sand deposited by streams of melting water which run parallel to a glacier are called eskers.

- ✓ **Outwash Plain:** An outwash plain consists of glacial sediments deposited by the melting ice at the terminus of a glacier. It appears as an extensive accumulation of sand, gravel and silt.

- ✓ **Wind:** When air blows horizontally at or near the earth's surface is called wind. The erosional, transportational and depositional action of wind is predominant in arid regions. This is called as Aeolian Process.

Erosional Landforms of wind

- Some of the erosional landforms of wind are mushroom rocks, Inselbergsand yardangs.

- ✓ **Mushroom Rock:** Rocks are made up of hard and soft layers. When a rock's bottom is soft, the sand-laden winds blow against it and wear it down. By the constant wearing down action of the wind, the bottom gets eroded away to form a mushroom like structure. This is called a mushroom or pedestal rock. Such rocks are found near Jodhpur in Rajasthan.

- ✓ **Inselberg:** Inselberg is a German term which means an island mountain. Certain hard rocks like igneous rocks are more resistant to wind action. Such isolated residual hills rising abruptly from their surroundings are termed as inselbergs. Eg. Uluru or Ayers Rock, Australia.

- ✓ **Yardang:** In arid regions, certain rocks have hard and soft layers arranged vertically. When winds blow over these rocks, the soft layers get eroded leaving irregular crests. These are called yardangs.

Depositional Landforms of wind

- Deposition occurs when the speed of wind is reduced by the presence of obstacles like bushes, forests and rock structures. The sediments carried by wind get deposited on both the wind ward and leeward sides of these obstacles. Some of the depositional landforms are sand dunes, barchans and loess.

- ✓ **Sand Dune:** In deserts, during sandstorms, wind carries loads of sand. When the speed of wind decreases, huge amount of sand gets deposited. These mounds or hills of sand are called sand dunes. There are different types of sand dunes.

- ✓ **Barchan:** Barchans are isolated, crescent shaped sand dunes. They have gentle slopes on the windward side and steep slopes on the leeward side.

- ✓ **Transverse Dunes:** Transverse dunes are asymmetrical in shape. They are formed by alternate slow and fast winds that blow from the same direction.

- ✓ **Longitudinal Dunes:** Longitudinal dunes are long narrow ridges of sand, which extend in a direction parallel to the prevailing winds. These dunes are called Seifs in Sahara

- ✓ **Loess:** The term loess refers to the deposits of fine silt and porous sand over a vast region. Extensive loess deposits are found in Northern and Western China, the Pampas of Argentina, in Ukraine and in the Mississippi Valley of the United States.

- ✓ **Wave:** A steady up (crest) and down (trough) movement of surface water are called waves. Sea waves are the most powerful agents of gradation

and their erosional, transportational and depositional processes are confined to a very narrow belt along coastal areas.

Erosional Land Forms of Waves

Some of the erosional landforms of sea waves are sea cliff, sea cave, arch, stack, beach, bar and spit and wave cut platform.

- ✓ **Sea Cave**: Prolonged wave attack on the base of a cliff erodes rock materials, which result in the formation of caves.

- ✓ **Sea Arch:** When two caves approach one another from either side of a headland and unite, they form an arch. (Eg.) Neil Island, Andaman and Nicobar

- ✓ **Sea Stack**: Further erosion by waves ultimately leads to the total collapse of the arch. The seaward portion of the headland will remain as a pillar of rock known as stack. Eg the Old man of Hoy in Scotland.

- ✓ **Sea Cliffs:** Sea cliffs are steep rock faces formed when sea waves dash against them. The rocks get eroded to form steep vertical walls.

- ✓ **Wave Cut Platforms:** Flat surface found at the foot of sea cliffs are called as wave cut platforms. Wave cut platform is also referred as beach, shelf, terrace and plain.

Depositional Landforms of Waves

- ✓ **Beach:**Sand and gravel are moved and deposited by waves along the shore to form beaches. This is the most dominant and constructive work of the sea. (Eg.) Juhu beach along Mumbai coast, Puri beach in Odisha and Marina beach in Chennai.

- ✓ **Bar:** A bar is an elongated deposit of sand, shingle or mud found in the sea, almost parallel to the shoreline.

- ✓ **Spit:** A spit is a ridge or embankment of sediment, attached to the land on one end and terminating in open water on the other end. Spits are common at the mouth of estuaries. Eg. Kakinada spit.

NOTE

- ❖ The disintegrated rock materials, in due course of time, are weathered further, to form soil. Soil is a mixture of disintegrated rock material and decayed organic matter called humus.
- ❖ **Tributary**– Small streams that join the main river. Eg. River Bhavani

- **Distributary–** River channels that get separated from the main river. E.g., River Kollidam.
- The highest waterfalls in the world is Angel falls (979 m) in Venezuela.
- The world's largest oxbow lake is Lake Chicot is Arkansas of USA. Lake Kanwar in Bihar (India) is Asia's largest fresh water ox bow lake.
- The Greek letter () pronounced delta closely resembles the triangular delta of the river Nile. The Ganga-Brahmaputra Delta is the largest delta in the world.
- The world's best known geyser is the Old Faithful geyser in the Yellowstone National Park in Wyoming, U.S.A
- **Karst Areas in India**
  - Guptadham caves - Western Bihar,
  - Robert cave and Tapkeshwar temple - Uttarakhand.
  - Pandav caves Pachmari - Madhya Pradesh,
  - Kutumsar - Bastar district in Chattisgarh,
  - Borra caves of Visakhapatnam - Andhra Pradesh.
- The World's deepest sinkhole is China's xianozhai Tienkang at 2172 feet. There are as many as 15000 Sinkholes in Illinois
- **Geo Connect:** Cave insects lose their senses of sight and develop extraordinary long antenna to compensate the loss of sight
- The thickest known deposit of loess is, 335 metre found in the loess plateau in China.
- **Major land forms**: First order land form - continents and oceans. • Second order land form – Mountains, plateaus and plains in both continents and oceans.
- **Minor Land Forms**: Third order land forms – deltas, fjords coasts, sand dunes, beaches valleys, cirques, Mushroom rocks, limestone caves.

Unit- 3
Atmosphere

- Earth is a unique planet where life is found. Can you imagine life on the earth without air? No. The air is essential for the survival of all forms of life. The blanket of air that surrounds the Earth is called the atmosphere. It is held close to the earth by gravitational attraction.

1. Composition of the Atmosphere

- Atmosphere is a mixture of gases, water vapour and dust particles in different proportions. Nitrogen (78%) and Oxygen (21%) are permanent gases of the atmosphere. They constitute 99% of the total composition and their percentagesalways remain the same without any change. The remaining one percentage is occupied by Argon (0.93%), Carbon-dioxide, (0.03%), Neon (0.0018%), Helium (0.0005%), Ozone (0.00006%) and Hydrogen (0.00005%). Krypton, Xenon and Methane are also present in trace. Water vapour (0 - 0.4%) is also found in the atmosphere, which plays an important role in predicting weather phenomenon. The other solid particles present in the atmosphere includes dust particles, salt particles, pollen grains, smoke, soot, volcanic ashes etc.,.

- Oxygen is most important for living organisms. CO2 absorbs heat and keeps the atmosphere warm by insulation and radiation. Nitrogen acts as a diluent and is chemically inactive. Ozone helps in protecting the earth from radiation. The solid particles in the atmosphere acts as nuclei on which water vapour condense to form precipitation.

2. Structure of the Atmosphere

- The atmosphere is thick near the earth surface and thins out until it eventually merges with space. The five atmospheric layers are: Troposphere, stratosphere, Mesosphere, Thermosphere and Exosphere.

Troposphere:

- The lowest layer of the atmosphere is the troposphere. The Greek word 'tropos'means 'turn' or change. The layer extends up to 8 kms at the poles and up to 18 kms at the Equator. The temperature decreases with increasing height. Almost all weather phenomenons take place in this layer. Hence it is called weather making layer. The upper limit of the troposphere is called as tropopause.

Stratosphere

- Stratosphere lies above the troposphere. It extends to a height of about 50km above earth surface. Since this layer is a concentration of ozone molecules, it is also

referred as ozonosphere. The temperature increases with increase in height in this layer. Large jet planes normally fly here. The upper limit of the stratosphere is called as stratopause.

Mesosphere

- Mesosphere extends between 50km and 80km. The temperature increases with increasing height. Radio waves transmitted from earth are reflected back to earth from this layer. Most of the meteors nearing the earth get burned here. The upper most limit of the mesosphere is the mesopause.

Thermosphere

- Thermosphere exists above the mesosphere. It extends to about 600 km. The composition of gases in the lower thermosphere is more or less uniform, hence it is called"Homosphere". T e upper portion of the thermosphere has uneven composition of gases and hence it is referred as "Heterosphere". Here the temperature increases with increasing height. Ionosphere is a layer of the thermosphere that contains Ions and free electrons.

Exosphere

- The uppermost layer of the atmosphere is called exosphere. T is layer is extremely referred with gases and gradually merges with the outer space. T is zone is characterized by aurora Australis and aurora borealis.

Weather and Climate

- Weather and climate are the terms that are related to the atmospheric conditions. Weather denotes the way the atmosphere behaves every day and climate reveals the average of weather conditions over relatively long periods of time. The difference between the two may be clearly understood with the following table.

Weather		**Climate**	
Partly sunny	Weather is the study of atmospheric conditions for short duration over small	Climate is the study of the average weather condition observed over a long period of time for a larger area.	Warm Climate
Windy	The weather changes very often; hour to hour and day to day	Climate is more or less permanent and remains the same always.	Monsoon
Rainy	A place can experience different types of weather conditions in a day. Eg. A day with hot morning can have a	A place can experience almost the same type of climate	Wet climate

	rainy moon.		
Chilly	Weather data is collected every day in the observatories	Climate is average of the weather data.	Extreme Climate
Stormy	Study of weather is called Meteorology	Study of climate is called Climatology	Cyclone

2. There are many factors that influence weather and climate.

- ✓ Distance from the equator
- ✓ Altitude
- ✓ Nearness to the sea
- ✓ Nature of the prevailing winds
- ✓ Mountain barrier
- ✓ Cloud cover
- ✓ Ocean currents Natural vegetation

✓ **Distance from the Equator:** The sun's rays fall vertically on the equator. The rays are inclined on the regions away from the equator and near the poles due to the spherical shape of the earth. The vertical rays heat up the earth more than the inclined rays. Thus, the places near the equator are warmer than the places which are far away from the equator.

✓ **Altitude:** Altitude refers to the height above sea level. The temperature decreases at the rate of 1° C for every 165 mt of height.This is called Normal lapse rate. So, places at the higher altitude have a lower temperature.

✓ **Nearness to the sea:** The climate of a place varies according to its nearness to the sea. Places near the coast experience equable climate due to the influence of the winds from the sea. Places located in the land, far from the sea, does not experience the moderating influence of the sea, such places experience a continental type of climate.

✓ **Nature of the Prevailing Winds:** The winds change the climate of a place based on, from where they blow. When wind blows from a warm region, it makes the place warm and cold, when blows from a colder region. The on-shore winds cause rainfall making the place cool whereas the off-shore winds bring dry weather.

✓ **Mountains barriers:** The location of the mountains influence the climate of a place. The mountain chains act as natural barrier for the wind. Sometimes they prevent the entry of cold winds into the country or the escapeof monsoon winds, thus having a great influence over the climate.

✓ **Cloud Cover:** Clouds reflect a large amount of radiation from the sun. This prevents the entry of heat to the earth's surface. So, in areas generally of

cloudless sky like the deserts, temperature is very high. On the other hand under cloudy sky, the temperature is low.

- ✓ **Ocean currents:** The warm ocean currents raise the temperature of the nearby coastal areas, while the cold current lower the temperature of aw place.

- ✓ **Natural vegetation:** The trees release water vapour into the air and makes it cool. Thus forest areas have lower range of temperature throughout the year in contrast to non-forested areas.

3. Elements of Weather and Climate

- ✓ Temperature
- ✓ Pressure
- ✓ Wind
- ✓ Cloud
- ✓ Precipitation
- ✓ Humidity

Temperature:

- Temperature is a measure of the warmth of an object expressed in terms of Celsius or Fahrenheit, measured with thermometer. Sun is the chief source of energy for the Earth.The atmosphere acts as an insulator and maintains the temperature of the earth. Without atmosphere, the earth would experience great extremes of temperatures during day and night. Some of the processes that are responsible for atmospheric heat are radiation, Conduction, Convection and Advection.

- **Heat Zones:** Based on the amount of insolation received from the sun and the heat, Earth is classified into three heat zones namely torrid zone, temperate zone and frigid zone.

- **Torrid Zone:** This largest thermal zone covers almost 50% of the earth's surface. It is located between the Tropic of Cancer (23½°N) and Tropic of Capricorn (23½°S). Torrid Zone experiences vertical sun rays almost throughout the year and is hot.

- **Temperate Zones:** The Temperate Zone stretches out between Tropic of Cancer (23½°N) andArctic Circle (66½°N) in the northern hemisphere and between Tropic of Capricorn (23½° S) and Antarctic Circle (66½° S) in the southern hemisphere. The sun's rays never fall vertical in this region. The Frigid Zone is found between Arctic Circle (66½°N) and North Pole (90° N)in the northern hemisphere and stretches out between Antarctic Circle (66½° S) and South Pole (90°S) in the southern hemisphere. The sun's rays fall slanting

in this zone. These are the coldest regions of the world. The surface remains permanently frozen under thick snow.

Pressure

- The atmospheric pressure is the weight exerted by air on a particular area of the earth surface. It is measured with a mercury barometer and the unit of measurement is millibar (mb).The distribution of atmospheric pressure on the surface of the earth is not uniform. It varies both vertically and horizontally.

Vertical distribution of atmospheric pressure:

- Air pressure decreases with altitude. The air molecules become scattered and more widely spaced at higher altitudes. The air pressure decreases by 34 millibars per 300 metres increase in height.

Horizontal distribution of atmospheric pressure:

- The horizontal distribution of atmospheric pressure in the world is not uniform. It varies from time to time and place to place due to (i) air temperature (ii) the earth's rotation (iii) presence of water vapour etc., The pressure belts along the latitudes are characterized by alternate high or low pressure belts. The pressure belts of the world are:
    - Equatorial low
    - Sub-tropical highs
    - Sub-polar lows
    - Polar highs

The Equatorial Low Pressure Belt: This belt extends from equator to 5° N and 5° S latitudes. At the equator, the earth gets heated by the vertical sun rays and in turn heats the air in contact with it. The heated air expands and raises upwards resulting in a low pressure belt. This belt is called doldrums due to virtual absence of surface winds.

The Subtropical High Pressure Belts: The sub-tropical high pressure belts extend from the tropics to about 35° latitudes in both the hemispheres. The air that raises in the equatorial region, becomes cold and heavy, and starts to descend in the Sub Tropical regions. This result in sub-tropical high pressure belts referred as the Horse latitude.

The Sub-polar Low Pressure Belts: The sub-polar low pressure belts extend between 45°N and the Arctic Circle in the northern hemisphere and between 45°S

and the Antarctic Circle in the southern hemisphere. The air present in this layer moves to the sub-tropical high pressure belt and polar high pressure belt making it free from air pressure forming the sub polar low pressure belt. This is made possible by the rotation of the earth.

The Polar High Pressure Belts: Sun rays are always slanting at poles resulting in low temperatures. Because of low temperature, air compresses and its density increases. Hence, high pressure is found here. Winds from these belts blow towards sub-polar low pressure belts.

Winds

- The horizontal movement of air along the surface of the earth is called the "Wind' while the vertical movement of air is a called an "Air Current". The winds always blow from a high pressure area to a low pressure area. Wind is mostly named after the direction from which it blows. For example, the wind blowing from the east is known as the easterly wind.An "anemometer" records wind speed while a "wind vane" measures the direction of the wind. The unit of measurement is kilometre per hour or knots

Types of Winds

Winds are generally classified into the following four major types:

- ❖ Planetary wind
- ❖ Periodic winds
- ❖ Variable wind
- ❖ Local wind

Planetary winds

- The winds which constantly blow in the same direction throughout the year are called the planetary winds. They are also called as permanent winds or the prevailing winds. These winds include Trade winds, Westerlies and Polar Easterlies

  - ✓ **Trade Winds:** Trade winds blow from the subtropical high pressure belt to the Equatorial low pressure belt in both the hemispheres. They blow with great regularity, force and in a constant direction throughout the year. These winds were very helpful to traders who depended on the winds while sailing in the seas. And so, they are named as Trade winds. As they travel over vast oceans, they collect more moisture and bring heavy rainfall to the East Coast of the continents of the

tropics. As they move westwards, they become dry and do not give rainfall.

- ✓ **Westerlies:** Westerlies are the permanent winds that blow from the tropical high pressure belt to the sub polar low pressure belt in both the hemispheres. They blow from South West to North East in the northern hemisphere and North West to South East in the southern hemisphere. The velocity of westerlies become so vigorous and fast to be called Roaring Forties at 400, Furious Fifties at 500 and Screaming Sixties at 600 latitudes.

- ✓ **Polar Easterlies:** Polar easterlies are cold and dry polar winds that blow from the polar highpressure belt to the sub polar low pressure belt. These are weak winds blowing from North East direction in the Northern Hemisphere and South East direction in the Southern Hemisphere.

Periodic winds:

- The periodic winds are the seasonal winds that change their direction periodically.These winds are caused by the differential heating of land and ocean.Winds which reverse their direction with the change of seasons are called monsoons. A tropical Monsoon wind of Indian subcontinent is a best example.

Variable winds:

- The disturbance and the changes in the local weather cause variations in the prevailing winds. These winds are known as the variable winds. Variable winds usually end up with the development of cyclones, anticyclones and storms.

- ✓ **Cyclones:**The term cyclone is a Greek word meaning "coil of a snake". Cyclones are centres of low pressure where, winds from the surrounding high pressure area converge towards the centre in a spiral form. Due to the rotation of the earth, the cyclonic winds in the northern hemisphere move in anti-clock wise direction, where as they move in clockwise direction in the southern hemisphere.Cyclones can be classified into: 1. Tropical cyclones, 2. Temperate cyclones, 3. Extra tropical cyclones

  - **Tropical cyclones:** Tropical cyclones develop in the Inter tropical convergence zone [ITCZ]. They are formed due to the differential heating of land and sea.Tropical cyclones are known as 'cyclones' in Indian ocean, 'typhoons' in the western pacific ocean, 'hurricanes' in the Atlantic and eastern Pacific ocean, 'Baguio's' in Philippines and 'willy willy' in Australia. Tropical cyclones often cause heavy loss of life and property on the coasts and become weak after reaching the landmasses.

- **Temperate cyclones:** Temperate cyclones are formed along a front where hot and cold air masses meet in mid-latitudes between 35° and 65°N and S. Temperate cyclones do not become weak like the tropical cyclones on reaching the land. Temperate cyclone commonly occurs over the North Atlantic Ocean, North West Europe, Mediterranean basin. Mediterranean basin's temperate cyclones extend up to Russia and India in winter. In India it is as called western disturbances.

- **Extra tropical cyclones:** Extra tropical cyclones occur in the latitudes between 30° and 60° in both the hemispheres. They are also called as mid-latitude cyclones. They collect energy from temperature differences which are found in higher latitudes. Extra tropical cyclones produce mild showers to heavy gales, thunderstorms, blizzards, and tornadoes.

✓ **Anticyclones:** Anticyclones are the opposite of cyclones. Here an area of high pressure region is found in the centre surrounded by low pressure on all sides. The wind from the high pressure region move outwards to the low pressure regions in a spiral form. Anticyclones are often accompanied by cold and heat waves.

Cyclonic occurrences in Tamil Nadu						
Year	**Cyclone Name**	**District**	**Atmospheric Pressure** (in millibars)	**Wind Speed** (km/h)	**Fatalities** (in numbers)	**Property loss(**M-Million G-Billion)
2010	**JAL**	Chennai	988	100	78	1.73M
2011	**THANE**	Cuddalore	972	140	48	235M
2012	**NILAM**	Mahapalipuram & Chennai	992	85	75	56.7M
2013	**MADI**	Chennai	986	120	323	1.5G
2016	**ROANU**	Nagapattinam & Chennai	983	85	22	2.0G
2016	**KYANI**	Chennai	997	85	-	-
2016	**NADA**	Chennai	1000	75	-	-
2016	**VARDAH**	Chennai	982	130	38	5.1G
2017	**OCKHI**	Kanyakumari	975	155	245	5.07G

Local Winds:

- Local winds are the winds that blow only in a particular locality for a short period of time, the effect of these local winds are experienced only in that particular area.They are mostly seasonal and have local names like....

- ✓ Foehn (Alps-Europe)
- ✓ Sirocco (North coast of Africa)
- ✓ Chinook (Rockies-North America)
- ✓ Loo (Thar Desert- India)
- ✓ Mistral (Mediterranean sea in France)
- ✓ Bora (Mediterranean sea in Italy)

5. Clouds

- Large amount of water evaporates each day from the surface of the sea. This is the principal source of atmospheric moisture. Cool moisture laden air, gets collected around particles like dust, salt content from the sea, smoke etc., and forms clouds. Sometimes, mixing of warmer and cooler air also produces clouds. A visible mass of condensed water vapour floating in the air above the ground level is called a cloud. The three layers of atmosphere such as troposphere, stratosphere and mesosphere are specific locations of clouds. According to their height, clouds are classified into the following types 1. High clouds (6-20km Height), 2. Middle clouds (2.5km-6km Height), 3. Low clouds (ground surface to 25 km height. These major types of clouds are further divided into different types on the basis of shape and structure.

High clouds

- **Cirrus:** Detached clouds in the form of white delicate fibrous silky filaments formed at the high sky (8000 meters to 12000 meters) are called Cirrus clouds. These clouds are dry and do not give rainfall.
- **Cirro-cumulus**: White patched, sheet or layer like clouds composed of ice crystals.
- **Cirro-stratus:** Smooth milky transparent whitish clouds composed of tiny ice crystals.

Middle clouds

- **Alto-stratus:** Thin sheets of grey or blue coloured clouds in uniform appearance. consisting of frozen water droplets
- **Alto-cumulus:** Clouds fitted closely together in parallel bands, called as 'Sheep clouds' or wool pack clouds.
- **Nimbo stratus:** These are clouds of dark colour very close to the ground surface associated with rain, snow or sleet.

Low clouds

- **Strato-cumulus**: Grey or whitish layer of non-fibrous low clouds found inrounded patches at an height of 2500 to 3000 metres, associated with fair or clear weather
- **Stratus**: Dense, low lying fog-like clouds associated with rain or snow

- **Cumulus**:- Dome-shaped with a flat base often resembling a cauliflower, associated with fair weather
- **Cumulo-nimbus**:- Fluffy thick towering thunderstorm cloud capable of producing heavy rain, snow, hailstorm or tornadoes

Precipitation

- Falling down of condensed water vapour in different forms is called Precipitation. When the dew point is reached in the cloud water droplets become saturated and start to fall. Hence, they fall on the earth as Precipitation. The climatic conditions/ factors influencing the forms of precipitation mainly are:

    - Temperature.
    - Altitude
    - Cloud type.
    - Atmospheric conditions.
    - Precipitation process.

  The main forms of precipitation include drizzle, rain, sleet, snow, hail etc.

- **Drizzle:** Falling of numerous uniform minute droplets of water with diameter of less than 0.5 is called a drizzle.mm from low clouds. Sometimes drizzles are combined with fog and hence reduce visibility.

- **Rain:** Rain is the most widespread and important form of precipitation in places having temperature above the freezing point. It occurs only when there is abundantmoisture in the air. The diameter of a rain drop is more than 5mm.

- **Sleet:** Sleet refers to a precipitation, in the form of pellets made up of transparent and translucent ice. This precipitation is a mixture of snow and rain
- **Snow:** Snow is formed when condensation occurs below freezing point. It is the precipitation of opaque and semi opaque ice crystals. When these ice crystals collide and stick together, it becomes snowflakes.

- **Hails:** Hails are chunks of ice (greater than 2cm in diameter) falling from the sky, during a rainstorm or thunderstorm.Hailstones are a form of solid precipitation where small pieces of ice fall downwards. These are destructive and dreaded forms of solid precipitation because they destroy agricultural crops and human lives.

Rainfall

Rainfall is the most predominant type of Precipitation. Moisture laden air masses raise upwards, forms clouds and bringrainfall. Based on the mechanisms of raising the air, there are three types of rainfall.

- Convectional rainfall

- Frontal or cyclonic rainfall
- Orographic rainfall.

- **Convectional rainfall:** Earth surface is intensely heated through solar radiation during the day time. When the air near the earth surface is heated, it rises and expands. This heating results is the formation of convectional air currents. Thus the ascending moist air cools, condenses and results in convectional rainfall. Convectional rainfall occurs regularly in the equatorial region in the evenings. It is also experienced in tropical, sub-tropical and temperate regions in the summer months and on warmer days.

- **Cyclonic rainfall:** Cyclonic precipitation occurs during cyclones when air masses are made to converge and move upward so that adiabatic cooling occurs. Cyclonic rainfall occurs in tropical as well as temperate regions. When warm and cold air masses converge,condensation and precipitation takes place on the boundary between warm and cold air masses called as Frontal rainfall.

- **Orographic rainfall** Orographic rainfall, also called relief rainfall, is caused when air is forced to rise against a high mountain. The mountain barriers lying across the direction of air flow, force the moisture laden air rise along the mountain slope. This results in the cooling of the air, which leads to the formation of clouds and rain. This rainfallis called Orographic rainfall. The side of the mountain facing the wind is called the windward side and receives heavy rainfall. It is called the rainfed region. The other side of the mountain that does not face the wind is called the leeward side and receives less rainfall becomes rain shadow region.

Humidity:

- Humidity is an important aspect of the atmosphere because it affects both weather and climate. The amount of water vapour present in the atmosphere is referred to as humidity. Humidity of the atmosphere is high when it has large quantities of water vapour. The amount of water vapour in the atmosphere is called absolute humidity. The ratio between the amount of water vapour in the atmosphere and the amount of watervapour it can hold is relative humidity Hot air can hold more water vapour then cold air. Relative humidity increases when air gets cold and decreases when air gets heated up.

NOTE

- ❖ In 1772 CE Daniel Rutherford discovered Nitrogen in atmosphere. In 1774 Joseph priestly discovered oxygen in atmosphere
- ❖ Magnetosphere lies beyond the exosphere. It is the earth's magnetic belt, where proton and electrons, coming out from the sun are trapped by the earth. The magnetic field extends to around 64,000 km above the Earth.
- ❖ Auroras are cosmic glowing lights produced by a stream of electrons discharged

from the Sun's surface due to magnetic storms that are seen as unique multi-coloured fireworks hanging in the polar sky during midnight

- During the day, the land masses get heated more rapidly than the oceans. Heated air ascends and this causes low pressure on the adjoining ocean. Therefore, the wind blows from ocean to land in the afternoon. This is called sea breeze. **Sea breeze** helps in reducing the temperature of the coastal region especially during the summer season. During the night, the land cools more rapidly than the ocean. Cool air sinks and forms high pressure. The wind blows from land to sea during the night, this is called **land breeze**.
- The windward is the side of a mountain which faces the prevailing wind. It receives heavy rainfall. The leeward side of the mountain is the side sheltered from the wind. It receives very less rainfall.
- Heat is the energy which makes objects hot, while temperature measures the intensity of heat.
  - The amount of heat received from the sun in the form of short waves is called Insolation or Incoming Solar Radiation.
  - The outgoing heat from the earth to space in the form of long waves is called terrestrial radiation. This is also called as re-radiation
  - Albedo is the fraction of solar energy reflected from the earth back into space without reaching or heating the earth surface.
  - There is a balance between insolation and radiation. This balance is termed as a heat budget of the earth.
  - Isotherms are imaginary lines drawn on maps, connecting points that have equal temperatures. Temperature varies from place to place, season to season and continent to continent. The average global surface temperature is about 13 °C.
  - **Conduction** is the transfer of heat from hot body to a cold body through contact.
  - **Convection** is transfer of heat by movement or circulation of air in a mass.
  - **Advection** is the transfer of heat through the horizontal movement of air.
  - An isobar is an imaginary line drawn through places having equal atmospheric pressure reduced to sea level.
  - At the top of Mount Everest (elevation 8848m), the air pressure is only about one third the pressure at sea level. When we fly in aircraft or travel fast on road to hill stations, our ears pop as they adjust to a rapid change in pressure when ascending or descending.
  - **ITCZ and Doldrums:** The Inter Tropical Convergence Zone (ITCZ) is the belt of converging winds and rising air encircling Earth near the Equator. Doldrums (the zone of calm) lies in the equatorial region with calms, light unpredictable winds and sudden cyclones
  - **HORSE LATITUDE:** In olden days vessels with cargo of horses passing through sub-tropical high pressure belts found difficulty in sailing under calm conditions. With little water and food left for the humans, sailors used to throw the horses in to the sea in order to make the vessels lighter. Henceforth these belts or latitudes are also called 'horse latitudes'.
  - The rotation of the Earth causes deflection of winds from their original path,

called the "Coriolis effect". Winds are deflected to the right in the northen hemisphere and to the left in the southern hemisphere which is known as "Ferrel's law". This was profounded by William Ferrel. He used "Coriolis force" named after G.G Coriolis (1792-1843) for proving Ferrel's Law

- **Super Cyclone**: A violent cyclone that hit Odisha, on Friday, 29 October 1999, was one of the most devastating and strongest storm to hit the Indian coast. Winds of up to 260 kph raged for over 36 hours. The winds caused a seven-metre tidal wave that swept more than 20 km inland and brought massive destruction and death to a number of coastal districts in the state of Odisha. It is estimated that more than 10 million people in 12 coastal belt districts were affected by the cyclone. More than 10,000 people lost their lives.
- A front is the boundary separating warm and cold air masses. One type of airmass is usually denser than the other, with different temperatures and humidity. This meeting of airmass causes rain, snow, cold days, hot days, and windy days.
- Deliberations for naming cyclones in the Indian ocean region began in 2000 and a formula was agreed upon in 2004. Eight countries in the region Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Srilanka, and Thailand contributed a set of names which our assigned sequentially whenever a cyclonic storm develops.
- During sunset cirrus clouds look colourful hence they are called as "Mare's Tails".
- The only sphere which contains all clouds in the atmosphere is troposphere
- Any thunderstorm which is associated with fall of hail stones is known as hailstorm. Hailstorm is one of the most feared weather phenomenon because it has the potential to destroy plant, trees, crops, animals and human life.
- Mawsynram is the wettest place of India as it is located in the windward side of the Purvachal hills, whereas Shillong lies on the leeward side and thus receives less rainfall. This is the same, in the case of Mumbai and Pune.
- Absolute humidity is expressed in terms of grams of water vapour present per cubic metre of air. Relative humidity is expressed in percentage.
- When the relative humidity of the air is 100%, the air is said to be saturated. Saturated air will not absorb any more water vapour. The temperature at which air gets saturated is called dew point. Humidity of the atmosphere is measured by the wet and dry bulb thermometer also called the Hygrometer

Unit - 4. Hydrosphere

- One of the most indispensable natural resources on earth is water. The Earth is also called the Blue planet, as it holds water in abundance and thus stands unique among all other planets. Hydrosphere consists of water in various forms found on the earth. Over 97% of the water on the Earth's surface is confined to oceans. Less than 3% of water is held on land as glaciers, ice caps, groundwater, rivers, lakes, and also as the water vapour in air.

Hydrological Cycle

- The Earth's water is not static. It is always in motion. This continuous movement of water on, above and below the earth's surface is called the Hydrological Cycle. The three major processes involved in the water cycle are evaporation, condensation and precipitation. Water changes its form constantly i.e. Ice, water and water vapour. This process happens in the blink of an eye or even over millions of years. Water resources of the Earth can be broadly divided into fresh water and salt water.

Fresh Water

- Rain water is considered to be the purest form of water, as it contains very less proportion of salts when compared to the oceans and seas. Hence it is called fresh water. A major part of fresh water is found in the frozen state in the form of ice caps and glaciers. Around 1% of it is found in the liquid state as rivers, streams, lakes, ponds etc. Surface water may also penetrate through porous rocks and gets collected beneath the Earth's surface. This is called groundwater.

Oceans

- The ocean is a continuous body of salt water that forms the major part of hydrosphere. Geoscientists believe that the oceans were formed on Earth nearly three billion years ago. It is difficult to believe that in the beginning there was no water on our planet. In due course of time, when the Earth started cooling, steam escaped from the interior and entered the atmosphere to form clouds. At first, the clouds brought incessant rains. The rain water filled the depressions for tens of thousands of years and eventually a super ocean was formed.

- The continents and oceans are however, not evenly distributed in the northern and the southern hemispheres. The northern hemisphere holds 61% of land whereas the southern hemisphere holds 81% of water. It is because of this pattern of land and water distribution, the northern hemisphere is called as the land hemisphere and the southern hemisphere is called as the water hemisphere. Oceans and seas are considered as resource bowl of the earth because of the immense availability of food, minerals etc., Present distribution of the world's oceans and major seas are illustrated in the map.

Relief of the Ocean Floor

- The ocean floor is not flat as it was believed to be in the earlier days. It comprises of many complex and varied relief as observed on the earth's surface. The ocean floor also has high mountains, deep trenches and large flat plains. These features are formed due to the tectonic, volcanic and depositional activities.

Comparative study of major oceans of the world

Ocean	Location	Average Depth(m)	Deepest Point(Below mean sea level)	Important Seas	Important Islands
Pacific Ocean	Bounded by North and South America on the east, Asia and Australia on the west and Antarctica on the South.	4,028	Challenger Deep in Mariana Trench (10,924 m)	Bering Sea, Sea of Japan , Okhotsk sea, yellow Sea, South china Sea, Coral sea	Hawali, Vancouver, Shakalin, Fiji
Atlantic Ocean	Extends from Greenland in the North to Antarctica in the South and located between North and South America in the west and Europe and Africa in the East.	3,926	Puerto Rico Trench (8,605 m)	Baltic sea, Black sea, Caribbean sea, North sea, Mediterranean sea, Norwegian sea	Canary island , New Found land, Azores, Greenland, Iceland,
Indian Ocean	Bounded by Asia in the north, Africa in the west, Australia in the east and Antarctica in the south.	3,963	Java Trench in Sunda Deep (7,258 m)	Red sea, Persian Gulf, Arabian sea, Andaman sea, bay of Bengal	Andaman and Nicobar, Islands, Lakshadweep Island, Sri Lanka, Pamban Islands
Southern Ocean	Found to the south of 60° South latitude and encircle Antarctica.	4,000 to 5,000	South Sandwich Trench (7,235 m)	Weddell sea, Amundsen sea, Davis sea, Ross sea	Trinity Islands Barry Islands, Wednesday Islands, Saddle Islands, Tasmania
Arctic Ocean	Surrounded by Europe, Asia, North		Fram Basin (4,665 m)	Beaufort sea, Hudson Bay,	Amsterdam Island,

	America, Greenland, and by several islands.	1,205		White sea,	Monumental Islands, Hyde Parker Islands, Shoe Islands

- The ocean basins are characterised by the following major relief features:

A. Continental shelf
B. Continental slope
C. Continental rise
D. Deep sea plain or Abyssal plain
E. Oceanic deep
F. Oceanic ridge

A. Continental Shelf: A shallow and gently sloping platform extending out from the adjoining continental land mass into the sea is called Continental Shelf. It is almost a uniform zone of sea bed with a gentle gradient. The continental shelf is of great significance for the following reasons:

- ✓ They are shallower, thus enables sunlight to penetrate through the water. This encourages abundant growth of grass, sea weeds and plankton. Hence these zones become the richest fishing grounds in the world. Eg. The Grand Banks of Newfoundland.
- ✓ The continental shelves have extensive deposits of minerals and mineral fuels. Hence, this zone becomes accessible for oil drilling and mining activities. E.g. Mumbai High in Arabian Sea.

B. Continental Slope: A steep slope which descends from the edge of the continental shelf to the deep ocean-bed is called continental slope. It forms a boundary between the Continental Crust and the oceanic crust. This zone is free from deposits as they are steep. The most important characteristic of continental slope is the presence of deep canyons and trenches. Due to the low penetration of sunlight, the slope has nearly freezing temperature. Hence aquatic life has very slow rate of metabolism.

C. Continental Rise: At the base of the continental slope is a gently sloping layer of sediments which merge into the deep-sea floor. This underwater feature found between continental slope and abyssal plains is called the continental rise. It consists of submarine fans which are similar to the alluvial fans found on land.

D. Deep Sea Plains or Abyssal Plains: The deep sea plains or abyssal plains are underwater plains found on the deep ocean floor. These plains extend from continental rise to the mid oceanic ridges. The gradient of the slope is very gentle and it appears as a uniform flat and featureless plain. These plains are usually covered by the thick layer of sediments composed of clay, silt and sand, brought by the rivers. These are often characterized by features like abyssal hills, sea mounts, guyots, coral, atoll etc.

E. Oceanic Deeps: Trenches are the deepest part of the oceans and occupy about 7% of the total relief of the ocean floor. The ocean temperature in

the trench is slightly cooler than the freezing temperature. As they are sediment free, most trenches are V-shaped with steep sides. Epicentre of the great earthquakes are all found in the trenches.

F. Oceanic Ridge: Oceanic ridge is a continuous submarine mountain chain. They are made of young basaltic rock formed when two tectonic plates moves apart. The mid-ocean ridge is probably the most extensive single feature of the earth's topography. Two of the most well known mid- ocean ridges are the Mid-Atlantic Ridge and the East Pacific Ridge. The Mid-Atlantic Ridge is the largest unbroken oceanic ridge.

Ocean Temperature and Salinity

- Like land masses, ocean waters also vary in temperature from place to place, both at the surface and at its depths. As the warming and cooling of water is slower than the land, the annual range of temperature in any part of the ocean is very much lower. The mean annual temperature of the ocean water in equatorial regions is about 21^{o} C and almost drops down to freezing point at the polar region.

- The degree of concentration of salts in the sea water is called salinity. It is usually expressed in terms of parts per thousand (ppt or ‰). Salinity varies both horizontally and vertically. The influence of temperature on ocean salinity depends upon the heating up of the surface water, which varies from tropics to polar regions. When the sun heats up the surface layer of water in the tropics, the salt content is left out in the oceans after evaporation. Thus salinity is maximum at the tropics and lower at the equator and the poles.

Movement of the Ocean Water

- The ocean water is dynamic. Temperature, salinity, density, external forces of the sun, moon and the winds keep the ocean waters in movement, both horizontally and vertically. Waves and currents are in horizontal motion while tides have vertical motion.

Waves:

- Of all the movements of the oceans, sea waves are considered to be the strongest. Sea waves are ripples on water caused when winds blow over the sea. The height of these waves depends on the speed of wind, its duration and the direction from which they blow. Sometimes waves are also caused by tremors felt on the ocean floor. Such waves are quite destructive and called Tsunami.

Tides

- ✓ The periodic rise and fall of sea water due to the gravitational pull of the sun and moon on earth are called tides. They are classified broadly into Spring tides and Neap tides.
- ✓ When the Sun, Moon and Earth are aligned in the same line, the collective gravitation pull of the sun and moon on earth's water strengthens to form a high tide known as spring tide. Such tides always occur on full moon and new moon days.
- ✓ When the sun and the moon are at right angles, their gravitational forces work against each other, causing a low tide called neap tide. A neap tide occurs between two spring tides i.e., twice a month, when the first and last quarter moon appears.

Oceans Currents

- The movement of oceanic water on the surface and at the depths in a definite direction is called ocean current. Ocean currents are in clockwise motion in the northern hemisphere and in the anti-clockwise motion in the southern hemisphere. The factors that generate ocean currents are: 1. Earth's rotation, 2. Prevailing winds and, 3. Differences in temperature and salinity of ocean water. On the basis of temperature, ocean currents are classified as warm currents and cold currents. The movement of ocean currents from the low latitudes (tropical zones) towards high latitudes (temperate and polar zones) is called warm current. Eg. Gulf Stream in Atlantic Ocean, North Equatorial Current in Pacific Ocean.

CASE STUDY Tides and Border Security Force(BSF).

The strategic role played by the Border Security Force (BSF) to guard the creek of Rann of Kutch is an enormous one. Firstly, most of the creek area gets submerged due to high tide and at times of low tide, the creek emerges out along with poisonous creatures like snakes, scorpions, etc. Even the landscape view differs in the morning and in the evening due to tidal effects twice a day. Secondly, the turbulence here in the creek area is more violent than the open sea. Thirdly, the salt marshy terrain and the humid weather conditions affect the health of the soldiers. Strong winds, scorching heat waves, high salinity of the coastal waters and mirages also affect the eyes of the soldiers. Natural factors like currents, tides, shifting sand bars and lack of permanent landmarks on the boundary, lead to great difficulty in safeguarding this sensitive area under military domain.

Distribution of Major Ocean Currents and Effects

Ocean	Name of the Current	Effects
		Leads to foggy conditions along the coast of

South Atlantic Ocean	Benguela Current (Cold)	Namibia. Helped in the development of Namibian & Kalahari deserts
North Atlantic Ocean	Canaries (Cold)	Influences the extension of Sahara Desert
	Gulf Stream (Warm)	Its confluence with the Labrador current produces heavy fog along the coast of Newfoundland, obstacles the navigation. Hence, Newfoundland is one of the major fishing grounds of the world.
	North Atlantic Drift (warm)	It keeps the ports at higher latitudes ice-free throughout the year. Eg. Port of Rorvik (Norway), Murmansk and Severodvinsk (Russia)
	Labrador (Cold)	Its confluence with Gulf Stream creates fog and hinders navigation.
South Pacific Ocean	Peruvian / Humboldt Current (Cold)	Helped in the desertification of the Atacama desert. EL-Nino effects the weather in western & S. America. It also affects timely arrival of Indian monsoon
North Pacific Ocean	Kuroshio Current (Warm)	It plays a vital role in carrying large amount of heat to the adjacent land areas and forms cloud cover that a use rainfall.
	Oyashio /Kurile Current (Cold)	Its confluence with the Kuroshio current produces heavy fogs around Hokkaido, which become potential hazards for navigation. Hence, Hokkaido acts as the major fishing ground of the world.
	Alaska Current (Warm)	Keeps the seaports of Alaska open throughout the year.
	California Current (Cold)	Leads to foggy Conditions along the coast of California. It helped in the development of Arizona & Sonata deserts.
India Ocean	West Australian Current (Cold)	Leads to foggy conditions along the western coast of Australia. It helped in the genesis of west Australian desert.

Marine Resources

- The biotic and abiotic resources found in the oceanic water and at the bottoms are called marine resources. The ocean's resources play a vital role in sustaining the needs of society. A diverse array of marine organisms is used for food, medicine, cosmetics, and a wealth of industrial applications. The world's demand for energy, minerals and water have become increasingly dependent on non-living marine resources.

Marine	Biological Resources: Eg. Fishes, Plankton, sea

	grass, Coral etc.
	Mineral Resources: Petroleum, Natural gas, Metallic minerals, Sand, Gravel etc.
	Energy resources: Eg. Energy fuels, Tidal energy, wave Energy etc.

Conservation of Marine Resources

- Oceans are the life blood of planet earth and mankind. The humankind depends on the marine resources for its survival. They are also essential for the economic prosperity, social well-being and quality of life. Oceans have extensive deposits of oil reserves. Besides a major fishing ground, it helps in generating non-conventional energy, development of many ports and harbours for trade activities. Coastal tourism also attracts people around the world, thereby contributing to the economy of many countries.

- The marine environment is faced with a number of increasingly severe threats. These include loss of biodiversity, loss of habitats, contamination through dangerous substances, and the impacts of climate change. Yet the marine resources are not deteriorating, it is necessary to find better ways of managing it.

NOTE

- Finland is known as the land of thousand lakes. There are 1,87,888 lakes in Finland.
- Water table is a level below the ground, where water is found collected beneath the Earth's surface. Aquifers are porous rock strata filled with water, found below the earth's surface.
- Sylvia Earle is a famous American oceanographer . She was named as the first, 'Hero for the Planet' by Time magazine for her efforts towards marine life protections.
- Jacques-Yves Cousteau (1910-1997) was a famous French Ocean explorer, who conducted extensive under-sea investigations.
- He belonged to the information service of the French Navy, and was sent on missions to Shanghai and Japan (1935– 1938) and in the USSR (1939).
- Honours: Cross of War 1939–1945 (1945), U.S. Presidential Medal of Freedom (1985)
- A Hypsometric Curve is a graphic representation which shows the height of a certain place found on land and the height of ocean features at sea. 'Hypso' means height in Greek.
- ONGC: Oil and Natural Gas Corporation is India's largest oil and gas exploration and production company. Its latest estimate is that about 20 million tons of oil reserves are found west of Mumbai High off shore.
- Abyssal plains in the Atlantic and Indian Oceans tend to be extensive than the Pacific Ocean because, majority of the world's largest rivers empty their sediments

into either Atlantic or Indian Ocean. E.g. Amazon, Ganga and Brahmaputra rivers.

- Dragon Hole is the deepest known underwater sink hole in the world. The local fishermen call it the 'eye' of the South China Sea.
- **Fathoms:** A nautical measurement of the depth of water in the ocean.
- **Isobath:** An imaginary line on a map joining the points of equal depths.
- **Isohaline:** An imaginary line on a map joining the points of equal salinity in oceans.
- The Bermuda Triangle, also called the Devil's Triangle, is a loosely defined region in the Western part of the North Atlantic Ocean, where a number of aircraft and ships are said to have disappeared. Collect recent news about this triangle and have a discussion about the same in your class room.
- The sea / ocean water does not contain calcium in great quantities. Many of the aquatic animals with shells use the dissolved calcium in the sea water to build their protective shells.
- The energy of the falling wave water is used to turn hydro turbines to generate power. Wave energy power plants have been installed at Vizhinjam in Kerala coast and Andaman and Nicobar islands of India.
- Potential tidal energy zones of India are the Gulf of Khambhat, Gulf of Kutch and Sundarbans.
- Maritime boundary of most the Countries is fixed to be 12 nautical miles from the baseline. This was fixed by the U.N. Convention on the Law of the sea 2013 where - as Jordan and Palau have 3 nautical miles as their maritime boundary and Benin, Republic of Congo, EI Salvador, Peru and Somalia have 200 nautical miles.
- NIO(National Institute of Oceanography) was established in 1st January 1966. The headquarters of NIO is located at Dona Paula, Goa. It Conducts research and observations to understand oceanic features, Ocean engineering, marine Archaeology etc.
- The Gangetic Dolphin was declared the National Aquatic Animal in 2010. This has become an endangered species. Are the Dolphins really at risk? If so, list out the reasons.
- **The Great Barrier Reef**: The Great Barrier reef is the world's largest coral reef system composed of 2,900 individual reefs and 900 islands stretching for about 2,000 kilometres. It covers an area of about 3,50,000 km. The reef is located in the Coral sea, off the coast of Queensland,Australia. The Great Barrier Reef can be seen from the outer space. This sprawling coral reef system is one of the most biologically diverse places on the planet.Coral reefs are built by billions of tiny organisms, known as Coral polyps. CNN labelled it as one of the seven natural wonders of the world.

Unit – 5
BIOSPHERE

- Biosphere, the fourth sphere of the Earth, is a life supporting layer that exists on the earth's surface. This layer on earth encompasses the Lithosphere, Hydrosphere and Atmosphere. It includes flora and fauna that thrive on or near the earth's surface. The vertical range of the biosphere is approximately 20 km, which is measured from the ocean floor to the troposphere. However, most plants and animals live in a very narrow section for about 1 km above and below the Mean Sea Level (MSL). Biosphere is made up of different ecosystems and biomes. All living things, large or small, are grouped Into Species.The area in which an animal, plant or micro organism lives is called its habitat. A wide variety of plants and animals live in a particular habitat known as *biodiversity.*

Ecosystem

- An ecosystem is a community, where all living organisms live and interact with one another and also with their non-living environment such as land, soil, air, water etc. Ecosystems range in size from the smallest units (Eg: bark of a tree) that can sustain life to the global ecosystem or ecosphere. (Eg: Cropland, Pond ecosystem, Forest ecosystem, Desert ecosystem etc.). Biosphere harbours all ecosystems on the earth and sustains life forms including mankind.

Components of ecosystem

- An ecosystem consists of three basic components, namely
- Abiotic components
- Biotic components and
- Energy component

a. **Abiotic Components:** Abiotic components include the non-living, inorganic, physical and chemical factors in the environment. Eg. Land, Air ,Water, Calcium, Iron etc.

b. **Biotic Components:** Biotic components include plants, animals and micro-organisms. Biotic components can be classified into three categories:

- **Producers**are self-nourishing components of the ecosystem. Hence they are calledAutotrophs. They are found both on land and water. Eg. Plants, Algae, Bacteria etc.

- **Consumers**are those that depend on producers, directly or indirectly. Hence they are called Heterotrophs. The common category of consumers are:
  - ✓ **Primary consumers**depend on producers for their food. They are exclusively herbivores. Eg. zebra, goat etc.
  - ✓ **Secondary consumers**are small carnivores i.e., they consume herbivores. Eg. lion, snake etc.
  - ✓ **Tertiary consumers**are top carnivores that prey on both herbivores and carnivores. Eg. owl, crocodile etc.
- **Decomposers**are some organisms that are incapable of preparing its own food. They live on dead and decaying plants and animals. Hence they are called Saprotrophs. Eg. fungus, mushrooms etc.

c. Energy Components: All organisms in the biosphere use energy to work and convert one form of energy into another. The Sun is the ultimate source of energy for the biosphere as a whole. The solar energy gets transformed into other forms of energy through the various components in the ecosystem. The producers, consumers and the decomposers contribute a lot to the energy flow in an ecosystem.

Functions of an ecosystem

- The living organisms form an interacting set of flora and fauna which are organized into trophic levels, food chains and food webs. The functioning of an ecosystem depends on the pattern of the energy flow, as it helps in the distribution and circulation of the organic and inorganic matter within an ecosystem. Energy flow generally takes place in a hierarchical order in an ecosystem through various levels. These levels are called trophic levels. The chain of transformation of energy from one group of organisms to another, through various trophic levels is called a food chain. A system of interlocking and interdependent food chains is called a food web.

Biodiversity

- Biodiversity or biological diversity refers to a wide variety of living organisms (plants, animals and other micro-organisms) which live in a habitat. It is highly influenced by topography, climate as well as human activities. It represents the strength of the biological resources of a place on earth. In biodiversity, each species, no matter how big or small, has an important role to play in the ecosystem. It maintains the ecological balance and facilitates social benefits such as tourism, education, research etc. over an area.

Loss of biodiversity

- The extinction of species (flora and fauna) due to human and natural influences is called loss of biodiversity. The biodiversity loss has a great impact on

mankind and also affects land, water, air etc. Habitat destruction due to deforestation, population explosion, pollution and global warming are the major cause for loss of biodiversity. Sometimes, habitat loss is so severe or happens so quickly that it results in a species being eliminated from the planet. Scientists are still trying to decide what caused the mass extinction of dinosaurs. A healthy eco system provides clean water, pure water, enriched soil, food, raw materials, medicines etc. Hence stable biosphere has to be conserved.

Biomes

- A biome is a geographically extensive ecosystem where all flora and fauna are found collectively. It is the total assemblage of plant and animal life interacting within the biosphere. Biomes are defined by abiotic factors like, relief, climate, soils and vegetation. They are classified into two broad categories, terrestrial biomes and aquatic biomes.

Terrestrial Biomes

- Terrestrial biomes is a group of living organisms that live andinteract with one another on land. They are mainly determined by temperature and rainfall. Some of the major terrestrial biomes of the world are A. Tropical Forest Biomes, B. Tropical Savanna Biomes, C. Desert Biomes, D. Temperate Grassland Biomes, E. Tundra Biomes

A. Tropical Forest Biomes

- The tropical forest biome is comprised of several sub-biomes, including evergreen rainforest, seasonal deciduous forest etc. This biome extends between 10° N and 10° S of the Equator. Central and South America possess half of the world's tropical forests. The climate in these biomes shows little seasonal variation with high annual rainfall and relatively constant, high temperature. This unique weather condition favours thick vegetative cover. Tropical forests have the highest biodiversity and primary productivity of any of the terrestrial biomes.

- The Amazon basin, Congo basin and Indonesian islands are the major regions of this biome. These regions have very dense forests and so have great economic importance. Human settlements are found scattered here. They sustain their livelihood through food gathering, fishing, lumbering and shifting cultivation. Due to the humid nature of this biome, the people get afflicted to tropical diseases like malaria, yellow fever etc. The chief trees found here are rubber, bamboo, ebony, etc. Bats, pheasants, jaguars, elephants, monkeys etc. are the important birds and animals found here.

B. Tropical Savanna (Grasslands) Biomes

- Tropical grasslands are generally found between tropical forests and deserts. Tropical Savanna biomes are found between 10o to 20o N and S latitudes. These grasslands are generally flat and are found in the Sahel, south of Sahara in East Africa and in Australia. This biome is generally hot and dry and experiences moderate to low rainfall. So, the grass which grow here are tall and sharp. Hence the chief occupation of the people found here is herding. The primitive people living here are nomadic. The common animals found here are the lion, leopard, tiger, deer, zebra, giraffe etc. Flora such as Rhodes grass, red oats grass, lemon grass etc. are found in this biome.

C. Desert Biomes

- Deserts are usually found on the western margins of the continents between 20° and 30° N and S latitudes. The annual rainfall is less than 25 cm in these regions. Due to the lack of rainfall and arid conditions, these regions do not possess any vegetation but have special vegetation type called Xerophytes. As the soil is sandy and saline, deserts remainagriculturally unproductive. Drought resistant thorny scrubs and bushes, palms are found here.

- Tribal people who live here practice food gathering and hunting. They move their temporary settlements frequently in search of pastures. Transportation becomes very difficult here and is carried on by camels. Reptiles like snakes, lizards, scorpions etc., are most commonly found here.

D. Temperate Grassland Biomes

- Temperate Grasslands are usually found in the interior of the continents and are characterized by large seasonal temperature variations, with warm summer and cold winter. The type of grassland in these regions strongly depends upon precipitation. Higher precipitation leads to tall and soft grass and lower precipitation leads to short and soft grass. These regions favour wheat cultivation. Extensive mechanised agriculture is practised due to lack of farm labour. Pastoral industry becomes the main occupation, thereby facilitating slaughtering of animals, packing of raw and processed meat, dairy products etc. The common birds and animals are grass hopper, wolf, bison, prairie dog etc.

E. Tundra Biomes

- These vast lowlands are found where the ground remains frozen. Greenland, Arctic and Antarctic regions and Northern parts of Asia, Canada and Europe fall in this biome. These regions are also called Barren lands. This biome experiences long severe winter and short cool summer. Due to the prevailing of low temperature and short growing seasons, the net primary productivity is very low in tundra.

People are nomadic. Hunting and fishing are their major occupations. The population here is extremely sparse and the harsh environment makes them change their settlement frequently.They live in igloos in winter and in tents during summer. Arctic moss, Arctic willow, lichens etc. grow here. Fauna like the polar bear, wolverine, reindeer, snowy owl are found here.

Aquatic Biomes

- Aquatic biome is a group of living organisms that live and interact with one another and its aquatic environment for nutrients and shelter. Like terrestrial biomes, aquatic biomes are influenced by a series of abiotic factors.It is broadly classified as fresh water biomes and marine biomes.

A. Fresh water Biomes: It comprises lakes, ponds, rivers, streams, wetlands etc. It is influenced by various abiotic components such as the volume of water, water flow, composition of oxygen, temperature, etc. Humans rely on freshwater biomes for drinking water, crop irrigation, sanitation and industry. Water lily, lotus, duck weeds etc. are the common plants found here. Trout, salmon, turtles, crocodiles etc. are the animals found here.

B. Marine Biomes: They are the largest aquatic biomes on earth. They are continuous bodies of salt water and provide a wide range of habitats for marine plants and animals. Coral reefs are a second kind of marine biomes within the ocean. Estuaries, coastal areas where salt water and fresh water mix, form a third unique marine biome. As water provides maximum mobility to marine organisms, nutrients are circulated more quickly and efficiently here than the terrestrial biomes.

- Apart from animals, plants such as kelp, algae, phytoplankton etc. also grow in water. Aquatic biomes are not only important for plants and animals, but also for humans. Humans use aquatic biomes for water, food and leisure activities. Some of the threats and issues to aquatic biomes are overfishing, pollution and rise in sea level.

Difference between Aquatic and Terrestrial ecosystem

Aquatic Ecosystem	Terrestrial Ecosystem
Aquatic ecosystem exists on water covering 71% of the earth surface.	Terrestrial ecosystem exists on land covering 29% of the earth surface.
Aquatic animals use 20% of energy to obtain oxygen.	Terrestrial animals use only 1-2% of energy to obtain oxygen.
In this ecosystem there is abundant of water with limited oxygen supply.	In this ecosystem there is less availability of water, greater availability of gases and temperature fluctuation.
The small drifting photo synthetic organisms of the ocean called photo phytoplankton are	The primary producer is the plants that produce food through photosynthetic process.

regarded as the major primary producer.	
Aquatic environment is more stable with smaller fluctuation in temperature and other variable.	Terrestrial environment is quite unstable as the land surface is affected by great risks from external impacts.

Case Study-Biosphere II

Scientists have created an artificial Biosphere called Biosphere-2, to understand the Earth which is refered as Biosphere-1.

Facts and Numbers

- ✓ Biosphere-2 covers 3.15 acres and is located in Arizona, America.
- ✓ It is 91 feet at its highest point.
- ✓ It is sealed off from earth below by 500 ton welded stainless steel liner.
- ✓ A host of instruments constantly monitors the air, soil and water.
- ✓ The 25 foot ocean contains a million gallons of salt water.
- ✓ Biosphere-2 contains five biomes - a rain forest, desert, savanna, marsh and ocean.
- ✓ It has more than three thousand species of living organisms.
- ✓ The habitat is opened for public tours. (To visit biosphere-2 log on to www.biosphere2.org)

Gulf of Mannar – Marine Treasure

- ✓ **Location:** Lies between the southeastern tip of India and the west coast of Sri Lanka, in the Coromandel Coast region.
- ✓ **Marine National Park**: The gulf of Mannar Marine National Park is a protected area consisting of 21 Small Island and adjacent coral reefs in the Gulf of Mannar in the Indian Ocean.
- ✓ **History:** Gulf of Manner was declared as National park in 1986. Later deckared as a biosphere reserve in 1989.
- ✓ **Flora**: They consist of species belonging to the mangrove, Rhizophora, Avicennia, Bruguiera, Ceriops and Lumnitzera genus.
- ✓ **Fauna:** Indo – Pacific bottlenose dolphin, Common dolphin, Melon-headed whale, and critically endangered whale species.

Conservation

- The biosphere extends from the deep ocean trenches to lush rain forests. People play an important role in maintaining the flow of energy in the biosphere. At the same time, the primary cause of today's loss of biodiversity is habitat.

alteration caused by human activities. The ever increasing population results in over exploitation of biological resources. This has an adverse impact on flora and fauna on earth. There are places on earth that are both biologically rich and deeply threatened. Hence it is man's duty to conserve and care for the earth and make it a better place to live in.

10th std
Unit -1
India – Location, Relief and Drainage

Introduction

- India is the seventh largest country in theworld and second largest country in Asia. Itforms a part of south Asia and is separated bythe Himalayas from the rest of the continent.India accounts for about 2.4 % of the total areaof the world with an area of 32,87,263 sq.km.many of the India states are larger than severalcountries of the world.

India's Land and Water Frontiers

- India shares its 15,200 km long landfrontier with Pakistan in the west, Afghanistanin the north-west, China, Nepal and Bhutan inthe north and Bangladesh and Myanmar in theeast. India's longest border is with Bangladesh(4156 km)while the shortest border is with Afghanistan. (106 km) About 6,100 km long coastline of India is washed on three sides of the country by the Indian Ocean and its two arms namely the Arabian sea in the west and the Bay of Bengal in the east. The total length of the coast line of India including the islands is 7,516.6 km. India and Sri Lanka are separated by a narrow and shallow sea called Palk Strait.

India and the World

- The Indian land mass has a central location between, the East and the West Asia. India and the southward extension of the Asian continent. The trans Indian ocean routes which connect the countries of Europe in the west and the countries of East Asia provide a strategic central location to India. Thus it helping India to establish close contact with West Asia, Africa and Europe from the western coast and with South East, east Asia from the eastern coast. India: A SubcontinentIndia along with the countries of Myanmar, Bangladesh, Pakistan, Nepal, Bhutan and Sri Lanka is called a subcontinent. This region is separated from the rest of Asia by a chain of mountains in the northwest, north and northeast and by seas in the south. This region also possesses a distinct continental characteristicsin physiography, climate, natural vegetation, minerals, human resources etc. Hence India is known as 'subcontinent'.

Location and Extent

- India extends from 8°4 'N to 37°6 'N latitudes and 68°7 'E to 97°25 'E longitudes.Hence India is located of the north EasternhemisphereThe southernmost point of the countryis Pygmalion Point or Indira Point (6°45'Nlatitude) located in the Andaman and NicobarIslands. The southernmost

point of main landof India is Cape Comorin (Kanyakumari).The north-south extent of India is 3,214 kmand it extends from Indira Col in Jammu andKashmir in the north to Kanyakumari in thesouth. The east-west extension is 2933 km andit stretches from Rann of Kutch (Gujarat) inthe west to Arunachal Pradesh in the east. TheTropic of Cancer (23°30' N) passes through themiddle of the country dividing it into two halvesas northern temperate and southern tropicallands. India has been politically divided into 29states and 7 union territories for administrativeconvenience.

Indian Standard Time (IST)

- The longitudinal difference between Gujarat in the west and Arunachal Pradesh in the east is about 30°. The Earth rotates through its axis around 360° in 24 hours. Thus, a difference of 1° longitude will make a difference of 4 minutes in time. The difference in longitude between Gujarat (68°7 'E) and Arunachal Pradesh (97°25 ' E) is 29°18'. Hence the difference in local time between these two places is 29°18' X 4' (minutes) = 1 hour 57 minutes 12 seconds (approximately 2 hours). Since Arunachal Pradesh is towards east, it will have sunrise about two hours earlier than the sunrise at Gujarat which is in the west. In order to avoid these differences, Indian standard time is calculated. The local time of the central meridian of India is the standard time of India. India's central meridianis 82°30' E longitude. It passes through Mirzapur and roughly bisects the country in terms of longitude. The IST is 5.30 hrs ahead of Greenwich Mean Time (GMT).

Major Physiographic Divisions of India

- The majestic Himalayan peaks in the north, the beautiful beaches in the south, the great Indian desert in the west and the breathtaking natural heritage in the east make India a geographically vibrant, colourful and truly incredible country. There is a varied nature of physiographic divisions in India. Though the country has many landforms based on the major differences, it is divided into the following five physiographic divisions:

1. The Himalayan Mountains
2. The Great Northern Plains
3. The Peninsular plateau
4. The Indian Desert
5. The Coastal Plains
6. The Islands

Himalayan Mountains

- The Himalayan Mountains (Northern Mountains) consist of the youngest and the loftiest mountain chains in the world because they have been formed only few millions years ago and also they were formed because of the folding of the earth crust due to tectonic activity.

- It stretches for a distance of 2,500 km from the Indus gorge in the west to Brahmaputra gorge in the east. The width of the Northern Mountains varies from 500 km in Kashmir to 200 km in Arunachal Pradesh. The Pamir Knot, popularly known as the "Roof of the World"is the connecting link between the Himalayas and the high ranges of Central Asia. From the Pamir, Himalayas extend eastward in the form of an arc shape. The term "Himalaya" is derived from Sanskrit. It means "The Abode ofSnow". The Northern Mountains that function as a great wall is grouped into three divisions. 1) The Trans-Himalayas, 2) Himalayas,3) Eastern or Purvanchal hills.

1. The Trans-Himalayas

- It is also known as western Himalaya's. It lies to the north of the great Himalayanrange. It lies in Jammu and Kashmir and Tibetian plateau. As its areal extent is more in Tibet, it is also known as Tibetean Himalayas. The Trans-Himalayas are about 40 km wide in its eastern and western extremities and about 225 km wide in its central part. They contain the Tethys sediments. The rocks of this regioncontain fossils bearing marine sediments which are underlain by 'Tertiary granite'. It has partly metamorphosed sediments and constitutes the core of the Himalayan axis. The prominent ranges of Trans Himalayas are Zaskar, Ladakh, Kailash, and Karakoram.

2. The Himalayas

Peak	Country	Height in Metres
Mt. Everest	Nepal	8848
Mt. K2 or Godwin Austen	India	8611
Kanchenjunga	India	8598
Makalu	Nepal	8481
Dhaulagiri	Nepal	8172
Nanga Parbat	India	8126
Annapurna	Nepal	8078
Nanda Devi	India	7817
Kamet	India	7756
Namcha Barwa	India	7756
Gurla Mandhata	Nepal	7728

- It constitutes the core part of northern mountains. It isan young fold mountain. It was formed by the movement of Angara land mass in the north and Gondwana land mass in the south. The Tethys sea found between these two land masseswas uplifted by the compression and the resultant landform was the Himalayas. It consists of many ranges. The main divisions of the Himalayas are the (i) Greater Himalayas,(ii) the Lesser Himalayas and (iii)the Siwaliks

The Greater Himalayas or the Himadri

- The Greater Himalayas rise abruptly like a wall north of the Lesser Himalayas. The Greater Himalayas are about 25 km wide. Its average height is about 6,000 m. The Greater Himalayas receive lesser rainfall as compared to the Lesser Himalayas and the Siwaliks. Physical weathering is less effective over the Greater Himalayas as compared to the other ranges. Almost all the lofty peaks of Himalayas are located in this range. The notable ones are Mt. Everest (8,848 m) and Kanchenjunga (8,586 m). Mt. Everest is located in Nepal and Kanchenjunga is located between Nepal and Sikkim. This range is the most continuous of all ranges. It is region of permanent snow cover. So, it has many glaciers. Gangothri, Yamunothri and Siachen are some of them.

The Lesser Himalayas or the Himachal

- It is the middle range of Himalayas. Height of this range varies from 3, 700 to 4,500 m. Its width varies upto 80 km. The major rocks of this range are slate, limestone and quartzite. This region is subjected to extensive erosion due to heavy rainfall, deforestation and urbanization. Pir Panjal, Dhauladhar and Mahabharat are the mountain ranges found in this part. Major hill stations of the Himalayas are located in this range. Shimla, Mussourie, Nainital, Almora,Ranikhet and Darjeeling are the familiar ones.

The Siwaliks or OuterHimalayas

- The Siwaliks extend from Jammu andKashmir to Assam. It is partly made by the debris brought by the Himalayan rivers. The altitude varying between 900-1100 metres elevation of this range is 1300 m. The width of Siwaliks varyfrom 10 km in the east to 50 km in the west. It is the most discontinuous range. The longitudinal valleys found between the Siwaliks and the Lesser Himalayas are calledDuns in the west and Duars in the east. Theseare the ideal sites for the development of settlements in this region.

Purvanchal Hills

- These are the eastern off-shoot of Himalayas. It extended in the north-eastern states of India. Most of these hills are located along the border of India and Myanmar while others are inside India. Dafla Hills, Abor Hills, Mishmi Hills, Patkai Bum Hills, Naga Hills, Manipur Hills, Mizo Hills, Tripura Hills, Mikir Hills, Garo Hills, Khasi Hills and Jaintia Hills are the hills which are collectively known as purvanchal Hills.

Importance of Himalayas

- ✓ Himalayas blocks southwest monsoon winds and causes heavy rainfall to north
- ✓ India.

- ✓ It forms a natural barrier to the subcontinent.
- ✓ It is the source for many perennial rivers like Indus, Ganges, Brahmaputra etc.
- ✓ The Northern Mountains are described as the paradise of tourists due to its natural beauty.
- ✓ Many hill stations and pilgrim centres like Amarnath, Kedarnath, Badrinath and
- ✓ Vaishnavidevi temples are situated here.
- ✓ It provides raw material for many forest based industries.
- ✓ It prevents the cold winds blowing from the central Asia and protects India from severe cold.
- ✓ Himalayas are renowned for the rich biodiversity.

Longitudinal Divisions of Himalayas

1. The Kashmir Punjab Himachal Himalayas- Located between the rivers of Indus and Sutlej.
2. The Kumaun Himalayas- Located between the rivers of Sutlej and Kali.
3. The Central-Nepal Himalayas- Located between the rivers of Kali and Tista.
4. The Assam Eastern Himalayas- Located between rivers of Tista and Dihang.

The Great Northern Plains

- The fertile land extending across seven north Indian states forms the Great Northern Plains. This extensive plain lies to the south of the northern mountains. This plain is one of the most extensive stretches of the alluvium in the world and is deposited by the rivers Indus, Ganga, Brahmaputra and their tributaries. The length of the plain is about 2,400 km and the width varies from 240 to 320 km. Its width increases from east to west. It covers an area of over 7 lakh sq.km. The Great Plains of India is remarkably a homogeneous surface with an imperceptible slope. They are formed mostly by the depositional process of the Himalayan and Vindhyan rivers. These rivers deposit enormous quantity of sediments deposited along the foothills and flood plains. The important characteristics featuress of sediment deposition in the plains areas as follows.

The Bhabar Plain

- This plain is made up of gravels and unassorted sediments deposited by the Himalayan rivers. The porosity of this plain is so high that most of the small streams flow over this region disappear. It lies to the south of the Siwalik from west to east (Jammu Division to Assam). Its width varies from 8 to 15 km. It is wider in the western plains (Jammu Division) than in the east (Assam). This plain is not suitable for cultivation, only big trees with large roots thrive in this region.

The Tarai Tract

- It is a zone of excessive dampness, thick forests and rich wild life. This tract lies to the south of Bhabar plains. The width of this belt is 15-30 km. The Tarai is wider in the eastern parts of the Great Plains, especially in Brahmaputra Valley due to heavy rainfall. In many states, the Tarai forests have been cleared for cultivation.

The Bhangar Plains

- The Bhangar represent the upland alluvial tracts of the Great Plains of India, formed by the older alluviums. The Bhangar land lies above the flood limits of the rivers. This soil is dark in colour, rich in humus content, well drained and useful for agriculture.

On the basis of deposition of sediments by various rivers and topographical characteristics, the Northern Plains of India is divided into the following four major regions:

a. Rajasthan Plains: It is located to the west of Aravalli range. It covers an area of about 1,75,000 sq.km. Rajasthan plain is formed by the deposition of the river Luni and the long vanished river Saraswathi. There are several salt lakes in Rajasthan. The Sambhar salt lake (Pushkar Lake) near Jaipur is the prominent one.

b. Punjab - Haryana Plains: It lies to the north-east of the Great Indian Desert. This plain is found over an area of about 1.75 lakh sq.km. The Punjab - Haryana plains are formed by thedeposition of the rivers Sutlej, Beas and Ravi. This plain acts as water - divide (doab). The twomajor watershed it divides are Yamuna – Sutlej and Ganga – Yamuna.

c. Ganga Plains: It extends from the Yamuna River in the west to Bangladesh in the east. The totalarea covered by this plain is about 3.75 sq.km. River Ganga and its tributaries such as Ghaghra,Gandak, Kosi, Yamuna, Chambal, Betwa etc. constitute this plain by their sediments and makea great plain in India. It is the largest plain of India. The general slope of the entire plain (upper,middle and lower Ganga plains) is towards east and south-east.

d. Brahmaputra Plains: It is located mainly in the state of Assam. It is a low - level plain located in the eastern part of the Great Plains of India and is formed by the deposits of river Brahmaputra. It covers an area of about 56,275 sq.km. These plains create alluvial fans and marshy tracts.

The Khadar Plains

- The new alluvium tracts along the courses of the rivers are known as the 'Khadar' or 'Bet' lands. The Khadar tracts are enriched by fresh deposits of silt every year during rainy seasons. The Khadar land consists of sand, silt, clay and mud. It is highly fertile soil.

Delta Plains

- The deltaic plain is an extension of the Khadar land. It covers about 1.9 lakh sq.km in the lower reaches of the Ganga River. It is an area of deposition as the river flows in this tract sluggishly. The deltaic plain consists mainly of old mud, new mud and marsh. In the delta region, the uplands are called 'Chars' while the marshy areas are called 'Bils'.

The Peninsular Plateaus

- The plateau region lies to the south of the Great Northern Plains. This is the largest physiographic division of our country. It covers an area of about 16 lakh sq.km (about half of the total area of the country). It is an old rocky plateau region. The topography consists of a series of plateaus and hill ranges interspersed with river valleys. Aravalli hills mark the north-western boundary of the plateau region. Its northern and north-eastern boundaries are marked by the Bundelkhand upland, Kaimur and Rajmahal hills.

- The Western Ghats and the Eastern Ghats mark the western and eastern boundaries respectively. The altitude of a large portion of the plateau is more than 600 m from mean sea level. The peak of Anaimudi is the highestpoint in the plateau. Its height is 2,695 m and is located in Anaimalai. The general slope of this plateau is towards east. The Great Plateau is a part of the Gondwana (very ancient one) land mass. Due to the old age, the rivers in this region attained their base level and developed broad and shallow valleys.

- The river Narmada divides the plateau region of India broadly into two parts. Theregion lying to the north of the Narmada is called the Central Highlands and the region lying to the south of Narmada is called the Deccan Plateau. All the major rivers (Mahanadi, Godavari, Krishna, Kaveri etc.) lying to the south of the Vindhyas flow eastwards and fall into the Bay of Bengal. Narmada and Tapti are the two rivers situated to the south of the Vindhyas flow westward. Their movement towards west is due to the presence of a rift valley in the region.

a. Central Highlands

- The Central Highlands extend between the river Narmada and the Northern Great Plains. The Aravallis form the west and north-westernedge of the Central Highlands. These hills extend from Gujarat, through Rajasthan to Delhi in the north-westerly direction for a distance of about 700 km. The height of these hills is about 1,500 m in southwest while near Delhi the height is hardly 400 m. Gurushikhar with 1,722 m is thehighest peak of this range. The Western part of the Central Highland is known as the Malwa Plateau. It lies to thesoutheast of Aravallis and to the north of Vindhyachal Range.

- The rivers Chambal, Betwa and Ken drain the Malwa Plateau before they join the river Yamuna. The part of the Central Highlands which extends to the east of Malwa Plateau is known as Bundelkhand and its further extension is known as Bagelkhand. The eastern part of the Central High lands which lies in the north-eastern part of the Indian Plateau is known as Chhota-Nagpur Plateau. It covers much of Jharkhand, adjacent parts of Odisha, West Bengal, Bihar and Chhattisgarh. This region is very rich in mineral resources particularly iron ore and coal.

b. Deccan Plateau

- This physiographic division is the largest part of the plateau region of India. The shape of this plateau is roughly triangular. One of the sides of this triangle is marked by the line joining Kanyakumari with Rajmahal Hills and this line passes through the Eastern Ghats. The second arm is marked by the Satpura Range, Mahadeo Hills, Maikal Range and the Rajmahal Hills. The third arm is marked by the Western Ghats. The area of this Plateau is about 7 lakh square km and the height ranges from 500 to 1000 m above sea level.

- The Western Ghats forms the westernedge of the Peninsular Plateau. It runs parallel to the Arabian Sea coast. The northern part of this range is called as Sahyadris. The height of the Sahyadris increases from north to south. Anaimudi is a sort of tri-junction of the Anaimalai Range, the Cardamom Hills and the Palani Hills. Kodaikanal is a beautiful hill resort situated on the Palani Hills. Eastern Ghats run from southwest to northeast form the eastern edge of this Plateau. This rangeis also called as Poorvadri. The EasternGhats join the Western Ghats at the Nilgiri hills, bordering Karnataka and Tamil Nadu. The Eastern Ghats are not continuous like the Western Ghats. The rivers of Mahanadi, Godavari, Krishna, Pennar and Kaveri have dissected this range at many places.

The Indian Desert

- The Thar desert, also known as the Great Indian desert is a large arid region in the northwestern part of the Indian subcontinent that covers an area of 2,00,000 km2 and forms a natural boundary between India and Pakistan. It is the world 7th largest desert, and world 9thlargest sub tropical desert located in Western part of the India. The desert lies in the western part of the aravalli range and covers 2/3 of Rajastan state. There are two major divisions in the Thar desert. They are known as the Actual desert region (Marusthali) and the semi desert region (Bhangar). Many different types of sand dunes and salt lakes (Dhands) are seenhere.

The Coastal Plains

- The Peninsula Plateau of India is flanked by narrow coastal plains of varied width fromnorth to south, known as the Western Coastal Plains and the Eastern Coastal Plains. They were formed by the depositional action of the rivers and the

erosional and depositional actions of the sea-waves. The Indian coastal plains are divided into the following two divisions: 1) The Western Coastal Plains and 2) The Eastern Coastal Plains.

1. The Western Coastal Plain

- It lies between the Western Ghats and the Arabian Sea. It extends from Rann of kutchin the north to Kanyakumari in the south and its width varies from 10 to 80 km. It is mainlycharacterised by sandy beaches, coastal sand dunes, mud flats, lagoons, estuary, laterite platforms and residual hills. The northern part of the West Coastal Plain is known as Konkan Plain. The middle part of this plain is known as Kanara. The southern part of the plain is known as Malabar coast which is about 550 km long and 20-100 km wide. This part of the coast is characterized by sand dunes. Along the coast, there are numerous shallow lagoons and backwaters called Kayals and Teris. Vembanad is a famous back water lake foundin this region.

2. The Eastern Coastal Plain

- It lies between the Eastern Ghats and the Bay of Bengal and, stretches along the states of West Bengal, Odisha, Andhra Pradesh and Tamil Nadu. These plains are formed by the alluvial fillings of the littoral zone by the east flowing rivers of India. The coastal plainconsists mainly of the recent alluvial deposits.This coastal plain has a regular shoreline with well-defined beaches. The coastal plain between Mahanadi and Krishna river is known as the Northern Circars and the southern part lies between Krishna and Kaveri rivers is called Coromandal coast. The Marina beach on this coast in Chennai and it is the second longest beach in the world. Among the back water lakes of this coast, lake Chilka (Odisha) is the largest lake in India located to the southwest of the Mahanadi delta, the Kolleru Lake which lies between the deltas of Godavari and Krishna and the Pulicat Lake lies in the border of Andhra Pradesh and Tamil Nadu are the well known lakes in the east coastal plain.

The Islands

- India has two major island groups namely Andaman and Nicobar and Lakshadweep. The former group consists of 572 islands and are located in Bay of Bengal, and the later one has 27 islands and are located in Arabian Sea. The islands of Andaman and Nicobar are largely tectonic and volcanic origin. India's only active volcano is found on Barren Island in Andaman and Nicobar group of Islands, while the islands of the Arabian Sea are mainly coral origin.

a) Andaman and Nicobar Islands

- These islands are located in an elevated portion of the submarine mountains. Since these islands lie close to the equator, the climate remains hot and wet

throughout the year and has dense forests. The area of the island group is about 8,249 sq.km. The entire group of islands is divided into two. They are Andaman in the north and the Nicobar in the south. These island groups are of great strategic importance for the country. Port Blair is the administrative capital of the Andaman and Nicobar islands. The Ten Degree Channel separates Andaman from Nicobar group. The southernmost tip, the Indira Point is a part of Nicobar Island.

b) Lakshadweep Islands

- This is a small group of coral islands located off the west coast of India. It covers an area of 32 sq. km. Kavaratti is its administrative capital. Lakshadweep islands are separated from the Maldive Islands by the Eight Degree Channel. The uninhabited "Pitt Island" of this group has a bird sanctuary. Earlier, it had three divisions namely Laccadive, Minicoy and Amindivi. It was named as Lakshadweep in 1973.

c) OffshoreIslands

- Besides the two group of islands, India has a number of islands along the Western Coast, Eastern Coast, in the delta region of Ganga and in the Gulf of Mannar. Many of these islands are uninhabited and are administered by the adjacent states.

Drainage System of India

- A drainage system is an integrated system of tributaries and a trunk stream which collects and drains surface water into the sea, lake or some other body of water. The total area drained by a river and its tributaries is known as a drainage basin. The drainage pattern of an area is the result of the geological structure of the respective areas. The river system provides irrigation, drinking water, navigation, power as well as grant livelihoods for a large number of population. The drainage system of India is broadly divided into two major groups on the basis of their location. They are Himalayan rivers and the Peninsular rivers.

Himalayan Rivers

- These rivers are found in north India and originate from Himalayas. So, they are also called

River	
Himalayan Rivers	**Peninsular Rivers**
> Indus > Ganga > Brahmaputra	> Mahanadi > Cauvery > Godavari > Narmada > Krishna > Tapti

a. The Indus River System

- The Indus River is one of the largest rivers of the world. It originates from the northern slope of the Kailash range in Tibet near Manasarovar Lake at an elevation of about 5,150 m. Its length is about 2,880 km (Only 709 km is in India). The river has a total drainage area extending 11,65,500 sq km in which 321,289 sq km areas are drained in India. The river flows through the Ladakh and Zaskar ranges and creates deep gorges. The river runs through Jammu and Kashmir, turns south near Chillar and enters Pakistan. Its major tributaries are Jhelum, Chenab (Largest tributary of Indus), Ravi, Beas and Sutlej. It enters into with the Arabian Sea.

b. The Ganga River System

- The Ganga River system is the largest drainage system of India it extend over and area of 8,61,404 sq km in India. The Ganga plain is the most densely populated place in India and many towns are developed on the banks of this river. The river Ganga originates as Bhagirathi from the Gangotri Glacier in Uttar Khasi District of Uttarkhand state, at an elevation of 7,010 m. The length of the river Ganga is about 2,525 km. Its major tributaries from the north are Gomti, Gandak, Kosi and Ghaghra and from south, Yamuna (largest tributary of Ganga), Son, Chambal etc. The river Ganga is known as the River Padma in Bangladesh. The combined river of Ganga and Brahmaputra creates the World's largest delta known as Sundarbans in Bangladesh before joining the Bay of Bengal.

c. The Brahmaputra River System

- The river Brahmaputra originates from the Chemayungdung Glacier of the Kailash range to the east of Lake Manasarovar in Tibet at an elevation of about 5,150 m. The total area is about 5,80,000 sq km but the drainage area lying in India is 1,94,413 sq km This river is known as Tsangpo (Purifier) in Tibet. The length of this river is about 2,900 km (900 km in India). It enters into India through a gorge in Arunachal Pradesh namely Dihang. It has many tributaries. Tista, Manas, Barak, Subansiri are some of them. This river is called as Jamuna in Bangladesh. After it joins with the river Gangain Bangladesh, the river is called as Meghna. Characteristics of Himalayan Rivers

- ✓ **Originate from Himalayas**
- ✓ **Long and wide**
- ✓ **Perennial in nature**
- ✓ **Unsuitable for hydro power generation**
- ✓ **Middle and lower courses are navigable**

Peninsular Rivers

- The rivers in south India are called the Peninsular rivers. Most of these rivers originate from the Western Ghats. These are seasonal rivers (non–perennial). They have a large seasonal fluctuation in volume of water as they are solely fed by rain. These rivers flow in valleys with steep gradients. Based on the direction of flow, the peninsular rivers are divided into the West flowing and East flowing rivers.

East Flowing Rivers
a. Mahanadi

The river Mahanadi originates near Sihawa in Raipur district of Chattisgarh and flows through Odisha. Its length is 851 km. Seonath, Telen, Sandur and Ib are its major tributaries. The main stream of Mahanadi gets divided into several distributaries such as Paika,Birupa, Chitartala, Genguti and Nun. All thesedistributaries form the Delta of Mahanadi which is one of the largest deltas in India. The Mahanadi empties its water in Bay of Bengal.

b. Godavari

- Godavari is the longest river (1,465 km) with an area of 3.13 lakh km2 among thePeninsular rivers. It is also called Vridha Ganga. It originates in Nasik district of Maharashtra, a portion of Western Ghats. It flows through the states of Telangana and Andhra Pradesh before joining Bay of Bengal. Purna, Penganga, Pranitha, Indravati, Tal and Salami are its major tributaries. The river near Rajahmundry gets divided into two Channels called Vasistha and Gautami and forms one of the largest deltas in India. Kolleru, a fresh water lake is located in the deltaic region of the Godavari.

c. Krishna

- The river Krishna originates from a springat a place called Mahabaleshwar in the Western Ghats of Maharashtra. Its length is 1,400 km and an area of 2.58 lakh sq km. It is the second longest Peninsular river Bhima, Peddavagu, Musi, Koyna and Thungabhadra are the major tributaries of this river. It also flows through Andhra Pradesh and joins in Bay of Bengal, at Hamasaladeevi.

d. Kaveri

- The river Kaveri originates at Talakaveri, Kudagu hills of Karnataka. Its length is 800 km. The river kaveri is called Dhakshin Gangaor Ganga of south Harangi, Hemavati, Kabini, Bhavani, Arkavathy, Noyyal, Amaravathi etc are the main tributaries of the river Kaveri. In Karnataka the river bifurcates twice, forming the sacred islands of Srirangapatnam and Sivasamudram. While entering Tamil Nadu, the Kaveri continues through a series of twisted wild gorges until it reaches Hogenakkal Falls and flows through a straight, narrow gorge near Salem.

The Kaveri breaks at Srirangam Island with two channels, river Coleroon and Kaveri. At last, it empties into the Bay of Bengal at Poompuhar.

West Flowing Rivers

a. Narmada: This river rises in Amarkantak Plateau in Madhya Pradesh at an elevation of about 1057 m and flows for a distance of about 1,312 km it covers and area of 98,796 sq km and forms 27 km long estuary before out falling into the Arabian Sea through the Gulf of Cambay. It is the largest among the west flowing rivers of Peninsular India. Its principal tributaries are Burhner, Halon, Heran, Banjar, Dudhi, Shakkar, Tawa, Barna and Kolar.

b. Tapti: The Tapti is one of the major rivers of Peninsular India with the length of about 724 km. It covers an area of 65,145 sq km. Tapti river rises near Multai in the Betul district of Madhya Pradesh at an elevation of about 752 m. It is one of only the three rivers in Peninsular India that run from east to west - the others being the Narmada and the Mahi. The major tributaries are Vaki, Gomai, Arunavati, Aner, Nesu, Buray, Panjhra and Bori. It outfalls into the Arabian Sea through the Gulf of Cambay.

Characteristics of South Indian

Rivers

- Originate from Western Ghats
- Short and narrow
- Non perennial in nature
- Suitable for hydro power generation
- Not useful for navigation

NOTE

- Amaravati is the new capital of Andhra Pradesh But according to Andhra Pradesh
- Reorganization Act, Hyderabad will be the capital for both the states of Andhra Pradesh and Telungana till 2024 (For 10 years from the act passed).
- Aravalli range is the oldest fold mountain range in India.
- The major passes in the Himalayan are Karakoram pass (Jammu and Kashmir), Zojila pass, Shipkila pass (Himachal Pradesh), Bomdila pass (Arunachal Pradesh), Nathala pass (Sikkim) and Jhelepla pass (Sikkim). The Khyber passwhich connects Pakistan and Afanisthan, and Bolan pass in Pakistan are important passes of the Indian subcontinent.
- Himalaya is the home of several high peaks. However, it holds the record of having the maximum number of highest peaks among any mountain range in world. Out of 14 heights peaks in this world, Himalayas holds 9.

Physical Features
Part – II
11th standard

Unit 1. Fundamentals of Geography

Introduction

- "The study of Geography is about more than just memorising places on a map. It is about understanding the complexity of our world, appreciating the diversity of cultures that exists across continents. And in the end it is about using all that knowledge to help bridge divides and bring people together" - Barak Obama, Former President of USA.The subject 'Geography' was considered as 'The Mother of all Sciences' as most streams of sciences took rootfrom geography.

- It is a subject much needed in everyday life .Unfortunately, in the recent past it has been demoted to the back seat in most parts of the world, while certain other sciences hold prominent places in the society. Just as an intellectual understands the value of a library, a financier understands the value of money, a parent understands the value of their child a geographer understands the value of our planet earth and the wealth of resources it offers to us.

- A societythatlacks sufficient geographic knowledge cannot be expected to exhibit its strength of resource potentials and empowerment to make decisions in real-world context.Therefore, the knowledge of geography is very much vital for the care and concern of the earth, growth and development of every country and for minimising the issues related to human activity. In this context, the National Geographic Society, USA defines geographic literacy as being equipped to understand the complexity of the world, how our decisions affect others (and vice versa), and the interconnectedness of this rich, diverse, and not-so-large world.

- This unit introduces the student to the foundations over which the subject had developed in the past, the content it offers now and the changes that it had undergone. It also opens the door to the world of physical geography and the practical skills to be acquired to understand geography which are explained in the units following this.

Defining Geography

- Geography is one of the oldest earth sciences and its roots date back to the works of the early Greek scholars. The term 'Geography' was coined by the Greek scholar Eratosthenes who combined two Greek words 'Geo' (The Earth) and 'Graphing' (to describe). Therefore, in the literary sense, geography is the description of the Earth. Over the ages, geography has become the art and science of studying the physical characteristics of the earth and man's role in adapting to and modifying the environment.

- Geography was born through explorations and discoveries. Earlier, the aim of geography was to discovernew lands, sea routes, prepare maps and describe them. Later, its emphasis had shifted to scientific investigation of earth's landforms, oceans and atmosphere, as well as the interactions with human beings and the environment.

- In essence, geography can be defined as a multifaceted discipline studying intra and inter relationships of various spheres of the earth, collects and analyses relevant data, applies the latest tools and methods to prepare maps and visuals and provides sustainable solutions to human and environmental issues of the earth.

Evolution of Geography

- Geography had evolved over a long period of time. Some of the earliest geographical studies go back about four thousand years ago through explorations. The early explorers travelled and tried to map the new places.The evidences of such explorations come from the archaeological discovery of a Babylonian clay tablet map that dates back to 600 BCE. During this time, Phoenician, Chinese and Egyptian civilisations were in the beginning to explore places outside their homelands. It was the ancient Greek scholars who laid the foundations and gave a solid form to geographic studies and on these foundations, the pillars of modern geography were erected by others in the subsequent ages. The Romans, the Arabs, the Indians, the Chinese, the Germans, the French, the British and the American geographers have contributed to the development and enrichment of the subject.

- The Greek philosophers and scientist focused on the spatial nature of human and physical features of the Earth. The first Greek geographer was Herodotus (484 - 425 BCE) who wrote a numberof volumes on the human and physical geography of the Persian Empire. The other early Greek contributors to geography are, Thales, Aristotle and Eratosthenes (276 - 194 BCE).

- The earlier geographers were descriptive geographers concerned with answering questions like 'what is where' on the earth and the question like 'why it is there' came later. Geographers study the location of the activities, carefully identify patterns using maps and find out the reasons for these patterns. The areas are then described based on the distribution of land forms, population, housing and agriculture. They discover the linkages and movements between places and are able to infer the spatial processes that are working in these areas.

- The development of geography can be summarised in three phases namely (1) The age of discovery (1400-1800), (2) The period between 1800 and 1950 and (3) The period after 1950.

The age of discovery between 1400 - 1800

- The period between 1400 and 1800 was when the subject matter and the methodology of geography were not fully developed. The discipline was in an embryonic stage. Tis period was characterized by exploration, discovery and conquest through the voyages of Vasco da Gama and Christopher Columbus. Numerous journeys of geographical exploration were commissioned by a number of Nations in Europe (Figure. 1.1, 1.2, 1.3 and 1.4). Most of these voyages were financed because of the potential commercial returns from resource exploitation. The voyages also provided an opportunity for scientific investigation anddiscovery. Making of maps (cartography) was important in the discipline of geography due to the emphasis on location of phenomena on the earth surface, e.g. location of trade routes, relief features and settlements.

The period between 1800 -1950

- The period between 1800 and 1950 was characterized by the work of various individual philosophers who helped to expand the scope of geography. The discipline of geography became more distinct as a subject matter. Geographic knowledge saw strong growth in Europe and the United States in the 1800s. Tis period also saw the emergence of a number of societies interested in geographic issues. In Germany, Alexander Von Humboldt, Carl Ritter and Friedrich Ratzel made substantial contributions to human and physical geography. Humboldt's publication 'Kosmos' in 1844, examines the geology and physical geography of the earth. Tis work is still considered by many academics as a milestone contribution to geography.

- There are two schools of thought that emerged during this period as an attempt to explain the relationship between human beings and their environment. These were environmental determinismand possibilism.Proponents of environmental deterministic school of thought such as Mackinder, Ellen Semple and Huntington believed that human actions and activities were moulded by the physical (natural) conditions. In several developing countries, human beings are susceptible to natural disasters such as drought, famine, floods and earthquakes. Human beings under such natural conditions usually surrender to nature. A good example of environmental determinism is the influence of the natural environment on human activities such as nomadic pastoralism. Nomadic pastoralism is so much dependent on the natural environment. Pastoralists do very little to modify their environment.

- The proponents of possibilistic school of thought, such as Vidal de la Blache saw the environment as a limiting factor rather than as a deterministic force. According to the possibilism school of thought, human beings have several alternatives in their environment and their actions are influenced by the decisions they make in the environment. For instance, humans can survive in hot or extremely cold conditions due to their ability to modify the environment to suit them. A good example is that in many arid countries such as Israel, humans have

overcome the constraints set by the natural environment such as low rainfall, high temperatures and poor soils.

The period after 1950

- Until 1950s, geography was more of an art subject where facts were established by casual observation in the field rather than by careful measurement and hypothesis testing. In the 1950s there was a new development in the discipline and several laws were established to explain geographical phenomena. Using the laws, it is possible to predict what willhappen in the future. If we can predict successfully, we can plan and limit the extreme possibilities.

- One of the important developments in this period was the use of quantitative techniques in physical and human geography. These techniques refer to various statistical tools that are used to synthesise the data from maps, field, laboratories and questionnaires. Quantification came about as a result of the expanding scope of the discipline as well the need to understand the processes that were becoming more diversified and complicated.

- This quantitative revolution was referred to as a revolution because it marked a new beginning in the way the subject matter of geography was to be studied. The quantitative revolution involves the use of statistics, mathematical equations and the use of deterministic models. Many geographers believed that numbers are more precise, and therefore perceived as more scientific compared to words. The map, both as graphic language and visual representation, continues to be used as a geographical tool and at present with the valuable assistance of remote sensing and Geographical Information Systems, map making has become digital and easier especially due to advances in computer and software technologies.

Themes of Geography

- In any subject there will be certain themes, around which the scholars work and contribute. In this way, geography subject also has certain traditional themes. Let us look at them carefully. In 1963, William D. Pattison identified the core themes of geographic studies as 'The Four Traditionsof Geography'. These distinct, but related, traditions, of the discipline are: Spatial tradition (areal distributions and spatialpatterns. Examples: Population movement) Area studies tradition, (hierarchy of areas, small to large) Man-land tradition(relationship between man and his physical environment) and Earth science tradition (processes of the earth).

- Like the major traditions identifed in geography, the signifcant themes of the subject are also identifed. Te Association of American Geographers put forward the 'Five themes of Geography' and it has been widely accepted by geographers worldwide (Figure1.5). Te themes are location, place, human – environment interaction, movement and regions.

Five Themes in Geography

Themes of Geography are the educational tools for understanding the geography subject in detail. It was adopted in the year 1984 by the Association of American Geographers and these five themes were publishedin the National Council for Geographic Education/Association of American Geographers' publication Guidelines for Geographic Education.

Location

Every point on earth has a location. The location can be described in two different ways:

- Absolute location is a location as described by its latitude and longitude on the earth. For example, the coordinates of Chennai Central Railway station are 13°04'56" N latitude and 80°16'32" E longitude.
- Relative location is the position of a place in relation to another well-known landmark. For example, Kallanai Dam or Grand Anicut is located roughly 350 km south –southwest of Chennai City. The absolute and relative location related surveys and studies fall under this category.

Place

- A place is an area that is defined by everything in it. All places have features that give them personality to distinguish them from other places. A number of place names in Tamil Nadu, like Redhills, Fort St. George, Mint, and George Town are examples to this theme.
- Toponym: A place name, especially one derived from topographical feature.
- Site: An area of ground on which a town, building, or monument is constructed.
- Situation: The location and surroundings of a place.

Human-Environment Interaction

The theme describes how people interact with the environment and how the environment responds. These are studied with reference to the following three key concepts:

- Dependency: How humans depend on the environment (Example: For water, fresh air, sunlight etc.)
- Adaptation: How humans adapt to the environment (Example: Life in polar or desert regions)
- Modifcation: How humans modify the environment (Example: Construction of Underground Metro rail, Agriculture in Israel).

Movement

- Movement is the network of travel of people, goods and ideas from one location to another. Examples: Rural-urban migration and metro train commuting in Chennai. Air transport which carries people and goods and the internet that allows access to ideas and knowledge across the world are also examples of this kind.

Region

- Regions are areas with distinct homogenous characteristics such as climate (Monsoon regions), natural vegetation (Tropical rain forests), crops (Corn Belt of USA), major landforms (Himalayan region), industries (Chota-Nagpur plateau) etc.

Geography's Relation with Physical and Social Science Disciplines

- While defining geography, we have seen that some branches of geography have strongest affiliations with subjects like mathematics and environmental sciences, while others have very close connection with history and sociology. Some subjects deal with distinctive type of phenomena while geography examines several kinds of phenomena together. Te diagram (Figure 1.6) gives clear idea about the relationship of geography with other disciplines.

Relations with Physical Sciences

Astronomy, Mathematics, Computer Science and Geography:

- Astronomy basically deals with the celestial bodies including stars, planets, satellites, their motions, constellations, as well as different kinds of phenomena occurring in the outer space. The precise location, nature of movements, form and size of celestial bodies, including those of the solar system, have been accurately measured with the help of mathematics. The interaction of astronomy, mathematics and computer science with geography has paved way for the development of modern cartography and GIS.

Geology and Geography:

- Geology is the study of rocks, their types, distribution, mineral content, petroleum, etc. The subject investigates all these phenomena, classify them and put them in a sequence. Geography interacts with the subject in studying the distribution of exposed rocks, interaction with climate and human activities, economic prospects of the minerals and so on. Interaction between geology and geography leads toformation of the new branch of study called geomorphology, the study of landforms.

Physics, Chemistry and Geography:

- As geography is the study of variable phenomena on the earth's surface, the dynamic mechanism of the phenomena requires to be studied within the framework of physics. The physics of atmosphere is studied under climatology and the physics of hydrosphere through oceanography, and both the subjects investigate, interpret and explain the atmospheric and hydrological processes. The chemical contents of rocks,soil, surface and groundwater, atmosphere are the interests of the geographers. They study how the physical and chemical contents are disturbed by human activities and vice versa.

Botany, Zoology and Geography:

- The systematic branches of botany and zoology have traditionally been confined to the classification and description of various kinds of species on the earth's surface. Geography, being the study of the spatial section of earth's surface, attempts to study the distributional aspects of fora and faunaespecially with reference to climate and relief. The integration among these subjects has given birth to biogeography.

The study of 'apartheid' (a system of institutionalised racial segregation as existed in South Africa) is an example of anthropo-geographic study.

Relationship with Social Sciences

Economics and Geography:

- Economics is concerned with how human needs and wants are satisfied with the available resources. Economic geography is concerned with the study of resources endowment and patterns of utilisation. The economic activities of the human beings including agriculture, fishing, forestry, industries, trade and transport are studied in this branch. The economic activities are highly influenced by the relief and climatic factors of the region or the country. Therefore, economics and geography have close links with each other, especially for integrated resources development.

Sociology and Geography:

- Sociology is mainly concerned with the institutional aspects of the society. A number of investigations including social behaviour, movement of people between rural-urban areas, spatial interactions between social groups, the relations between innovation and tradition in rural and urban areas etc., have been jointly undertaken by sociologists and geographers in different countries of the world. Social geography is the logical expression of the interaction betweensociology and geography as it studies social phenomena in spatial context.

Anthropology and Geography:

- Anthropology attempts to study human races and their classification. Both anthropology and geography seek to identify and classify the human races on the basis of their habitat and cultural traits and attempt to study the variable racial phenomena on the spatial context of the earth's surface. The relationship between anthropology and geography has resulted in the development of 'anthropogeography' or geography of humans.

History and Geography:

- History is a framework of events as per time and place. Geography attempts to study these events with reference to the physical earth and depict the places of historical events using thematic maps. Anyone who attempts to study any historical events of India should always integrate the temporal and the spatial phenomena of that period together to arrive at a conclusion.

Tamil Rulers and Geographic Knowledge

History reveals to us that how the Great rulers like Raja Raja Chola or RajendraChola had trade relations with other countries of the world, especially South Asian countries by understanding the relief, seasons, ocean current movements etc., The sailors would have been experts in every aspect of geography to move their troops, sail overseas and trade with all known nations of that time. They also utilised the ocean currents to transport teak and other valuable timbers from Indonesia, Myanmar, and other countries to South India.

Approaches to the Study of Geography

- Geography has undergone several changes in its approach. Te earlier geographers were descriptive geographers. Later, geography came to be developed as an analytical science. Today the discipline is not only concerned with descriptions but also with analysis as well as prediction. There are two distinct approaches or methods to study geography. They are:1. Systematic approach and 2. Regional approach

Systematic Approach:

- Systematic or nomothetic approach was introduced by Alexander Von Humbolt, a German geographer (1769-1859). In this approach a particular phenomenon is considered for detailed understanding. Te study of specifc natural or human phenomenon that gives rise to certain spatial patterns and structures on the earth surface is called systematic study. Generally, systematic geography is divided into four main branches.

i. Physical Geography: Study of various elements of earth systems like atmosphere (air), hydrosphere (water), lithosphere (rock) and biosphere (life) and their distributions.

ii. Biogeography, including environmental geography: It focuses on various kinds of forests, grasslands, distribution of flora and fauna, human-nature relationships, quality of the living environment and its implications for human welfare.
iii. Human Geography: It describes the human culture, population, dynamic socio economic and political aspects.
iv. Geographical methods and techniques: Itisconcernedwith methods andtechniques for field studies, qualitative, quantitative and cartographic analysis.

Regional Approach:

- It isotherwisecalled as ideographical approach. It was developed by Carl Ritter(1779 – 1859), a contemporary of Humboldt. The regions could be classified based on a single factor like relief, rainfall, vegetation, percapita income or there could also be multi-factor regions formed by the association of two or more factors. Administrative units like states, districts and taluks can also be treated as regions. The main sub branches of regional geography are : i) Regional studies ii) Regional analysis iii) Regional development and iv) Regional planning.

Born on 14 September 1769 Alexander Von Humboldt was a Prussian polymath, geographer, naturalist, explorer. Humboldt's quantitative work on botanical geography laid the foundation for the field of biogeography Humboldt resurrected the use of the word cosmos from the ancient Greek and assigned it to his multi-volume treatise, Kosmos. He was the first person to describe the phenomenon and cause of human-induced climate change, in 1800. He described the Guanoco asphalt lake as "The spring of the good priest". Humboldt and Bonpland discovered dangerous electric eels, whose shock could kill a man. His stay in Ecuador was marked by the ascent of Pichincha and their climb of Chimborazo, where Humboldt and his party reached an altitude of 19,286 feet (5,878 m). This was a world record at the time. U.S President, Jefferson later referred to Humboldt as the most scientific man of the age.

Geographical Data Matrix:

- The matrixis a simple method of arranging information in rows and columns for better understanding of complex spatial problems. Brian J.L. Berry adopted this method from anthropology for studying geography more effectively.Geographic data can be arranged in a rectangular array or matrix. Row-wise group of variables represent the systematic or topical branches of geography while, regions are represented by columns. Berry has explained that regional synthesis could be derived with the help of a series of geographic matrices in correct temporal sequence. Each time period has been taken to be equivalent to a 'slice' of the three-dimensional cake. The diagram of 'Third Dimension' makes it possible to examine rows and columns, cutting across time.

Branches of Geography

- Based on content and the available techniques, the discipline can be divided into three major domains. Each one has many sub divisions which deal with specific objectives (Figure 1.7).
  a. Physical Geography
  b. Human Geography and
  c. Geographic Techniques.

Physical Geography

- It is the study of natural features of the earth such as land, water, air and living organisms. The changes taking place within and among these natural features and their resultant features are studied under its various branches. The branches of physical geography are:

i. **Geomorphology** deals with the distribution of land forms, their origin and the forces causing changes over these landforms. Geology provides basic information to the study of geomorphology.
ii. Soil Geography is a study related to soil formation, soil profile, soil types, their fertility level and distribution. Soil erosion and conservation measures are also dealt in this branch.
iii. Climatology deals with the study of global and regional weather and climatic conditions by analysing relevant statistical data. Meteorology provides basic information on the composition, structure and the changes in the atmosphere.
iv. Hydrology encompasses the study of earth's realm of water such as oceans and surface water bodies like rivers, reservoirs and ponds. It also makes a study of underground water and its recharge and also pollution of water bodies.
v. Oceanography is the study of seas and oceans. The shape, size, depth and bottom relief of ocean, distribution of oceans, ocean currents and variouslife forms existing in ocean are also studied under oceanography.
vi. Biogeography is a study of ecosystems over geographical space. It also analyses the changes in the ecosystems. Phytogeography or plant Geography, Zoo Geography or animal geography and Ecology are the branches of biogeography.
vii. Environmental Geography is the study of environmental issues arising out of misuse of various spheres of the earth and their implications. The ozone layer depletion, global warming, melting of polar ice caps, rising sea level and other related aspects are also givendue importance. It also tries to give sustainable solutions to these problems.

Human Geography

- Human Geography is concerned with the changes made by the humans over the natural or physical landscape. The ethnic and political aspects are taken into

consideration. The issues like climatic change, natural and anthropogenic disasters are also the major concerns.

i. Population Geography is the study of distribution and density of population, the changing patterns in age and sex composition, birth and death rates, life expectancy, literacy level and dependency ratio, migrationsat national and international level and the causes and consequences of migration.
ii. Settlement Geography deals with the characteristics of rural and urban settlements and transportation network. It seeks better understanding of the present landscape and plans for the future. The study is more important for town and country planning.
iii. Historical Geography tries to picturise the geography of an area or region as it was in the past and studies how it has evolved over time. The forces involved in transforming region such as colonisation by the Europeans or a natural disaster are also included in the study.
iv. Anthropo Geography deals with the distribution of human communities on the earth in relation to their geographical environment.
v. Cultural Geography gives emphasis on the location and diffusion of customs and cultural traits such as food habits, skills, clothing and beliefs and social organisations and their developments in different parts of the earth.
vi. Social Geography is closely related to cultural geography. It examines the relationships among the social groups and their social relationships in the places of their living.
vii. Political Geography tries to understand the countries and their neighbours, problems of resources sharing, boundaries and territorial limits.Thisbranchis also concerned with understandingthepoliticalbehaviour of the population, relations between independent states, and patterns of voting and delimitation of electoral constituencies.
viii. Economic Geography deals with the distribution of economic activities such as, primary, secondary and tertiary. The primary activities include food gathering, hunting, animal rearing, agriculture, and mining. The secondary activities include manufacturing and the tertiary activities include the service sectors such as trade, transport, communication and other related areas.
ix. Medical Geography mainly deals with study of geographical aspects of origin, diffusion and distribution of various communicable diseases and health care planning.

Geographic Techniques

- Geography has developed a number of methods and tools to investigate and identify the spatial structures and patterns. Besides, it also lends or borrows some methods and tools to measure and investigate precise understanding of the spatial locations and patterns.

i. Mathematical Geography deals with the study of earth's size and shape, motions of the earth, concept of time and the time zones.
ii. Statistical Geography is concerned with the practice of collecting, analysing and presenting data that has a geographic or areal dimension, such as census data.

iii. Cartography is the study of making maps of various scales using authentic information.

iv. Remote Sensing is the art, science and technique of capturing the earth surface features using sensors or cameras in airplanes or satellites, processing and presenting the spatial information tousers.

v. Geographic Information System (GIS) is a computer-based tool of the recent decades for geographical studies. It is used for storing, retrieving, transforming, analysing, and displaying data to prepare useful thematic maps.

vi. Global Navigation Satellite System (GNSS) is used to pinpoint the geographic location of a user anywhere in the world. Airlines, shipping, travel agencies and automobile drivers use the system to track the vehicles and follow the best routes to reach the destination in the shortest possible time.

Global Navigation Satellites System

GNSS is the standard generic term forsatellite navigation systems that provide geo-spatial positioning with global or regional coverage. This term includes the GPS (USA), GLONASS (Russia), Galileo (Europe), Beidou (China), IRNSS (India) and other systems. The GPS was the first GNSS system of the United States and originally used for military applications. Today it is commonly used in mobiles, vehicles, agriculture and other areas that allow us to use it in all fields of mapping.

- Geography is undergoing frequent changes to tackle the challenges of the dynamic world. The subject is more flexible and accommodates many principles of related subjects. At the same time, it lends concepts and knowledge to many related disciplines. Owing to these changes, the subject is attaining more refinement, accuracy, precision, depth and scientific rationale.

Geographical Tools and Skills

- Every day the news media report several geographically significant events of near-by or faraway places. Such reports include the occurrence of earthquakes, floods, forest fire, landslides etc., which trigger the interests of everyone to recollect their geographic knowledge they had acquired earlier.The essential tools of geography are maps and globes and now the digital versions of aerial photographs, satellite images, Geographical Information Systems (GIS) and Global Navigation Satellite System (GNSS).These tools have become an integral part of geography and these products help us to visualise the spatial patterns over the surface of the earth.

- The GIS technique has enhanced the skills and capabilities to compare and overlay the digital layers to create maps quickly and efficiently. It helps us to study the areas affected by floods or cyclones or forest fire and the damages can be assessed accurately and losses be estimated within a very short span of time. The navigation satellites provide accurate location of these occurrences.

- In recent years, geography aims to develop a set of marketable skills to the students rather than preparing the students only for the teaching in educational institutions.

- The job market is changing frequently. Therefore, the teaching methodology of the subject is to be adapted to the changing trends of the society and provides a couple of specialisations to the students so that they could be acquainted with the global market and get suitable employment. The maps still remains an important visual medium for geographers although the microchip revolution is expanding exponentially to address a number of societal issues.

Cartography:

- Geographers who specialise in this branch make traditional maps, digital maps, atlases, charts, globes and models. Quantification and cartography are considered as two sides of the 'geography coin'. Owing to quantitative and computer revolutions, handling of spatial data become easier, not only for the preparation of 'instant maps' but also for statistical graphs, graphic images and models. Preparation of the computer-aided-maps and updating the existing ones become easier and faster. Creation of three dimensional models, changing the viewing angle of these models and plotting the images are made possible due to the introduction of computer expertise in cartography.

Land use Studies:

- For studies of quickly changing phenomena on the earth surface, such as foods, drought, forest fires, etc, remote sensing data provide accurate information in different scales. The remote sensing organisations employ geographers who have the knowledge to process the frequently changing earth's surface features. Even before the introduction of satellites in remote sensing, aerial photographs were widely used by geographers for natural resources surveysand urban and regional planning. The satellite data from Landsat, SPOT, IRS and other satellites made it possible to repeatedly view each part of the earth surface at frequent intervals and thereby geographers' 'data thirst' is considerably quenched.

Geospatial Analysis:

- A geospatial analyst designs databases, analyses geographical data, uses appropriate GIS software to a wide range of applications including defence, real estate, pollution and government administrations. The skill helps to identify optimum size and ideal location, establish new or relocate existing facilities like hospitals, police station, banks, shopping centres etc.,

Environmental Impact Assessment:

- This investigation requires voluminous data related to physical, social, economic and other aspects of the area under study. The data are collected from maps, satellites and field and synthesised to provide meaningful visual results. Such complex thematic visual results allow the decision makers to take appropriate steps to tackle the day to day and long term environmental issues.

Regional Planning:

- A planner who is responsible for planning an urban or a regional unit needs to have an overall view of the area. They should be able to synthesise the issues from multiple perspectives. The problems are increasingly concerned with balancing different, sometimes contradictory, interests into functional and sustainable suggestions and proposals. Tis specialisation is concerned with planning, housing, and smart city development projects. The regional land use maps are to be preparedto locate facilities and optimise the existing land for various uses.

Weather Forecasting / Now casting:

- At present the meteorologists are using ground data and satellite data to forecast the wind direction, rainfall possibilities and cyclone movement. However, with the advancement of satellite sensors, navigation satellites and GIS technology it is possible to nowcast the weather conditions and provide live cyclone movement tracts, otherwise known as weather nowcasting.Geographers are utilising spatial and non–spatial data to analyse weather and climate parameters and conduct research concerning climate and climate changes and forecast the earth's future climate and weather conditions and their implications.

Surveying, Utilising Large Scale Maps/Sketches:

- Surveying with instruments, starting from chain survey to differential GPS (DGPS), are an integral partof geography curriculum. The students survey and prepare sketches of various features in an area. They also survey the campuses with advanced survey instruments and prepare large scale maps. The geographical knowledge and training enable the students to interpret large scale maps of India and other countries of the world. Ground Penetrating Radar (GPR), one of the emerging field survey instruments, is gaining importance not only in earthsciences discipline but also in archaeology, civil engineering, city planning and other related fields.

- The students of geography undergo special trainings in their college level studies and seek employment in the areas of their specialisation. Depending upon their area of specialization; geographers are employed as scientists in national and state planning commissions, water resources organizations, and land use planning units, agricultural or economic institutes or as demographers in government and research organizations.

- The geographers are also employed as climatologists, geomorphologists, GIS specialists and hydrologists. Geography background is an asset for careers in travel and tourism, particularly for 'Travel Journalism'. Besides these, the geography graduates apply for civil services examinations conducted by various States of India and also the UPSC. Recent developments in geography are technological in nature and mostly computer oriented. The average geography graduate is therefore well versed in the use of computers, and as they are trained in understanding patterns and relationships over space.

Geography in Tamil Nadu

- A number of institutions of higher learning in Tamil Nadu have been offering graduate and post graduate programmes in geography for several decades. Some of the Departments are recognized asresearch centers and these are engaged in undertaking national and international research projects besides conducting research programmes in geography. The departments are also engaged in organizing short term and long term training programmes and workshops to disseminate the latest geographic knowledge and technology for the benefit of students, researchers and teachers of geography.

Annual Geography Talent Tests for College / University Students and School Students of Tamil Nadu

The Indian Geographical Society is conducting talent test examination to final year UG and PG geography students across the State and present awards and cash prizes to a tune of Rs. 15,000 (top three M.Sc. students) and Rs. 10,000 (top three B.Sc. students) in the names of the IGS Founder Prof N.Subrahmanyam and the former Head of the Department of Geography of University of Madras Prof. A.Ramesh, respectively.

The Association of Geography Teachers of India conducts Annual Geography Talent Tests to the school students. The talent test is conducted at two levels: Students of classes 7 and 8 take Junior Level test while the students of classes 9 and 10 take it at the Senior Level. Prizes and certificates are awarded to top ranking candidates.

- Two geographical Associations are functioning in Tamil Nadu to disseminate geographic knowledge to the students and teachers of schools, colleges and universities through publishing journals, organizing workshops and conduct talent tests to the geography students.

Databases for Geography Teaching and Learning

- Geographers are concerned about certain global and local issues like disasters, environmental problems, natural resources and other related aspects. Often these issues are discussed in the classrooms. Data relating to the issues are necessary for better understanding of the same and for seeking real world solutions. A number of organizations in India are engaged in disseminating such valuable information through special publications, especially to the student community. The schools, colleges, universities and research institutions can write to the following organizations and enroll themselves to receive the published materials like booklets, pamphlets, satellite images, manuals etc. They can also enroll for short term trainings / field visits / workshops arranged by these organizations.

Awards to Geography Teachers and Scientists

The Indian Geographical Society has instituted Awardsin the names of renowned Geographers Prof. B. M. Thirunaranan, Prof. A.R. Irawathy and Prof. V. L. S. PrakasaRao to the leading geographers who work in the areas of geomorphology, remote sensing and regional planning respectively.

- The students can make use of the free software available from these organizations to visualize the earth's surfaces from space and map the existing and changing land cover details, traffic density, pollution levels etc., A number of spatial information, including satellite images can be downloaded freely for educational purposes such as classroom teaching, preparation of maps, for project work, field work and other activities.

Glossary

1. **Absolute Location:** The exact position of an object or place stated in spatial coordinates of a grid system designed for the location purposes. In geography, the reference system is the global grid of parallels of latitudes north or south of equator and of meridians of longitude east or west of the Prime meridian.

2. **Cartography:**The art, science and technology of making maps.

3. **Field Measurement Book (F.M.B):** The FMB depicts the dimensions of each field boundaries and the sub divisions. In FMB the individual survey number maps are maintained at a scale of 1:1000 or 1:2000. Each survey number is divided into several sub divisions. Each sub division is owned by a owner. The FMB's also depicts the dimensions of each field boundaries and the sub divisions.

4. **GlobalPositioning System (GPS):** A method of using satellite observations for the determination of extremely accurate location information.

5. **Greenhouse Effect:** The heating of the earth's surface as shortwave solar energy passes through the atmosphere, which is transparent to it but opaque

to reradiated long wave terrestrial energy. It also refers to increasing the opacity of the atmosphere through the addition of increased amounts of carbon dioxide, nitrous oxide, methane and chlorofluorocarbons.

6. **Greenwich Mean Time (GMT):** Local time at the prime meridian (Zero degree longitude), which passes through the observatory at Greenwich, England.

7. **Map Projection:** A method by which the curved surface of the Earth is shown on a flat surface map. As it is not possible to show all the Earth's features accurately on a flat surface, some projections aim to show direction accurately at the expense of area, some the shape of the land and oceans, while others show correct area at the expense of accurate shape.

    a. One of the projections most commonly used is the Mercator projection, devised in 1569, in which all lines of latitude are the same length as the equator. This results in increased distortion of area, moving from the equator towards the poles. This projection is suitable for navigation charts.

    b. The Mollweide projection shows the land masses the correct size in relation to each other but there is distortion of shape. As the Mollweide projection has no area distortion it is useful for showing distributions such as population distribution. The only true representation of the Earth's surface is a globe.

8. **Nation:** A culturally distinctive group of people occupying a particular region and bond together by a sense of unity arising from shared ethnicity, beliefs and customs.

9. **Natural Resource:** A physically occurring item that a populationperceives to the necessary and useful to its maintenance and well-being.

10. **Ozone Layer:** A gas molecule consisting of three atoms of oxygen (O3) formed when diatomic oxygen (O2) is exposed to ultraviolet radiation. In the lower atmosphere, it constitutes a damaging component of photochemical smog; in the upper atmosphere, it forms a normally continuous, thin layer that blocks ultraviolet light. A layer of ozone in the atmosphere (stratosphere) protects life on earth by absorbing ultraviolet radiation from the sun.

11. **Prime Meridian:** An imaginary line passing through the Royal Observatory at Greenwich, England, serving by agreement as the zero degree line of longitude.

12. **Region:** In geography, the term applied to an area of the earth that displays a distinctive grouping of physical or cultural phenomena or is functionally united as a single organisational unit.

13. **Relative Location:** The position of a place in relation to a well-known place.

14. **Site:** The place where something is located; the immediate surroundings and their attributes.

15. **Situation:** The location of something in relation to physical and human characteristics of a larger region.

16. **Toponym:** A place name with reference to topography.

Unit III Lithosphere Endogenic Processes

Introduction

- Do you know that the Russians tried to dig through the centre of the Earth? It indeed is a daring attempt.

- While the famous Voyager 1 satellite took 26 years to exit our Solar System (16.5 billion km away), almost the same amount of time (24 years) was taken for man to dig out a mere 12.3 km into the earth's surface.

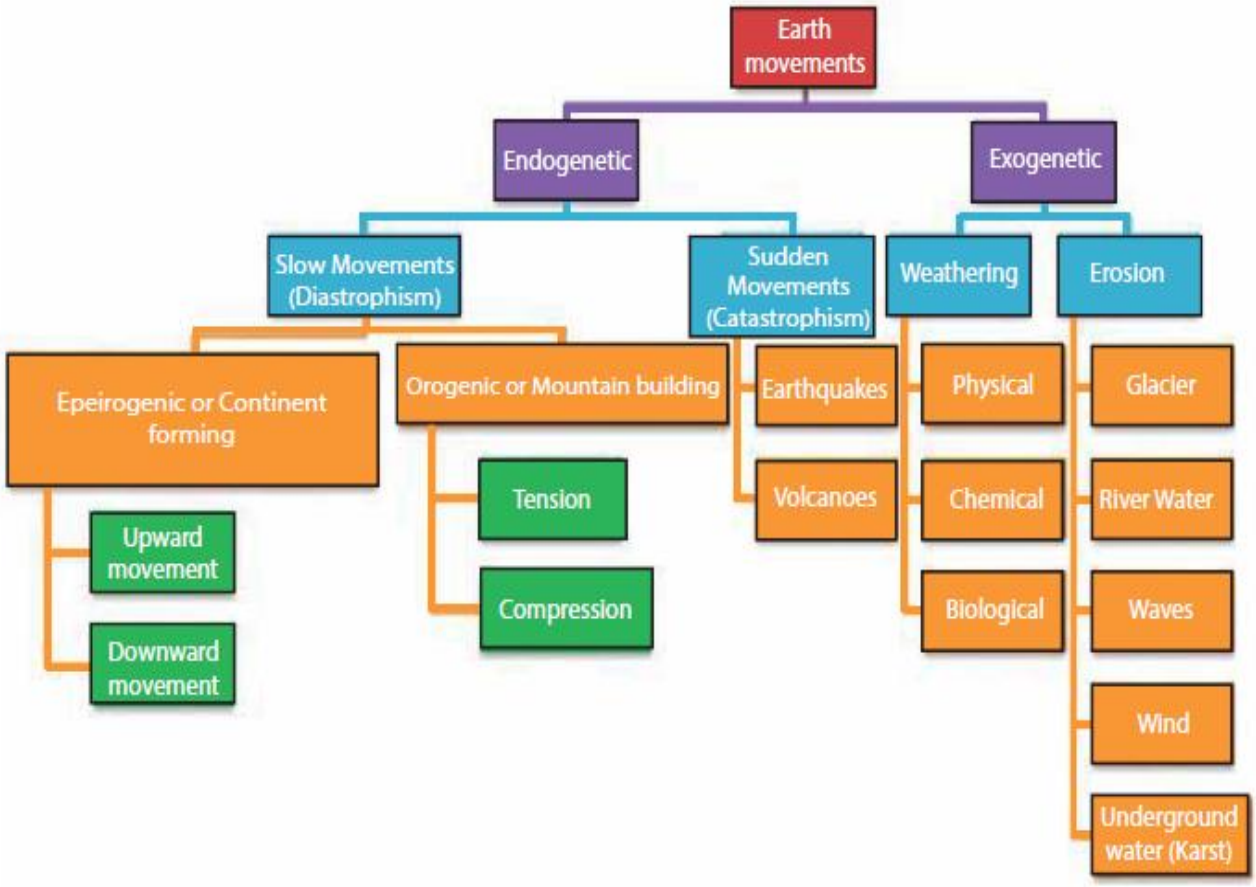
- Russia drilled Kola Super Deep bore hole between 1970 and 1994. The deepestpart of it, named 'SG-3 (Star Gate), extends 12.3 km into the Earth. Look at figure 3.2 and amaze the highest and deepest points of the earth.

- The earth's surface is being continuously reshaped by both the internal (Endogenic forces) and external forces (Exogenic forces). The changes that the endogenic and exogenic forces bring about in the appearance of the surface of the earth are collectively known as geomorphic processes. (figure. 3.3)

- The process by which the earth's surface is reshaped through rock movements and displacement is termed as diastrophism. Diastrophism includes both orogenic and epeirogenic processes.

- Our knowledge of the earth is mostly limited to its surface. But the earth has a complicated interior. The earth is composed of lithosphere, atmosphere, hydrosphere, and biosphere.

- The lithosphere is the outermost rigid rocky shell of the earth. It comprises the crust and the upper portion of the mantle. The word lithosphere is derived from the Greek words lithos meaning rocky and sphaira meaning sphere. The term lithosphere was introduced by Joseph Barrel, an American Geologist.



Interior of the Earth

- The interior of the earth is composed of many minerals both in the solid and liquid state. The temperature in general increases at the rate of 1° C for every 32 metres towards the earth's interior.Look at the figure.3.4 the layers of the earth. Earth's interior can be divided into the crust, upper mantle, lower mantle, outer core, and inner core.

The Crust

- The crust is further divided into upper crust (continental crust), composed of silica and aluminium (sial) and the lower crust (oceanic crust) made up of silica and magnesium (sima). The boundary between the upper crust and the lower crust is termed as 'Conorod boundary'. The thickness of the crust varies from oceanic areas to continental areas. Oceanic crust is thinner when compared to the continental crust. The mean thickness of oceanic crust is 5 km while the continental crust is around 30 km. The continental crust is thicker in the areas of major mountain systems. It is as much as70 km thick in the Himalayan region. The density of the crust is less than 2.7 g/cm3.

The mantle

- The mantle is composed of silica, magnesium and iron. It lies between the lower crust and the outer core. It extends for about 2,900 km. It is divided into

upper mantle and lower mantle. The mantle generally is in a solid state. The upper part of the mantle is called asthenosphere. The word Asthen in Greek means weak. It extends up to 400 km and it is the main source of magma. The Mohorovicic is the boundary which divides the lower crust and the upper mantle. The density of the mantle is 3.9 g/cm3.

The core

- The core forms the centre of the earth. Its density is 13.0 g/cm3. Its temperature is about 5500° C to 6000° C. The core has two parts namely the outer core and the inner core. The boundary between the lower mantle and the outer core is called Guttenberg margin.

- The outer core and inner core are separated by Lehmann boundary. Theouter core is in the liquid state while the inner core is in the solid state. Generally, the core is composed of Nickel and Ferrous (Iron) which is called NiFe (Barysphere). The core is extended from 2,900 km to 6,370 km from the surface of the earth.

Continental Drift Theory

- In 1912 Alfred Wegener (1880-1930) postulated that all the continents once were together forming a single continent. According to him, about 250 million yearsago, the earth was made up of a single landmass called Pangaea (meaning "all lands"), and a single ocean surrounding it called as Panthalassa. Over a long period of time, probably 220 million years ago, they drifted apart and gradually moved to form their present position. First, Pangaea broke into two landmasses namely Laurasia in the north and Gondwana in the south.

- Laurasia further split into Eurasia and North America. Gondwana land split into Africa, South America, Antarctica, Australia, and India.

Wegener put forward certain evidences to support the continental drift theory. Let us deal with it in detail.

Evidences to support continental drift theory

- The continental drift theory is supported by the following evidences

1. Certain identical rare fossils have been found in different continents.
   The fossils of Mesosaurus (a small Permian reptile), for example, have been found only in Africa and South America.
2. The fossil of a Fern tree, about 360 million year old, has been found only in India and Antarctica.
3. Rocks of similar type, formation, and age have been found in Africa and Brazil.

4. Geological structure in Newfoundland matches with that of Ireland, Scotland and Scandinavia. Geological Structure of Appalachian Mountains matches with Morocco and Algeria in North Africa.
5. The corresponding edges of the continents fit together. For example,the western side of Africa and the eastern side of South America fit together.

Enchanted rock in the Texas Hill Country is about a billion years old. TheHawaiianIslands are the youngest lava forms of the Hawaiian hotspot.

Plate Tectonics

- Have you heard about diving between two continents? It is possible in the Silfra rift of Iceland. Look at Figure.3.7. It is located in the Tingvellir National Park. It is in the boundary between the North American plate and the Eurasian plate. It is the visible boundary between these two plates.

Plate boundaries

- Plate boundaries are the zones where two or more plates move about. Plate tectonics describes the distribution and motion of the plates. The earth's surface is composed of rigid lithospheric slabs technically called "plates". The word Tectonic is derived from the Greek word tekton meaning builders.

GNSS (Global navigation satellite System) measures the speed of plate movement. Rate of seafloor spreading ranges from 1 to 2 centimetres per year along the oceanic ridge in the northern Atlantic Ocean to more than 15 cm per year along the East Pacific Rise.

- Lithospheric plates are sometimes called as crustal plates or tectonic plates. Earth's lithosphere is divided into a series of major and minor mobile plates. Eurasian plate, Into-Australian platen North, American plate, Pacific plate, African plate and Antarctic plate are the major plates. Arabian plate, Caribbean plate, Cocas plate and Scotia plate are the examples of minor plates. Plates move at the rate of 2 to 3 centimetres per year.

- Plates are composed of the continental or oceanic landmass. The subduction of the oceanic plates results in the occurrence of earthquakes and volcanoes adjacent to trenches.

- Plate margins mark the occurrence of the most significant landforms, including volcanoes, fold mountains, island arcs and deep-sea trenches. There are three principal types of plate boundaries. They are divergent, convergent, and transform boundaries.

Divergent plate boundaries

- Divergent plate boundary is the margin where two plates move apart. For instance, the African plate and South American plate move apart and form a divergent plate boundary. Narrow oceans represent young divergent boundaries and wide oceans are indications of old ocean basins. Ocean ridges are the boundaries between plates of the lithosphere.

Atlantic Oceanis widening at an estimated rate of 1 to 10 cm a year

- A fissure is created when oceanic lithosphere separates along the oceanic plate boundary. The gap is filled by magma that rises from the asthenosphere. The magma cools and solidifies to create a new oceanic crust. Hence, the divergent plate boundary is termed as the constructive plate boundary. It is also called as accreting plate margin.

- Let us see what happens in the divergent plate boundary. Firstly, submarine mountain ridge is formed through the fissures in the oceanic crust when the plates move apart. The Mid-Atlantic Ridge is an ideal example of a submarine mountain ridge in the Atlantic Ocean. It is the longest mountain ridge in the world.

- It extends for about 16,000 km, in a 'S' shaped path, between Iceland in the north and Bouvet Island in the south. It is about 80 to 120 km wide. It reaches above the sea level in some places thus forming theislands such as the Azores, Ascension, St. Helena and Tristan da Cunha.

Secondly, rift valley is formed when two plates move apart. If a divergent boundary runs through the continent, the continent splits apart and rift valley is formed. The African Rift Valley of East Africa is an example.

Convergent plate boundary

- Convergent plate boundary is the margin where two plates collide with one another. For instance, the South American plate and Nazca plate collide with each other. There are two kinds of surface features associated with the convergent margin. The first is the ocean trench that forms a line between the two colliding plates.

Wadati-Benioff zones are nothing but Subduction zone

- A trench is a narrow and deep depression of the ocean floor. It is formed when the oceanic plate slides down underneath continental plate as the oceanic plate is denser than the continental plate. For instance, Mariana Trench in the Pacific Ocean, is the deepest trench in the world. It is formed when the Pacific plate sinks down the Eurasian plate. It is about 10,994 metres (10.99 km) deep. Mariana Trench stretches for more than 2,540 km with a width of 69 km.

- You could take Mount Everest and sink it in the Mariana Trench, the deepest point in the ocean, and still you have a km of depth to reach the surface of the

ocean.When a continental plate and an oceanic plate collide with each other, denser oceanic plate sinks below the lighter continental plate, subduction zone is formed.

- A subduction zone is a boundary where one plate sinks under the other plate. It was first identified by KiyooWadati and Benioff.Secondly fold mountain is formed when two plates collide each other. For instance, the Himalayas were formed when the Indian plate collided with the Eurasian plate. The zone marking the boundary of the two colliding plates is known as suture line.

- As the crust is less dense than the mantle, the newly formed magma will tend to rise to the Earth's surface, where it may form volcanoes. The area in the subduction zone where most earthquakes occur is known as the Benioff zone.

Transform plate boundaries

- Transform plate boundary is the margin where two plates move side by side. The lithosphere is neither destroyed nor created by the transform plate boundary. Hence it is called as the Conservative or passive plate boundary. The San Andreas Fault, California, is a transform boundary that separates the North American plate and Pacific Plates.

Convection Cell

- Now you may think why plates keep moving. The plate movements are caused by the convection cells. Convection cell is the circulation of the molten materials caused by the heat derived from the core. When looking at the figure.3.13 you will understand how and why plates move in different directions.

- When the molten materials(magma) circulate in different directions, they push or pull the plates in different directions. Thus, the plates move towards each other, move away from one another and move side by side. The plate movements cause the formation of fold, fault, earthquake, and volcano to occur. Let us see the cause, effects, and distribution of the internal forces.

Internal forces

- The internal forces are also called as the tectonic forces. They generally occur in the plate boundaries. They are caused by convection cell and plate movement. They form fold, fault, earthquake and volcano.

Fold

- Horizontal movements are produced by forces of compression and tension. Folding is the bending of rock strata due to compression. Folding on a large scale results in mountain building generally referred to as orogeny.

Parts of a Fold

- Up thrown part of a fold is called anticline. Down thrown part of a fold is syncline. The side of the fold is a limb. The top of the fold is the crest. The plane which bisects the angle between two limbs is called the axis of fold or axial plane. The fold is formed by the plate movements.

Types of Folds

- The type of fold depends on the nature of the rock, the intensity of compression forces, etc. The types of the fold can be many but we will deal with five of the following.

1. When compressional force is equal from both sides, the angle of the limb is same on both sides. Such a fold is called symmetrical fold.
2. When compressional force is more from one end, one limb is steeper than the other. Such a fold is called asymmetrical fold.
3. Isoclinal folds are similar to symmetrical folds, but these folds both have the same angle and are parallel to each other. 'iso' means 'the same' (symmetrical), and 'cline' means 'angle,' so this name literally means 'the same angle.'So isoclinal folds are symmetrical and aligned in a parallel fashion.
4. When one limb of the fold is pushed over the other limb of the fold, it is called as over turned fold. Limbs are seldom horizontal.
5. When one side of the fold is pushed so much that it lies positioned over the other, such a fold is called recumbent fold.

- When plates converge, the weak rocks and sediments lying between two plates get squeezed and folded. Parallel folds form long chains of fold mountain ranges with high peaks. The fold mountains are characterised by peaks and valleys. The tops of anticlines become the peaks and synclines become the valleys. Intermontane plateaus (plateau surrounded by the mountain ranges all sides) may be found between the high ranges. Example, Tibet.

Fault

- A fault is a break in earth's crust where blocks of rock crust slide past each other.Usually it occurs along plate boundaries, where the forces of plate motion compress, pull or shear the crust that breaks the crust. Energy release associated with rapid movement on active faults is the cause of most earthquakes.

- The fault plane is the flat surface along which broken blocks of rock slide past one another. A fault dip is an angle between the fault plane and horizontal plane. Up thrown side represents the uppermost block of a fault. Down thrown side represents the lowermost block of a fault. Sometimes it becomes difficult to find out, which block has really moved along the fault plane. Hanging wall is the upper wall of a fault. Foot wall represents the lower wall of a fault.

- A fault scarp is the steep wall like slope caused by faulting of the crustal rocks. Sometimes the fault scrap is so steep that it resembles a cliff.

Types of Faults

- Based on how plates move about, the fault can be divided into as follow:

Normal Fault

- Vertical displacement of the crust is called a normal fault. The normal fault is caused by tensional forces where plates diverge. One block lies above the other (hanging wall). The other block lies below the fault (footwall).When movement occurs along a normal fault, the hanging wall slips downward.

Landforms made by Normal fault are:

1. Rift Valley or Graben

- When a narrow block of land drops or subsides between two parallel normal faults, rift valley (Graben) is formed. Graben originates from the German word meaning 'trough'. A Rift Valley may subsequently get filled by water and a river may flow through it. Normally, a rift valley is long, narrow and very deep. For example,

i. Rhine rift Valley is flanked by two Block Mountains namely the Vosges and the Black Forest.
ii. The rift of River Narmada in India lies between the Vindhyas and Satpura block mountains.
iii. The great rift valley of Africa.

- The Great Rift Valley of Africa is the longest rift valley in the world. It stretches for 6,400 km from Mozambique in the south to Syria in the north. The depressions have become lakes. The lakesof Africa, Dead Sea of Israel and the Red Sea form the parts of the Great Rift Valley.

2. Horst

- When a block of land between two faults is pushed up, block mountainor horst is formed. In this case, the central block is not only up thrown but the side blocks are also relatively downthrown so that the whole central mass appears like a dome.

- In India, specifically the mountain ranges of Vindhya and Satpura found in the central western part of the India are block mountains.

Reverse Fault

- A reverse fault is a horizontal displacement of the crust. It is formed where two fractured blocks move towards each other. It is caused by compressional forces alongconvergent plate boundaries. One side of the fault lies at an angle above the other.

Shear Fault / Transform Fault/ Strike – Slip Fault

- It is created by shearing along transform boundaries. Rocks on either side of fault slip past each other sideways with little up or down motion. It mostly occurs in the ocean basin and connects offsets in the mid ocean ridge.

Earthquake

- Earthquake is a sudden shaking of the earth's surface. **Focus** is the location inside the earth where the earthquake originates. **Epicenter** is the point on the earth's surface vertically above the focus of an earthquake. Earthquake results from the sudden release of pressure which has slowly built up within the earth's crust. Energy is released in the form of shockwaves known as seismic waves. The seismic waves can broadly be classified into two types namely Body waves and surface waves.

I. **Body Waves**are the waves that travel through the interior of the earth. They are further divided into the following.

a. P or Primary or Compressional waves are the fastest seismic waves (6 km/ sec. in the upper crust). They cause the matter to oscillate forward and backward, parallel to the motion of the seismic wave front. P waves push (compress) and pull (dilate) the rock that they pass through. They pass through all medium.
b. S or Secondary or Shear waves are slower than the primary waves (3.5 km/sec. in the upper crust). They cause matter to oscillate side to side, perpendicular to the motion of the wave front. S waves shear the rock that they pass through. They pass through only solid medium.

II. Surface Waves are the waves that travel along the earth's surface. They are slower than body waves. They cause damage during earthquakes.

Love waves shake the ground side to side like S wave.

Rayleigh waves displace the ground like rolling ocean waves. The ground rolls forward and up and then down and backwards. This is similar to a p wave but with the extra up-down motion.

Measuring the earthquake

- It is estimated that about 100,000 earthquakes occur but all cannot be felt. A few earthquakes may be severe causing huge damage to property. Earthquake magnitude is measured on the Richter scale (named after the seismologist who devised it), which rates them on a scale of 1 to 10. Earthquake intensity is measured on the modified Mercalli scale, which ranges from 1 to 12, depending upon the intensity. The seismograph is an instrument used to detect and record seismic waves created by the earthquakes.

Causes of Earthquakes

- There are many factors controlling the occurrence of the earthquake. Some of the major factors include:

1. Plate Tectonic Movements
2. Volcanic Eruptions.
3. Construction of large dams results in earthquake. Example. Koyna dam, Maharashtra.
4. Other Reasons: The nuclear explosions also release massive energy to cause tremors in the earth crust. When underground cave collapses, earthquake may occur.

Effects of the Earthquakes

1. Damage to buildings, roads, rails, factories, dams, bridges etc.

2. Landslides caused by earthquakes damage infrastructure.

3. Fires in the forest and urban areas.

4. Flash floods.

5. Tsunami - The high amplitude oceanic waves caused by submarine earthquake (measuring more than 7 on Richter scale). The seismic waves travel through seawater generates high sea waves. They cause severe loss of life and property. For instance, on 26th December 2004, a tsunami originating from a magnitude 8.9 earthquake in northern Sumatra killed over 1,50,000 people in countries surrounding the Indian Ocean.

Distribution of earthquakes

1. Circum-Pacific region: This region includes all the coastal areas around the Pacific Ocean. It extends through the coasts of Alaska, Aleutian Islands, Japan, Philippines, New Zealand, west coast of North and South America. This zone accounts for 68% of all earthquakes on the surface of the earth.

2. Mediterranean-Himalayan region: This region extends from Alps mountain to the Himalayan Mountains and Tibet to China. About 31% of world's earthquakes occur in this region.

3. Other Areas: These include Northern Africa and Rift Valley areas of the Red Sea and the Dead Sea.

Volcano

- A volcano is an opening in the earth's crust through which magma, gases and ash are released to the earth's surface. The molten rock material found in the interior of the earth is called magma. It can be noted that when magma reaches the earth's surface, it is known as lava (Figure. 3.25). Vent is an opening or mouth of a volcano. Fumaroles are the gushing fumes through the gap in the volcano. Crater is a saucer shaped depression in the mouth of a volcano. When the crater is widened, it is called asCaldera. Volcanic ash consists of fragments of pulverized rock, minerals and volcanic glass, created during volcanic eruptions. Volcano generally erupts either through the vent (E.g. Mt. Fujiyama, Japan) or fissure (The Deccan Plateau, India). Pumice is a volcanic rock produced when lava with a very high content of water and gases is discharged from a volcano.

Causes of Volcanic Eruptions

The following are the causes of volcanic eruptions:

- Weak Zones in the Earth Crust: The parts of the earth where two tectonic plates collide against or drift apart from each other are considered very weak. Volcanoes may erupt in such zones, for example, African and Eurasian plates.

- Magma Saturated with Gases: The magma, in the interior of the earth, is often found saturated with gases like carbon dioxide, and hydrogen sulfide. These gases together with water vapour make the magma highly explosive. Magma is forced out as lava on the surface of the earth due to the pressure exerted by these gases.

Mt. Krakatau

- The greatest volcanic explosion known to humans is perhaps Mt. Krakatau in August 1883.
- Krakatau is a small volcanic island in the Sunda Straits, between Java and Sumatra.
- The explosion could be heard in Australia, almost 4,000 km away.
- The vibration set up enormous waves over 30 m high which drowned 36,000 people in the coastal districts of Indonesia.

Cotopaxi in Ecuador is the world's highest active volcano

.

Types of Volcanoes

Based on the frequency of eruption, there are three types of volcanoes:

1. **Active Volcanoes:** Volcanoes which erupt frequently are called active volcanoes. Generally, their vent remains open. Mount Etna of Italy, Cotopaxi in Ecuador are some examples.

2. **Dormant Volcanoes:** These volcanoes may not have erupted in the recent past but there is a possibility of eruption at any time. In other words, they may lie dormant awaiting active eruption anytime. Sometimes gases and steam come out of them. They cause great destruction to life and property once they become active again. Mt. Vesuvius of Italy and Mt. Fujiyama of Japan are examples.

3. **Extinct Volcanoes**: These volcanoes have exhausted their energy and havenot erupted during the known geological period. The vent of these volcanoes remains closed with solidified lava. The formations such as craters may be filled with water and crater lakes may be formed. The slopes of these landforms may be covered with vegetation. Popa in Myanmar and Mt. Kenya in eastern Africa are the examples of extinct volcano.

- On the basis of nature of eruption and form developed on the surface, they are classified into following types:

1. **Shield Volcanoes**: These are made up of basalt, a type of lava that is very fluid when erupted. They become explosive when water gets into the vent. They develop into a cinder cone. Hawaiian volcano is an example of this category.

2. **Composite cone volcanoes**: They are also called 'strato volcanoes'. They are cone-shaped volcanoes composed of layers of lava, ash and rock debris. Mount Vesuvius and Mount St. Helens are examples of composite volcanoes.

3. **Cinder Cone Volcano** : It forms when magma is thrown out to the surface, cooled in to ash and cinders and settled around the mouth of volcano. It is less dangerous than other volcanoes.

4. **Lava Dome**: Unlike composite and shield volcanoes, lava domes are of significantly smaller structure. They are formed when the lava is too viscous to flow to a great distance. As the lava dome slowly grows, the outer surface cools and hardens as the lava continues to pile within. Eventually, the internal pressure can shatter the outer surface, causing loose fragments to spill down its sides.

Effects of Volcanic Activities Destructive effects of volcano

- Showers of cinders and bombs can cause damage to life and properties. Sometimes ash can precipitate under the influence of rain and completely cover large areas.

- The volcanic gases pose potential hazard to people, animals; agriculture, while sulfur dioxide gas can lead to acid rain and air pollution.

Positive Effects of Volcanoes

- Volcanism creates new landforms. Volcanic rocks yield very fertile soil upon weathering and decomposition.The Kimberlite rock of South Africa, the source of diamonds, is the pipe of an ancient volcano.

- In the vicinity of active volcanoes, waters in the depth are heated from contact with hot magma giving rise to springs and geysers. The Puga valley in Ladakh region and Manikaran (Himachal Pradesh) are promising spots in India for the generation of geothermal electricity.

Distribution of Volcanoes across the World

- Most known volcanic activity and the earthquakes occur along converging plate margins and mid-oceanic ridges. The major regions of volcanic distributions are as follows.

1. Pacific Ring of Fire

- Circum-Pacific region, popularly termed the 'Pacific Ring of Fire', has the greatest concentration of active volcanoes. Volcanic belt and earthquake belt closely overlap along the 'Pacific Ring of Fire'. It is estimated to include two-thirds of the world's volcanoes.

2. Mid-Atlantic Region

- The Mid-Atlantic Region coasts has comparatively fewer active volcanoes but many dormant or extinct volcanoes, example. St. Helena, Cape Verde Islands and the Canary Islands. But the volcanoes of Iceland and the Azores are active.

3. The Great Rift valley of Africa

- In Africa some volcanoes are found along the East African Rift Valley. Kilimanjaro and Mt. Kenya are extinct volcanoes. The only active volcano in West Africa is Mt. Cameroon.

4. Mediterranean Region

- Volcanoes of the Mediterranean region are mainly associated with the Alpine folds. Example, Mt. Vesuvius, Mt. Stromboli (known as the Light House of the Mediterranean Sea).

5. Other Regions

- Elsewhere in the interiors of continents of Asia, North America and Europe active volcanoes are rare. There are no volcanoes in Australia.

Volcanoes in India

- There are no volcanoes in the Himalayan region of India. However, Barren Island, lying 135 km north-east of Port Blair became active in 1991 and 1995.

- However, the other volcanic island in Indian Territory is Narcondam (Andaman and Nicobar Islands) It is probably extinct. Its crater wall has been completely destroyed.

Rocks

- Rock is the solid mineral material forming the surface of the earth. Petrology is the science of rocks. The age of the rock is determined based on Carbon-14 dating.

Rock Types

- Based on their origin, the rocks are classified as follows:

1. Igneous Rocks

- Igneous rocks are formed out of magma and lava and they are known as primary rocks. If the magma cools slowly at great depths, mineral grains increase in their size. Sudden cooling (at the surface) results in small and smooth grains. The igneous rocks are the oldest of all the rocks. Granite, pegmatite, basalt, etc are some of the examples of igneous rocks. There are two types of igneous rocks: intrusive rocks (Granite) and extrusive rocks (Basalt-Deccan Traps).

Granite is less dense and is lighter in colour than basalt rocks.

1. Intrusive Igneous rocks

- Intrusive Igneous rocks are formed when magma rises and cools within the crust. The intrusive activity of volcanoes gives rise to various forms. We see them one by one as follow.

i.Batholiths

Batholiths are large rock masses formed due to cooling and solidification of hot magma inside the earth. It is granitic in origin.

ii. Laccoliths

Laccoliths are large dome-shaped intrusive rock connected by a pipe-like conduit from below. These are basically intrusive counterparts of an exposed domelike batholiths. The Karnataka plateau is spotted with dome hills of granite rocks. Most of these, now exfoliated, are examples of laccoliths.

iii. Lapoliths

When the magma moves upwards, a saucer shape, concave shaped body called Lapolith is formed.

iv. Sill

Sill is a solidified sheet-like horizontal lava layer inside the earth. The near horizontal bodies of the intrusive igneous rocks are called sill or sheet, depending on the thickness of the material. The thinner ones are called sheets while the thick horizontal deposits are called sills.

v. Dyke

When the magma makes its way through cracks and the fissures developed in the land, it solidifies almost perpendicular to the ground. It gets cooled in the same position to develop a wall-like structure. Such structures are called dikes.

These are the most commonly found intrusive forms in the western Maharashtra area. These are considered the feeders for the eruptions that led to the development of the Deccan traps.

2. Sedimentary Rocks

- Sedimentary rocks are also called as detrital rocks. They are formed as a result of denudation. These deposits throughcompaction turn into sedimentary rocks. They occupy only 5 percent of the earth. They are layered or stratified of varying thickness. Example: sandstone, shale etc. Ice deposited sedimentary rocks is called Till. Wind-deposited sediments are called Loess. Depending upon the mode of formation, sedimentary rocks are classified into

1. Mechanically formed sedimentary rocks: sandstone, conglomerate, limestone, shale, loess, etc.
2. Organically formed sedimentary rocks: geyserite's, chalk, limestone, coal etc.

3. Chemically formed: halite, potash, etc.

3. Metamorphic Rocks

- The word metamorphic means 'change of form'. The metamorphic rocks form under the action of pressure, volume and temperature (PVT) change.

- Metamorphism is a process by which the already consolidated rocks undergo recrystallisation and reorganization of materials within original rocks. Gneiss, slate, schist, diamond, marble, quartziteetc. are some examples of metamorphic rocks. The igneous and metamorphic rocks together account for 95 percent of the earth.

Rock Cycle

- Rock cycle is a continuous process through which old rocks are transformed into new ones. Igneous rocks can be changed into sedimentary or metamorphic rocks. The fragments derived out of igneous and metamorphic rocks form into sedimentary rocks.

- Igneous and sedimentary rocks can change into metamorphic rocks. The crustal rocks (igneous, sedimentary and metamorphic) may be carried down into the mantle (interior of the earth) through subduction process and the same melt and turn into magma, the original source for igneous rocks. In this way the rock cycle is a continuous process.

Glossary

1. **Orogeny:** structural deformation of lithosphere due to interaction between tectonic plates.
2. **Conorod boundary:**Margin between the upper crust and the lower crust.
3. **Shearing fault:** the fault is created by shearing along the plate boundary.
4. **Laccoliths:** are large dome-shaped intrusive rock connected by a pipe.
5. **Lapolith:** When the magma moves upwards, a saucer shape, concave shaped body called lapolith.
6. **Syncline:** down slope of a fold
7. **Crest:** the top of the fold.
8. **Catasrophism:** sudden movements of the earth caused by plate movements.
9. **Metamorphism:** the process by which both igneous and sedimentary rocks get changed into metamorphic rocks.
10. **Rock cycle:** a continuous process through which old rocks are transformed into new ones.

Unit -5
Lithosphere Exogenic Processes

Introduction

- Let's recall that you have learned in the previous chapter about geomorphic processes - Endogenic processes in detail. Now we deal with the exogenic processes. The forces which act on the earth's exterior are called as exogenic forces or externalforces. The action of exogenic forces results in wearing down the rock and hence, they are considered as land wearing forces.

Exogenic Processes

- The processes which occur on earth's surface due to the influence of external forces are called as exogenic processes. Weathering, mass wasting and denudation are the major exogenic processes. The elements of nature capable of doing these exogenic processes are termed as gradational agents. For instance, the wind, river, glacier, waves and ground water.

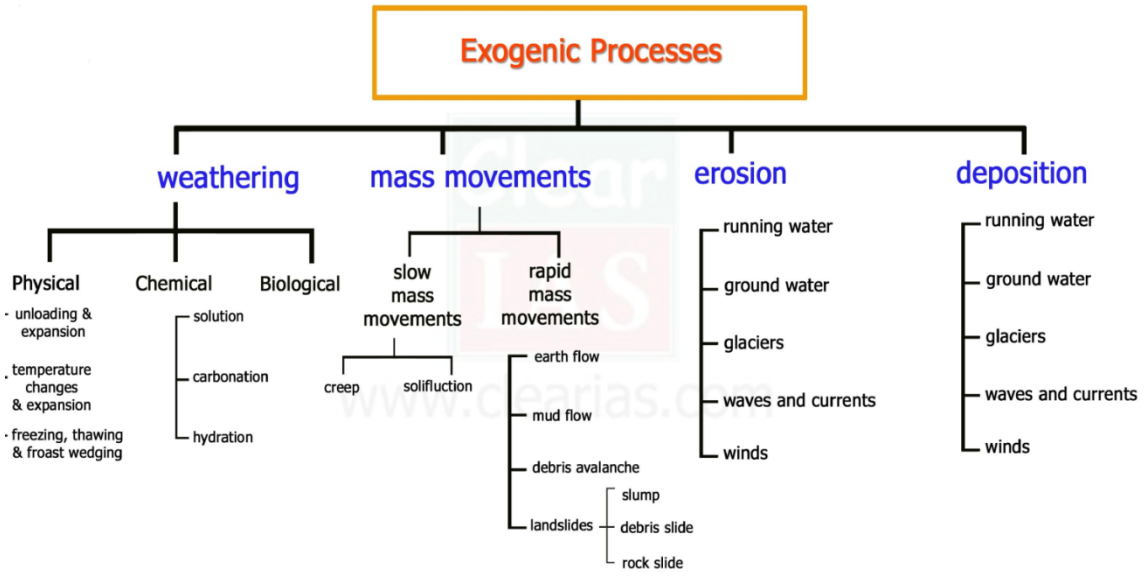
Weathering

- Weathering is the process of disintegration and decomposition of rocks. It is due to the action of climate, plants, animals and other living organisms which cause the rocks to break down physically, chemically and biologically.

- There are three types of weathering. They are physical weathering, chemical weathering and biological weathering.

Physical weathering

- Physical Weathering is the disintegration of rock mainly induced by elements of weather. It produces smaller, angular fragments of the same rock. It is caused by the change in temperature, pressure, water and wind. Physical weathering is further divided into different categories. They are thermal weathering, frost wedging and exfoliation.



Thermal weathering

- In arid and semi-arid areas, the temperature increases, heat up and expand the rocks during the day and contract the rock materials when cooling at night. Under extreme temperature conditions, due to alternate expansion and contraction, the rocks crack and eventually split. The thermal weathering's are of two types. They are;

(a) Granular disintegration and
(b) Block disintegration

- Alternate expansion and contraction of minerals of varying properties in the rocks due to temperature changes, makesthe rocks break down into small pieces (Figure 4.2). Due to this, the breakup of rocks occurs, grain by grain. This is known as granular disintegration.

- Block disintegration occurs in rocks such as granite rock. So in the areas of jointed igneous or layered sedimentary rocks due to the great diurnal range of temperature, the rocks may break up along the joints and cracks into a large rectangular shaped blocks.

Frost Wedging

- Almost all liquids contract when frozen, but when water freezes it becomes larger in size or takes up more space. As water expands it puts great pressure on rocks. When water enters into the cracks ofrocks and freezes, the pressure exerted on the rock is enough to wedge the walls of the crack farther apart, thus expanding and deepening the crack. Thus, frost wedging results in weathering of rock.

Exfoliation

- Rocks generally heat or cool more on the surface layers. The alternate changes in temperature could cause their outer layers to peel off from the main mass of the rock in concentric layers just as the skin of an onion. The process by which curved layers of rock breakaway from the rock beneath them leaving behind dome shaped monoliths is called exfoliation (Figure 4.2). It is also called as 'onion weathering'. Exfoliation occurs commonly in the arid areas.

Chemical Weathering

- Chemical weathering is the decomposition of rock. For example it creates altered rock substances, such as kaolinite (china clay) from granite. The types of chemical weathering are as follows:

1. **Solution:** Some soluble minerals in the rock get dissolved when come in contact with water. Over a long period minerals get washed away from rock and sometimes leading to the formation of caves.

2. **Oxidation:** When oxygen combines with water and iron, it weakens the rock and breaks it. Example, rusting of iron.

3. **Hydrolysis:** It is the chemical breakdown of a rock substance when combined with water and forms an insoluble precipitate like clay mineral. The most common example of hydrolysis is feldspar found in granite changing to clay.

4. **Carbonation:** Carbonation is the mixing of water with carbon dioxide to make carbonic acid. This acid reacts with minerals in the rocks. This type of weathering is important in the formation of caves.

5. **Hydration:** It is the absorption of water into the mineral structure of the rock. Hydration expands volume and also results in rock deformation. A good example of hydration is the absorption of water by anhydrite, resulting in the formation of gypsum.

Biological Weathering

- Biological weathering is the alteration of rock by the action of plants, animals, and man. Burrowing and wedging by organisms like earthworms, termites, rodents, etc., helpin exposing the rock surfaces to chemical changes with the penetration of moisture and air. Human beings by removing vegetation for agriculture and other activities also help in mixing and creating new contacts between air, water, and minerals in the rock materials. Plant roots make a great pressure on the rock materials mechanically breaking them apart.

Mass wasting

- Mass wasting is the movement of a large mass of rock, soil and debris downward by the pull of gravity. It is also called a mass movement or slope movement. It may happen suddenly or slowly. Generally, mass wasting is classified by the type of material involved (mud, soil, and rock) and type of motion (fall-free-falling pieces, slide-material moves along the rock slope and flow–material mixed with water).

Types of Mass Wasting

Following are the types of mass wasting:

Rock falls

- Rock falls occur when pieces of rock break from a cliff. Frost wedging may also eventually loosen large blocks causing them to fall. Te accumulation of rock debris at the base of a steep slope is called talus.

Rockslides

- Rockslides usually follow a zone of weakness. Presence of water increases slippage. Collisions down the slope generally break the rock mass into rubble that eventually results in rockslides.

Landslides

- Landslides occur when a large piece of rock breaks off and slides down -hill. It is often initiated by earthquakes and very heavy rain.

Slump

- Great mass of bed rock moves downward by rotational slip from a high cliff is known as slump. Most common reason for slumping is erosion at the base of the slope which reduces the support for overlying sediments.

Debris Slide

- Debris slide is more extensive and occurs on a larger scale than slump but there is a little amount of water. The materials involved in debris slide are a mixture of soils and rock fragments.

Debris flows

- Debris flow is defined as mass wasting event in which turbulence occurs throughout the mass. Debris flow includes earth flows, mudflows, and debris

avalanches. Debris flow occurs when the rock or soil mass loses coherency when lots of water is involved. Debris becomes mixed up completely and flows as liquid mud. It often carries large boulders which can bevery destructive. When earth material moves down a hillside as a fluid-like mass, it is called an earth flow. These flows typically occur in humid areas on steep slopes with thick, clay-rich soil that becomes saturated with water during storms.

A mudflow

- Mudflow is a liquid mass of soil, rock debris and water that moves quickly down a well-defined channel. They occur most often in mountainous semiarid environments. A mudflow originating on a volcanic slope is called a lahar.

Debris avalanche

- The deadliest type of debris flow is the debris avalanche. It is a rapidly churning mass of rock debris, soil, water, and air that moves down steep slopes. The trapped air may increase the speed of an avalanche by acting as a cushion between the debris and the underlying surface

Creep

- Creep is a slow and gradual movement of soil downhill. Its velocity is typically less than a centimetre per year. Freezing and thawing contribute the soil creep by progressively moving soil particles down the hill. Creep is manifested at the surface by things like tilted utility poles, fences and trees Vegetation helps reduce the rate of soil creep.

Gradational Processes

- Gradation is the process by which the earth's surface gets levelled. It can be further divided into degradation, the process of eroding the earth's elevated surface and aggradations, the process of filling up the earth's depressions.

Gradational Agents

- The forces which act on the surface of the earth are termed as Gradational agents. Water, wave, wind, ice are the important gradational agents. Let us now discuss the gradational agents one by one.

The River

- The streams have a huge capacity to erode the rock over which they flow. In fact, the formation of the river channel is the result of the erosional capacity of the stream. The erosional capacity of the stream depends on its volume of water and

velocity of flow. The river performs three types of work. They are erosion, transportation and deposition.

1. **Erosion:** The breaking of rocks by the river in along its course is called erosion. Erosional work of a river is performed mechanically and chemically. River erosion is carried out in the following ways:

    i. **Hydraulic action:** It refers to the physical force of the moving water which breaks the rocks in its course.
    ii. **Corrasion (abrasion):** It refers to the breaking of rock in the bed and on the bank by fragments carried by the stream.
    iii. **Corrosion(solution):** It refers to the dissolving process of soluble minerals by the splashing of stream water.
    iv. **Attrition:** It refers to the eroded materials carried by the stream strike against each other.

2. **Transportation:** Stream carrying the fragmented materials broken by the stream is called transportation. After erosion, the eroded materials get transported alont with the running water. This transportation of eroded materials is carried in four ways:

    i. Traction: The heavier and larger rock fragments like gravels, pebbles etc are forced by the flow of the river to roll along its bed. These fragments can be seen rolling, slipping, bumping and being dragged. This process is called as traction and the load transported in this way are called traction load.

    ii. Saltation: Some of the fragments of the rocks move along the bed of a stream by bouncing continuously. This process is called as saltation.
    iii. Suspension: The holding up of small particles of sand, silt, and mud by the water as the stream flows is called suspension.

    iv. Solution: Some parts of the rock fragments dissolve in the river water and transported. This type of transportation is called solution transportation.

3. **Deposition:** When the velocity of the stream decreases, the stream deposits sand, silt and other fragments. It iscalled as the deposition. When a river moves in a gentle slope, its speed reduces and river begins to deposit its load. The river starts depositing larger materials first and smaller and finer materials are carried further down to the mouth of the river.

Stages of the River

- The course of a river includes the upper stage, the middle stage, and the final stage. Each stage of the river is dominated by a kind of work. Let's discuss the stages of a river, the main work and the landforms made in each stage.

1. The Upper Stage

- The upper stage of a river is also called the youthful stage or mountain stage. The velocity and speed of the stream are very high because the slope here is steep. The vertical erosion is the most dominant work here. The valley is formed here. The place where a river starts is called a **source**. In the mountain stage, the number of small streams originates from different locations. They are called **Tributaries**. The placewhere two rivers join is called as the confuence. The mountain which has two river systems draining on either side of the slope is termed as the water divide.

2. The Middle Stage

- Middle stage is the matured stage of a river. Vertical erosion or deepening of the valley is significantly reduced. Lateral erosion is the dominant work. Due to the lateral erosion of this stage, the widening of the valley occurs. The volume of the river water increases and the slope of river is moderate. The depth of the river is deep here.

3. The Lower Sage

- This is the final stage of a river where the valleys are extremely broad and it has generally gentle slope. The valley becomes almost fat which is called a pen plain. Most of the pen plain forms low residual hills with steep slopes which are called as Monadnocks. T e main work of the river in this stage is the deposition. The depth of the river is shallow here. When the main river splits into many small rivers, they are called as the distributaries. The place where the river ends is called mouth of the river. (for example: Sea coast, Lake.)

4. Landforms by the Erosional Work of River

- The significant landforms resulting from erosion by rivers include gorge, canyon, V-Shaped Valley, waterfall, pothole, structural bench, river terrace, river meander, ox-bow lake, peneplain, etc.

Gorges are formed due to active down cutting of the valleys. So, a Gorge is a narrow and deep river valley which has steep slopes.

Canyons are extended form of gorges. Canyons represent very deep, narrow but long valleys. The steepness of the valley sides depends on the nature of the rocks. The Grand Canyon of the Colorado River in the state of Arizona, USA having

a length of 482.8 kilometers and depth of 2088.3 meter is the largest canyon in the world. The Canyon of Gandikota is situated on the Pennar River in Andhra Pradesh is known as the Grand Canyon of India.

V-Shaped Valley The valleys made by the rivers are erosional landforms. The valley is formed in the youthful stage of the river erosion. Due to the steep slope and large volume of water, the river cuts its bed vertically forming narrow and deep river valley. This is called as V-shaped valley.

Rapids and waterfalls Rapids are stream sections with extremely strong currents, numerous obstacles, and steps in their streambeds. A waterfall is a vertical drop in a streambed. Both water fall and rapids are formed by vigorous erosion. Series of a waterfall in a river is called as Cascade.

Plunge poolA plunge pool is a deep depression in a stream bed at the base of a waterfall. It is created by the erosional forces of falling water at the base of a waterfall.

Angel Falls, in Venezuela, is Earth's highest waterfall (979 m). Hogenakal falls, Dharmapuri, Tamil Nadu some times is called as the Niagara of India.

Grooves

- Long and narrow depression at the base of a waterfall made by river runoff is called a groove. The grooves are created by water eroding soil from a hill or mountain in a short period of time.

- The swirling movement of the water falling into the plunge pool is called eddying.

Interlocking spurs

- An interlocking spur, also known as an overlapping spur, is a projectingridge that extends alternately from the opposite sides of a V-shaped valley. A river with a winding course flows down the interlocking spur.

Pot Holes

- The kettle-like small depressions in the rocky beds of the river valleys are called potholes. They are always cylindrical in shape. Potholes are generally formed in coarse-grained rocks such as sandstones and granites.

River Terraces

- The narrow step like flat surfaces on either side of the valley floor are called river terraces. They represent the level of former valley floors.

Landforms by the deposition of river

1. Alluvial fan

- Alluvial fans are often found at the foot of arid or semiarid mountain ranges where intermittent streams flow. An alluvial fan is a fan shaped deposit of gravel, sand and other smaller particles of sediment.Alluvial fans are found in Kosiriver, Himalayan region, Death Valley National Park and along the sides of the Colorado River at Grand Canyon National Park, U.S.

2. Penplains

- Pen plains represent low featureless plain having undulating surface and remnants of convex-concave residual hills.

3. Meander

- A meander is a winding curve or bend in a river. Meanders are the result of both erosional and depositional processes. They are typical landform of the middle and lower course of a river. This is formed by vertical erosion, lateral erosion, and deposition within the floodplain.

4. Oxbow lake

- Oxbow lake is a free standing body of water formed when the meander is cutoff from the main river. This landform is so named because it resembles horse shoe

5. Levees:

- Raised bed and a bank of the river due to frequent flooding and deposition of the sediments is called levees.

6. Flood Plain

- A flood plain is a flat area of land adjacent to a river. It stretches from the bank of its channel to the base of the enclosing valley walls which experiences flooding during the period of high discharge.

7. Estuary

- The word "estuary" is derived from the Latin word aestuarium meaning tidal inlet of the sea, which is derived from the term aestus, meaning tide. An estuary is a partially enclosed coastal body of brackish water with one or more rivers flowing into it, and with a free connection to the open sea.The inflow of both sea water and fresh water provide high levels of nutrients both in the water column and in sediment. Hence, it makes estuaries among the most productive natural habitats in the world. Narmada river estuary is located in Gujarat.

8.Delta

- Delta is found in the old stage of a river. It is the triangular shaped landform made up of alluvial deposition in the mouth of the river. It is named after the fourth Greek alphabet called delta. Example, The Ganges Brahmaputra delta is the largest delta in the world.Types of Delta: Delta is classified into the following based on the shape and kind of the load deposited by the river.

1. **Arcuate Delta:** A bowed or curved delta with the convex margin facing the body of water. It is also known as fan-shaped delta. Example, River Nile Delta in Egypt and Ganga Delta in India.

2. **Estuarine Delta** : it is formed at the mouth of submerged rivers depositing down the sides of the estuary. Example, Seine River of France.

3. **Birds foot Delta:** They are formed due to deposition of finer materials by river water. Deposited alluvial material divides the river into smaller distributaries. Such delta is also called as finger delta. Example, Mississippi river delta, the USA.

4. **Lacustrine Delta:** It is formed when a river flows into a lake. Example, Lough Leanne river delta, Ireland.

5. **Truncated Delta:** Sea waves and ocean currents modify and even destroy deltas deposited by the river through their erosional work. Thus, eroded and dissected deltas are called truncated deltas.

6. **Abandoned Delta:** when the river shifts its mouth, the delta already made is left abandoned. Such a delta is called abandoned delta. Example, Yellow river delta, China and the Western part of Ganga delta made by Hooglyriver, India.

7. Cuspate delta is a tooth shaped delta formed when a single distributaryflows through and deposits its load on its either side. Example, Tiber River of Italy

Glacier

- A glacier is a huge mass of ice that moves slowly along the mountain slope. The term "glacier" comes from the French word glace which means ice. Glaciers are often called "rivers of ice". It forms where the accumulation of snow exceeds its ablation over many years.

- The places where the snow lies for the whole year are called snowfields. The imaginary line above which there is a permanent snowfield is known as the snow line. The snowfields are always situated above the snow line. The snow line differs according to latitude, amount of snowfall, the direction of the wind and the physical features of the region. Snow starts melting below the snow line. Under the pressure of the upper layers, the lower layers of the snow field begin to melt causing the mass of snow to move down slope as glacier. Glacier moves at an average speed of 1meter per day. Over 96 percent of the glaciers occur in Antarctica and Greenland.

The worlds largest glacier is the Lambert Glacier in Antarctica, more than 96 km wideand 435 km long and 2,500 metres deep.

Types of Glaciers

The Glaciers are of three types. They are;

1. Continental Glaciers
2. Ice Caps
3. Mountain and Valley Glaciers

1. Continental Glaciers

- The continental glaciers are found in polar regions. In these areas, all the precipitation is in the form of snow. The snow that falls from year to year gradually gets accumulated. As a result, these regions are covered by an extensive ice mass. This is known as ice sheet or continental glacier. It is estimated that the maximum thickness of the ice sheets of Greenland is 3,400 meter, while the maximum thickness of the ice sheet of Antarctica is 4776 meter. Sometimes, the ends of the ice sheet projects outwards over the sea. The waves of the sea strike against them and break the ice sheets into blocks of floating ice known as Icebergs.

2. Ice Caps

- It is the covering of snow and ice on the oceans of poles. The ice caps can cover vast areas with the extensive accumulation of snow and ice. Example, Svartissen ice cap in Northern Norway.

3. Mountain and Valley Glaciers

- These are also known as Alpine glaciers. They flow like tongues of ice down through the mountain valleys from the ice caps. The piedmont glaciers form continuous ice sheets at the base of mountains. The valley glaciers or Alpine glaciers are found in higher regions of the Himalayas and on all such high mountain ranges of the world.

Characteristics of Glaciers

- A moving ice mass or glacier possesses certain characteristics of movement, speed, and surface structure. The rate of movement of the glacier is very slow.

- Terate of movement or the speed of a glacier depends upon the size of the glacierand the slope of the valley. Sometimes, the surface of the glacier forms cracks known as **Crevasses**. Crevasses are the deep fissure of variable width in the surface of a glacier. These crevasses are dangerous to the Mountaineers.

Action of glaciers

- The glacier performs three actions namely erosion, transportation and deposition.A glacier erodes its bedrock by the action of 1. Plucking and 2. Abrasion

1. **Plucking**

- The glacier plucks big pieces of rocks from the valley floor and creates large grooves or hollows. These pieces are dragged along the valley floor as the glacier moves. The boulders and rocky floor are grounded by mutual contact.

2. **Abrasion**

- Pure ice is capable of wearing down massive rocks when equipped with angular rock fragments. The glacier can groove, scratch, and chisel the rock surface. It has a powerful abrasive effect.As a result, a glacier during its lifetime creates various landforms which may be classified into erosional and depositional landforms.

Erosional landforms of Glaciers

- The landforms created by glaciers are mainly found in the mountainous regions.The chief erosional landforms by the glaciers are as follow:

1. **U-Shaped Valley**

- U-Shaped Valley is a typical glacial feature. Since glacial mass is heavy and slow moving, erosional activity is uniform in all directions. A steep-sided curved bottom valley has a U shaped profile.

2. **Hanging Valley**

- Hanging valley is formed when tributary glaciers are unable to cut as deeply as main ones and remain "hanging" at higher levels than the main valley as discordant tributaries. These tributary valleys appear hanging over the main valley and enter the main valley at some height.

3. **Cirque and Tarn**

- A Cirque or Corrie is an amphitheater-shaped hollow basin cut into a mountain ridge. It has a steep-sided slope on three sides, an open end on one side and a flat bottom. When the ice melts, the Cirque may develop into a Tarn Lake and the whole thing appears like a big armchair.

4. **Aretes**

- It is a steep-sided, sharp-tipped saw toothed ridges which have undergone glacial erosion from two sides. These comb like ridges are called as arete.

5. **Horn**

- If the summit of the Arete is roughly inclined, it gives rise to pyramidal peaks which are known as horns. Example, Matterhornof Alps-Switzerland.

6. **Roche Moutonnees or Sheep Rock**

- Roche Moutonnees or sheep rock is a glaciated bedrock surface, usually in the form of rounded knobs. The upstream side of a rochemoutonnee has been subjected to glacial scouring that has produced a gentle, polished, and striated slope and the downstream side has been subjected to glacial plucking that has resulted in a steep, irregular and jagged slope.

7. **Nunataks**

- A rock mass surrounded by ice is called Nunatak. It stands out as an island in the ice.

8. **Fjord**

- The fjord is formed as a steep-sided narrow entrance like feature at the coast of a glaciated region where the stream meets the coast. Fjords are common in Norway, Greenland and New Zealand.

Depositional landforms of glaciers

- When the glaciers melt or recede they deposit the rock material, brought by them, forming hillocks of various shapes

and sizes. The depositional landforms of the glaciers are;

1. **Moraines:** Moraines are the piles of dirt and rock that are deposited by a glacier as it moves across the landscape. These debris fields exist in places where glaciers have moved through in the past. There are many kinds of glacial moraines that form. Moraines are generally classified based on their location.

   a. Lateral Moraines

   Lateral moraines are ridges of debris that run parallel to the sides of a glacier. This is often accompanied by scraping of the valley sides which means the debris from the moraine creates high ridges above the glacier.

   b. Ground Moraines

   Ground moraines are glacial depositions formed on the floor of glacial valley. Ground moraines can be deposited in between lateral moraines in the case of many alpine glaciers.

   c. Medial Moraines

   Medial moraines are ridges of debris that are left down a valley floor at the middle of two glaciers. Both glaciers merge together and their debris combine to form a consistent moraine field along their borders. They are actually the merging of two lateral moraines which continue as medial moraines.

   d. Terminal or End Moraines

   Terminal or end moraines are left by the end of a glacier. The slower a glacier moves the bigger the moraine will be as the glacier has more time to accumulate outside debris.

   e. Recessional Moraines

   This recessional moraine runs across the landscape behind a terminal moraine. They are caused by times when the glacier slows or stops in its movement. It is formed because the receding glacier pauses in certain places for a long time before continuing its movement.

2. **Outwash Plain;**

When the glacier reaches its lowest point and melts, it leaves behind a layered deposition of rock debris, clay, sand, gravel, etc. This layered surface is called as an Outwash Plain.

3. **Esker :**

It is a winding ridge of depositions of rock, gravel, clay, etc, running along a glacier in an outwash plain. The Eskers resemble the feature of an embankment and are often used for laying roads.

4. **Drumlins:**

It is an inverted boat-shaped deposition in an outwash plain caused by deposition.

5. **Kames:**

Kamesare the number of ridges formed along the ice front.

Ground water (Karst Topography)

- The word "karst" literally means "rocky mountain" comes from a region in former Yugoslavia that includes Croatia and Slovenia. The word is derived from the Slavic word Kras.

What does Groundwater do?

- Any limestone, dolomite or gypsum region showing typical landforms produced by the action of groundwater through the process of solution and deposition is called as Karst Topography (Karst region in the Balkans).

Erosional Landforms due to Groundwater

- Following are the erosional landforms formed due to the action of groundwater

1. **Sinkholes**

A sinkhole is an opening more or less circular at the top and funnel-shaped towards the bottom. When as sinkhole is formed solely through the process of solution, it is called as a solution sink.

2. **Doline**

A doline is a closed depression draining underground in karst areas. It can be cylindrical, conical, bowl or dish shaped. The diameter ranges from a

few meters to many hundreds of meters. The name doline comes from doline, the Slovenian word meaning valley.

3. **Lappies**

Lappies are the irregular grooves and ridges formed when most of the surfaces of limestone are removed by solution process.

4. **Uvala**

Series of smaller sinkholes coalesce into a compound sinkhole is called uvala.

5. **Polje**

Polje is an elongated basin having a fat floor and steep walls. It is formed by the coalescence of several sinkholes. The basins often cover 250 square km and may expose "disappearing streams." Most of these basins have steep enclosing walls that range from 50 to 100 meter in height, giving rise to the name "blind valley."

6. **Caves**

Caves normally have an opening through which cave streams are discharged. Caveshaving an opening at both the ends are called tunnels.

Depositional Landforms due to Ground water

The following depositional features are formed within caves.

1. **Curtains**

Rain water drips from long crack in a cave roof forms a continuous strip of calcites. It is called as curtains.

2. **Stalactite**

Drops of water containing dissolved limestone seep down through cracks in the cave roof. Drops of water lose carbon dioxide and deposit calcite. Overtime deposition of calcite forms pillars hanging down from the roof of the cave. It is called as stalactite and where the stalactite stretches towards the sides are known as Helactites.

3. **Stalagmite**

Deposition of calcite forming icicles growing upward from the cave floor is called as stalagmite.Stalactites are calcium carbonate deposits hanging as icicles while Stalagmites are calcium carbonate deposits which rise up from the floor.

4. **Pillar**

When both the stalagmite and stalactite join together, it is known as pillar.

Wind

- The wind is the main geomorphic agent in the arid region. Wind in arid region has greater speed which causes erosional and depositional activities in the desert. The landforms which are created by erosional and depositional activities of wind are called as Aeolian Landforms.

Action of the wind

The action of the wind is carried in the following ways;

1. **Deflation:** Removal of sand and dust particles by wind. It forms depression in the desert. When depression is filled with water, it is called as Oasis

2. **Abrasion:** Action of wind in which sand particles carried by the wind strike against the rock.

3. **Attrition:** Sand particles carried by the wind striking each other is known as attrition.

Erosional Landforms of Wind

1. **Deflation Hollows**

- When deflation causes a shallow depression by persistent movements of wind, they are called as deflation hollows.

2. **Mushroom Rock**

- A mushroom rock, also called rock pedestal, or a pedestal rock, is a naturally occurring rock whose shape, as its name implies, resembles a mushroom.

- In deserts, a greater amount of sand and rock particles are transported close to the ground by the winds which cause more erosion in the lower part of the rock than the top. These result in the formation of rock pillars shaped like a mushroom with narrow pillars with broad top surfaces.

3. **Yardang**

- Yardangs areextensively grooved, fluted, pitted and irregular rock ridges or reliefs of about 1 to 10 meters high running parallel to the prevailing winds. They are caused by differential erosion. When the sand-laden wind corrades zones of softer or weaker rock between harder vertical ridges from old lake sediment where soft, consolidated rock and bedrock surfaces are eroded into alternating ridges and furrows. Large-scale yardangs are found in Egypt (near KomOmbo, north of Lake Aswan).

Zeugen

- Zeugen is a landscape of alternate horizontal ridges and furrows made by the action of wind abrasion. It may be as high as 30 m height.

Depositional Landforms of Wind

1. **Sand dunes**

Dry hot deserts are good places for sand dune formation. According to the shape of a sand dune, there are varieties of sand dune forms like Barchans, Seif dune, etc. The barchan is one of the classic desert landforms. It is a crescent-shaped dune with the horns of the crescent stretching out in the leeward direction. Barchan dunes may reach more than 27 meter in height. Seif dunes are long ridges of sand. In general they are aligned in the direction of the prevailing wind. The slip face of seif dunes are probably formed by eddies. The depressions between seif dune ridges are swept clear of sand by the winds. The ridgesrun for long distances, sometimes several kilometres.

2. **Loess**

- In several large areas of the world, the surface is covered by deposits of wind transported silt that has settled out from dust storms over many thousands of years. These depositions are called as Loess.

3. **Pedi plains**

- When the high relief structures in deserts are reduced to low featureless plains by the activities of wind, they are called as Pediplains.

Waves (Coast)

Horizontal movement of sea water caused by the wind, rotation of the earth, etc., are called waves.

How do Waves Erode?

Waves carry out the erosive work in the following ways.

1. **Abrasion:** The waves striking against the coast witheroded materials iscalled abrasion. Abrasion is also called as the corrasion.

2. **Hydraulic action:** The waves force water and air into the cracks in the rock. The parcel of air can be compressed by the surging water and the waves retreat, air expands explosively, weakening the joints and cracks and causing the rock to break. This is called the Hydraulic action.

3. **Corrosion:** The action of dissolving soluble rocks by waves is termed as the corrosion or solution.

4. **Attrition:** Eroded materials like boulders and rocks knock together to wear out into smaller particles. This is called attrition.

Landforms by the Erosion of Waves

- Erosional landforms dominate rocky coasts but are also found in association with predominantly depositional landforms.

1. Sea cliff is steep rocky coast rising almost vertically above seawater is called sea cliff.

2. Wave Cut Platform: Rock cut flat surfaces in front of a cliff are called wave-cut platform. They are slightly concave upward. It is also formed when blowhole is collapsed.

3. A sea cave is a hollow excavated by waves in a zone of weakness on a cliff. The cave depth is greater than the entrance width.

4. Sea caves usually form at points of geological weakness, such as bedding planes, joints, and faults. A 90 meter long sea cave is found in the Loliem beach in Canacona in Goa. The world's most extensive cave is 1.5 km long Matainaka cave in New Zealand.

5. A blowhole may form in the roof of a sea cave by the hydraulic and pneumatic action of waves, with fountains of spray

6. emerging from the top. If blowholes become enlarged, they may collapse.

5. Arch is formed when the sea cave is cut right through by wave action. The arch is termed as sea tunnel if it is comparatively longer.

6. The stack is a steep and often vertical column of rock in the sea near a coast, formed by wave erosion.

7. It is formed when the natural arch is collapsed. It is also called chimney rock, needles, columns, pillars, skerries, etc,

7. Stump is the worn out stack. 4.10.3 Transportation Work of Waves

8. The eroded materials are transported by the waves in different ways. The materials involved in the transportation by sea waves include silt, sand, gravel, cobble, pebble and boulder.

Landforms by the deposition of waves

Depositional landforms developed by the sea waves include the beach, bar, lagoon, spit, tombolo, barrier island, etc. Let us see one by one in detail

1. Beach is an elongated stretch of sands, pebbles, gravels, etc deposited along the coast. It can be a sandy beach or pebble beach. Praia da Cassino beach in Brazil is the world's longest beach stretching for 200 km from the Rio Grande to the border with Uruguay. Marina beach, Chennai is the second longest beach in the world.
2. The Bar is a stretch of sand deposition off the shoreline. The larger form of a bar is called barrier.
3. The Lagoon is enclosed seawater between the bar and the coast. For example,Pulicatlake, located in the Tamil Nadu and Andhra Pradesh is a lagoon.
4. Spit is a long, narrow ridge of sand or pebble with one end connected to the coast and the other end running into the sea. For example, Rameshwaram, Tamil Nadu.
5. A Tombolo is a bar connecting an island with the coast.

Glossary

1. **Streambed:** A chanel in which a stream flow or formerly flowed
2. **Cataracts**: water fall with volume of water.
3. **The Ice Caps**:It is the covering of Snow and Ice on the oceans of poles.
4. **Offshore** is the zone shallow bottom of the continental shelf.
5. **Source of a river:** place where river starts.
6. **Water Divide:** relief having two river systems.
7. **Oasis:** depression in the desert filled with rain water.
8. **Desert:** waste land unfit for human use at the moment.
9. **Snow line**: an imaginary line below which snow starts melting.
10. **Delta**: A triangular shaped fertile land built by river at the mouth.

Unit V Hydrosphere

Introduction

"World cannot survive without water and morality cannot exist without rain"

- As thirukkural quotes, water is the most important resource in the world. Over 90% of the world's supply of fresh water is in Antarctica. You must know that 85% of the world population lives in the driest

half of the planet. Now we shall learn about the hydrosphere in detail.

70% of human brain is water.

- Water is the most common substance found on earth. It is an important constituent of all life forms on the earth. Hydrosphere is one among the four spheres of the earth. The hydrosphere includes the water on the surface of the earth, the water below the surface called ground water and the water in the atmosphere above earth's surface. Oceans, rivers, lakes and glaciers form part of surface water. There is substantialamount of water under the surface of the earth. The atmosphere has water in all the three forms. The total amount of water on the earth does not change over time. Water is constantly in motion within the spheres of the earth which is being transformed and reused all over the earth. The earth's hydrosphere, thus, acts as a closed system.

Distribution of Land and Water in the Earth

- Earth is covered by land and water. About 70.8% of its area (361millionsq km) is covered by water and 29.2% (148 million sq km) of its area by land. About 96.5% of water is salty found in seas and oceans. Fresh water occupies only 2.5%. Saline ground water and saline lakes together form 1%.

Fresh water

Fresh water is defined as water with a salinity of less than1% compared to that of the oceans (i.e. below 0.35%). Water with salinity between 0.35‰ and 1‰ is typically referred to as marginal water because it is marginal for many uses by humans and animals.

- Considering the distribution of fresh water 68.6% of it is locked in Glaciers and icecaps. About 30.1% is stored as ground water and the remaining 1.5% is available as surface water.

- Surface water includes ice and snow on the land and sea, water in the lakes, rivers, swamps and marshes, moisture in soil, atmosphere and biosphere. Rivers and lakes are the major sources of fresh water around the world, and are vital to the communities they serve.

- **Rivers:** Rivers generally have a source on a mountain either from a glacier, a spring or a lake. River Ganga has its source from Gangotri glacier in the Himalayas. River Cauvery has its source from a spring in Talacauvery located in Kodagu district of Karnataka. River Nile has its source near Lake Victoria in Uganda. The river flows through confined channel between two banks and ends up at the mouth which is either on a sea or lake. When rivers drain their water into a lake or an inland sea, it is said to be an inland drainage.

- The Nile River in Africa is the longest river in the world. The Nile River flows through Egypt, Uganda, Ethiopia, Kenya, Tanzania, Democratic Republic of the Congo, Rwanda, Burundi, Sudan and Eritrea drains and into the Mediterranean Sea forming a delta to the north of Cairo city.

- The river Amazon in South America, is the second longest river, and has the largest drainage basin of any river. The Amazon River flows through Peru, Colombia, and Brazil and drains into the Atlantic Ocean forming an estuarine delta.

- The Yangtze River, which flows in China, is the longest river in Asia, and the third longest river in the world. The longest river system in the United States, the Mississippi-Missouri system is considered the fourth longest river in the world.

263 rivers either cross or demarcate international political boundaries.

- The total volume of water in rivers in the world is estimated at 2,120 km3. Asiaexcluding Middle East, has the largest run off of 13,300 km3/year followed by North America with 12,000 km3 per year.

A nationwide water resources information system, "Generation of Database

and Implementation of Web Enabled Water Resources Information System (India-WRIS) in the country" contain all aspects of water resources and related data provide data and information in public domain through India-WRIS Web GIS portal.

Lakes:

- Lakes are larger bodies of water with outlet through a river or stream. Lake may have their origin through tectonic activity, volcanic activity, river, glacier and wave action or sometimes meteoric origin. Caspian Sea, Lake Baikal and Wular Lake have been formed by earth movements. Lake Baikal is the deepest freshwater lake in the world. Caspian Sea is the largest salt water lake in the world.

Tmcft, is the abbreviation for one thousand million cubic feet (1,000,000,000 = 1 billion), commonly used in India with reference to volume of water in a reservoir or river flow.

- Lagoon lakes are formed by wave deposition. Chilika Lake is the largest lagoon lake in India. Lonar Lake in Maharashtra is believed to be formed by depression created by meteor impact which hit during Pleistocene Epoch.

- Lake Toba on the island of Sumatra is the largest resurgent caldera on Earth.
- Sambhar Lake in Rajasthan is the largest salt water lake in India.
- Finland is known as land of thousand lakes.

Wetlands:

- Wetlands are areas of marsh, fen, peat land or water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. Marshes are shallow wetlandsaround lakes, streams, or the ocean where grasses and reeds are common, without trees. Rann of Kutch in India is a salt marsh. A swamp is a wetland with lush trees and vines found in a low-lying area beside slow-moving rivers. Pallikaranai wetland is a fresh water swamp adjacent to the Bay of Bengal situated in the southern part of Chennai.

Groundwater

- Groundwater is the most valuable resource for any country. The rain water that falls on the earth cither runs off as surface water or percolates into the ground to recharge the groundwater. The permeable rocks that can hold water and allow water to pass through them are called aquifers. The upper part of the saturated zone of the aquifer is called the water table. The level of water table fluctuates according to seasons (Figure 5.1).

Saltwater intrusion

If excessive water is taken from the aquifers along the coast, the sea water enters the coastal aquifer. This process is termed as saltwater intrusion.

Cryosphere

- Cryosphere includes the water in frozen state. Glaciers, ice sheets, ice caps, lake and river ice, permafrost, seasonal snow and ice crystals in the atmosphere together form cryosphere. Earth's climate is highly influenced by the extent of cryosphere as it controls the energy budget of the earth (Figure 5.2).

- Perennial ice cover is found in Greenland and Antarctica as ice sheets, as mountain glaciers and as permafrost in higher latitudes. Permafrost is the condition prevailing when water freezes above and below the ground, (including rock or soil) for more than two consecutive years. Most permafrost regions are located in high latitudes, but alpine permafrost may exist at high mountains in much lower latitudes.

Mount Kilimanjaro (5895m) in Tanzania, Africa, located closer to the equator has permafrost.

- Seasonal snow and ice crystals are confined to middle latitudes and high mountains in lower latitude. Sea ice is frozen ocean water. Its formation, growth and melting are all confined to the ocean. An ice shelf is a thick, floating slab of ice that forms where a glacier or ice flowsdown a coastline. The world's largest ice shelves are the Ross Ice Shelf and the Filchner-Ronne ice shelf in Antarctica. An iceberg is ice floating in open water that has broken off from glaciers or ice shelf.

Interaction of cryosphere with other spheres

- Cryosphere is a climate indicator. Cryosphere with its high albedo influences the energy balance of the whole planet. Changes in cryosphere will alter land cover, surface temperature, soil moisture, air temperature, radiation, air circulation, clouds, precipitation, sea level, sea surface temperature, salinity, ocean current, fauna, flora and microbes. There is a complex interaction and balance among the spheres of the earth which makes life to flourish in the earth. If there is a change in one sphere it affects the other spheres as well. Nature maintains this balance. Understanding this complex interactions and living in harmony with nature will help to mitigate the environmental problems faced by the earth.

Carbon is removed from the atmospheric cycle by cryosphere during the formationof ice and is released when the ice melts.

Oceans and Seas

- The water in the oceans and seas is termed as marine water. Continuous water body that surrounds the continents, created by earth's internal force is known as Ocean. The term ocean takes its origin from the Greek word 'Oceaonus' meaning enormous river encircling the earth. Thearea of the World Ocean is 361 million square kilometre. The earth has at present five major oceans: The Pacific Ocean, the Atlantic Ocean, the Indian Ocean, the Arctic Ocean, and the Southern ocean (Figure 5.3). All these oceans are interconnected to form one Global Ocean or World Ocean. This nature of water to level up quickly has made it as a reference point to measure the height of the land features and the depth of the sea features.

Mean Sea Level (MSL) is the average height of the surface of the sea for all stages of the tide. MSL is reference point to measure the height of land features and depth of the sea features.

- **Sea** is a body of saline water (generally a division of the world ocean) partly or fully enclosed by land. Marginal sea is a sea partially enclosed by islands, archipelagos, or peninsulas and extension of oceans towards land. They are generally shallow. Andaman Sea, Arabian Sea, Bay of Bengal, Java Sea, Persian Gulf and Red Sea are marginal seas of the Indian Ocean.

- **Bay** is a water body surrounded on three sides by land and the fourth side (mouth) wide open towards an ocean. Gulf is a large body of water, **with** a narrow mouth, that is almost completely surrounded by land. The world's largest gulf is the Gulf of Mexico. Sound, creek, bight and cove are bays which vary in size and depth.

- Strait is a narrow channel of water, connecting two larger bodies of water. Palk Strait connects Gulf of Mannar and Bay of Bengal. Isthmus is a narrowstrip of land connecting two larger land masses. Isthmus of Suez connects Africa and Asia.

- Enclosed **seas** are seas that reach very deep into the continent stay connected with one or the other ocean of the world through straits. Mediterranean Sea is the best example for enclosed sea. Partly Enclosed Seas are those types of seas that are connected to the oceans by a very wide opening and have similar characters of the adjacent ocean. A series of islands may also occur between a partly enclosed sea and the ocean to which it is connected. Caribbean Sea is a perfect example.

- **Landlocked Seas** are completely surrounded by landmass on all sides without any natural outlet. They are actually hyper saline lakes. Dead Sea and Caspian Sea are good examples of landlocked seas. Jordon River and Volga River flow into Dead Sea and Caspian Sea respectively.Fjord is a long indented bay with steep slope that has been created by the

submergence of U shaped glacial valley. Example: sogne Fjord in Nor way (203 km).

- **Ria** is an indented bay with gradual slope formed by the submergence of V shaped river valley. George River in Sydney is the best example for Ria.

Oceans of the world

1. The Pacific Ocean

- Pacific Ocean is the largest ocean in the world. It is bigger than all continents put together. Portuguese explorer Ferdinand Magellan in 1521 named the ocean Pacific Ocean meaning 'peaceful' because he felt the ocean to be calm after sailing from the Atlantic Ocean through the stormy and dangerous Strait of Magellan. Average depth of this ocean is 4,280 meters.

There is life cycle for oceans too! It is known as Wilson cycle.

2. The Atlantic Ocean

- Atlantic Ocean is the second largest ocean of the world. The Atlantic Ocean's name refers to Atlas of Greek mythology. The North Atlantic Ocean was formed by the break-up of the supercontinent Pangaea and the south Atlantic was formed when the Gondwanaland broke in thegeological past.

The Suez Canal, an artificial sea-level waterway in Egypt, connecting the Mediterranean Sea to the Red Sea through the Isthmus of Suez was officially opened on November 17, 1869.

3. The Indian Ocean

- The Indian Ocean is the third-largest in the world. It is named after India. Its calm open water has encouraged the sea trade earlier than the Atlantic or the Pacific Ocean.

4. The Southern Ocean

- The Southern Ocean is the worlds fourth largest ocean. The Southern Ocean is the youngest ocean and was formed 30 million years ago when South America moved away from Antarctica, opening the Drake Passage (Figure 5.4). This ocean has the boundary where cold, northward flowing water from the Antarctic mixes with warmer sub Antarctic water. During summer in southern hemisphere over half of the Southern Ocean is covered with ice and icebergs.

5. The Arctic ocean

- The Arctic Ocean is shallower and smaller than the other four oceans. Itis completely surrounded by Eurasia and North America. It is covered by ice completely in winter. The Arctic Oceans surface temperature and salinity vary seasonally as the ice cover melts and freezes alternatively. Its salinity is the lowest on an average of the five major oceans. Bering Strait connects the Arctic Ocean with the Pacific Ocean while the Greenland Sea and the Labrador Sea connects it with the Atlantic. The deepest point is Litke Deep in the Eurasian Basin, at 5,450 m.

The International Hydrographic Organization (IHO) is the intergovernmental organisation that surveys and produces charts for the world's seas, oceans and navigable waters.

Maritime zones

- The low-tide line forms the base line for marking maritime zones. Water landward of the baseline in defined as internal waters over which the state has complete sovereignty. A country's territorial sea extends up to 12 nautical miles(22.2 km) from its baseline (Figure 5.5). The contiguous zone is a zone of water extending from the outer edge of the territorial sea up to 24 nautical miles (44.4 km) from the baseline.

- An Exclusive Economic Zone (EEZ) extends from the base line to a maximumA nautical mile is based on the circumference of the earth, and is equal to one minute of latitude which is equivalent to one sixtieth of a degree of latitude. A nautical mile is a unit of measurement defined as 1,852 metres. Nautical miles are used in Navigational charts.

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Relief of ocean

- The bottom of the ocean has a variety of landforms just as it is seen on the earth's surface. There are large mountain ridges, deep depressions, flat plains, basins and volcanoes. The configuration of an ocean floor is shown with the help of aIndian National Centre for Ocean Information Services (INCOIS) with its Marine Satellite Information Services uses the remotely sensed sea surface temperature (SST) to identify the locations of fish aggregation. The details of the Potential Fishing Zones (PFZ) are then disseminated to the fishermen once in every three

days along the Indian Coast by displaying the details in the Lighthouse in their respective regional language (Figure 5.6).

Indian National Centre for Ocean Information Services (INCOIS) with its Marine Satellite Information Services uses the remotely sensed sea surface temperature (SST) to identify the locations of fist aggregation. The details of the Potential Fishing Zones (PEZ) are then disseminated to the fishermen once in every three days along the Indian Coast by displaying their respective regional language

'Hypsometric curve' or 'Hypsographic curve'. It is a graph denoting the proportion of a landmass standing above or below the sea level (Figure 5.7).

Continental shelf

- Continental shelf is the seaward extension of land that lies under the sea water. It occupies 7% of the sea floor. The continental shelf slopes gently away from the land and is covered with shallow seas with an average depth of 200fathoms. The width of the continental shelf varies according to the nature of the rock beneath the crust. If the crust is dynamic then the shelf would be narrow and vice versa. Continental shelves are formed due to either any one or combination of the factors like fluvial deposits, marine erosion, tectonic forces, and the fluctuations in sea level in the past. Continental shelves are well known for oil, natural gas, mineral deposits and coral reefs. World famous fishing grounds like Grand Bank are situated here. The world's widest continental shelf (1210 km long) is located along the coast of Siberia, in Russia.

- Continental shelf on the east coast of India is formed by deltas of the Ganga, the Godavari, the Krishna and the Cauvery. On the West coast of India the continental shelves are formed due to faulting and consequent submergence.

Continental Slope

- The zone of steep slope extending from the continental shelf to the deep sea plain or abyssal plain is called continental slope. The slope angle varies from 5° to 60°. It occupies 9% of sea floor. This is the region in oceans where landslides, turbid currents, large sediment slumps, under water canyons, gorges cut by the currents and rivers occur. The deposit from the continental shelves immediately falls down here. The origin of continental slope is believed to be due to erosional, tectonic and aggradational processes.

Continental rise

- The area between the continental slope and the sea floor is known as the continental rise. This part is noted for the accumulation of sediments similar to the alluvial fans near the foot hills in the land. It represents the boundary between continents and abyssal plain. It constitutes about 5% of the oceanic area.

Abyssal plain

- The Abyssal plain is the vast area of flat terrain in the bottom of the oceans. It isthe largest part of ocean relief covering more than 50% of the total area. There is an accumulation of very fine sediments on the floor. The sediments are combinations of fine particles of clay and microorganisms. As in the case of sedimentary rocks of earth's surface these sediments are in layers and are used to trace geological events in the past.

Mid oceanic ridges

- The mid-ocean ridges are submarine mountains. They are continuous and are connected to form a single global mid-oceanic ridge system. They are formed by the tectonic forces acting from within the earth. Mid oceanic ridges are located on the divergent plate boundaries where magma flows through the fissure to form new oceanic crust. They form the longest mountain range in the world extending for more than 56,000 km long and has a maximum width of 800–1,500 km.

Ocean trench

- The long, narrow, steep-sided depressions formed by tectonic forces beneath the abyssal plain are called Ocean trenches. Oceanic trenches actually extend 3 to 4 km below the level of the abyssal plain. There are 26 oceanic trenches in the world: 22 in the Pacific Ocean, 3 in the Atlantic Ocean and only one in the Indian Ocean. The Challenger Deep in the Mariana Trench, (10,994 m) in the Pacific Ocean is the deepest part of the earth. A trench forms along the convergent boundary where one plate subducts below the other (Figure 5.9).

Island

- An island is a landmass surrounded by water on all sides. Islands may be formed on the continental shelf or as oceanic islands. Most of the oceanic islands are volcanic in origin. Groupof islandsOcean deepis grouped into two categories based on their size.

- Very deep but less extensive depression are called deeps. Long narrow linear and more extensive depressions are called 'trenches'.formed by subduction of ocean plate are known as archipelago. Islands of Japan form an archipelago.

- Marine organisms, the coral polyps colonize the tropical warm water and form islands known as coral islands. Lakshadweep Island in Indian Territory is made of corals. Andaman Nicobar islands are of volcanic origin.

Guyots

- Flat topped volcanic hills submerged under the sea water are called guyots. It is a part of an underwater chain of volcanic mountains produced by slow plate movement.

Seamounts

- Seamounts are conical, volcanic hills submerged under ocean water. It does not reach to the water's surface. It is an isolated rise with an elevation of thousand metres or more from the surrounding sea floor and with a limited summit area. It occupies 4.39 percent of ocean region. Seamounts and guyots are most abundant in the North Pacific Ocean.

Bottom relief of Pacific Ocean

- Continental shelf of the Eastern Pacific Ocean is very narrow due to the presence of trenches while those on the western coast are wide. Continental shelf adjoining coasts of Australia and Indonesia varies in width from 160 to 1,600 km. In the Pacific Ocean, the abyssal plains are very vast. Absence of mid oceanic ridges is the main reason for deep sea plains. Prominent submarine ridges of the Pacific Ocean are Albatross plateau, Cocas ridge and Aleutian ridge. Tasmania basin (New Zealand) and east pacific basin are major basins of Pacific Ocean. Pacific Ocean has about 25,000 islands. There are number of archipelagos both in north and south Pacific Ocean. The Hawaii islands were formed by hotspot. The challenger deep in Mariana trench is the deepest part of Pacific Ocean (10994m).

Bottom relief of Atlantic Ocean

- In the North Atlantic Ocean, extensive continental shelves are found around the
- shores of Newfoundland (Grand bank) and British islands (Dogger Bank). In the South Atlantic Ocean, a very extensive continental shelf is found between Bahia Blanca and Antarctica (Figure 5.10).

- The most striking relief feature which is the 'S' shaped Mid–Atlantic ridge which extends for 16,000 km from Iceland in the north to Bouvet Island in the south. The ridge separates the Eurasian Plate and North American Plate in the North Atlantic, and the African Plate from the South American Plate in the South Atlantic. Iceland and Faroe are the few peaks of the Mid-Atlantic ridge.

- The mid-Atlantic ridge divides the Atlantic Ocean into two major basins, i.e., East and West Atlantic basins. Other basins are Spanish basin, north and south Canary basin, Guinea basin, Brazilian basin and Labrador basin. Puerto Rico Deep (8,380 m) is the deepest of all deeps in the Atlantic Ocean. Other deeps are Romanche Deep and South Sandwich Trench.

- The West Indies is an island archipelago near the main land of North America. British Isles and Newfoundland are famous islands, formed on the continental shelf in the North Atlantic Ocean. Sandwich island, Georgia Island, Falkland and Shetland islands are islands in the South Atlantic Ocean.

Bottom Relief of the Indian Ocean

- The Indian Ocean has continental shelf of varying width. Continental shelf along the coast of Arabian Sea, the Bay of Bengal and Andaman varies in width from 192km to 280km. A variety of coral reefs thrive in the warm tropical water of the Indian Ocean.

- Indian Ocean has a continuous central ridge called the Arabic Indian ridge. Other important ridges include the East Indian ridge, West Australian ridge, SouthMadagascar ridge. Basins of Indian Ocean include Comoro basin, North Australian basin, South Indian basin and the Arab basin (Figure 5.11).

- The average depth of the Indian Ocean is 3890m. Sunda deep near Java is the deepest part of this ocean (7450m). Madagascar and SriLanka are the most prominent islands present in Indian Ocean. Andaman and Nicobar islands in the Bay of Bengal are the raised part of mountains that are the extension of ArakanYoma which forms a part of Himalayas. Reunion Island is located on a Hot spot.

Ocean Temperature

- The measurement of degree of hotness or coldness of ocean water is referred to asocean temperature. Temperature isnormally measured in the unit of degree Celsius by thermometers. The major source of heat energy for ocean water is the radiation from sun. The heating and cooling capacity of water differs significantly from that of land.

Factors affecting horizontal distribution of ocean temperature

The factors affecting distribution of ocean temperature are latitude, prevailing winds, ocean currents and local weather.

1. Latitude: The temperature of surface water decreases from equator towards the poles because of the slanting rays of the Sun pole ward.
2. Prevailing wind: Direction of the wind affects the distribution of temperature of ocean water. The off shore winds blowing from the land towards ocean or sea raise the temperature of ocean water. Winds blowing from snow covered regions in winter lower the surface temperature. In trade wind belt, the off shore winds initiate upwelling of cooler water from beneath and on shore winds pile up warm water to increase the temperature to certain extent.

3. Ocean currents: Warm currents raise the temperature of the oceans where they flow whereas cold currents lower down the temperature. Gulf Stream (warm current) increases the temperature of the eastern part of North America and the west coast ofEurope. Labrador cold current reduces the temperature near north eastern coast of North America.
4. Apart from these, some minor factors like submarine ridges, local weather conditions like storms, cyclones, hurricanes, fog, cloudiness, evaporation and condensation also affect the surface temperature of ocean water.

- These images show the sea surface temperature in Celsius. The Figure 5.12 shows the sea surface temperature in July and the Figure 5.13 in January. Cold temperatures are shown in purple, moderate temperatures in aquatic green and warm temperatures in yellow to red. Landmass is shown by black colour. The diurnal range and annual range oftemperature of ocean is much less than that of the land. The temperature of the sea surface is highest (27°C to 30°C) not near Equator but few degrees north of the Equator. The lowest temperature recorded is -1.9°C near the poles. The maximum and minimum annual temperatures of ocean water are recorded in August and February in the Northern hemisphere and reverse in case of the southern hemisphere.

Vertical distribution of temperature in oceans

- The uppermost layer of ocean water is warm and well mixed surface layer with average temperature between 20° and 25°C. The depth of this layer varies according to seasons. On an average this layer extends up to 200 m in tropical region. Beneath this layerlies the thermocline layer. This layer varies in depth between 200 metre to 1000 metre. This layer is unique that the temperature decreases rapidly with increasing depth. Below the thermocline temperature decrease is gradual up to 4000m. Beneath this depth the temperature of ocean water is constant at 4°C (Figure 5.14).

Salinity of the ocean

- Salinity is defined as the ratio between the weights of dissolved salts (in grams) per 1000 grams of water. It is expressed as part per thousand (‰) and has no units. Example: 30‰ means 30 grams in 1,000 grams of sea water. The average ocean salinity is 35%

- Sources of salt in the ocean: Sea water is a weak but complex solution made up of many things including mineral salts and decayed biological marine organisms. Most of the ocean salts are derived from

weathering and erosion of the earth's crust by the rivers. Some of the ocean salts have been dissolved from rocks and sediments below the sea floor, while others have escaped from the earth's crust through volcanic vents as solid and gaseous materials.

In partially enclosed seas, their bottom relief and the submarine ridges with shallow water do not allow free mixing of open sea water. The temperature at the depth of 1800m in the Red Sea is higher than the temperature recorded at the same depth in the Indian Ocean.

Depth of water is measured in the unit 'Fathom'. One fathom is equal to 1.8 metre (six feet)

Factors affecting the salinity of ocean water

The salinity of ocean water depends upon

a. The rate of evaporation
b. Amount of precipitation,
c. Addition of fresh water flow from rivers
d. Ice in Polar Regions
e. Upwelling of deep water initiated by prevailing winds and
f. Mixing of water by ocean currents.

Distribution of salinity

- On an average the salinity decreases from equator towards the poles. The highest salinity is observed between 20° and 40° north latitudes because this zone is characterized by high temperature, high evaporation but less rain than the equatorial region.

- The marginal areas of the oceans bordering the continents have lower salinity than their interior due to addition of fresh water to the marginal areas through the rivers (Figure 5.15).

- Very high salinity is recorded in Lake Von, Turkey (330%) Dead Sea (238%) and Great Salt Lake, Utah, USA (220%).

Raking refers to the use of a rake, a traditional wooden tool with the long handle and long pointed wooden toothed spade at the bottom for collecting salt.

Isohaline is an imaginary line drawn to join places having equal salinity.
Salinity of Dead Sea is 8.6 times saltier than other oceans. The shore of Dead Sea is 423m below sea level. It has the lowest elevation on land. The sea is 377m deep. The high salt content will make people float on the sea. The high salt content has made the Dead Sea devoid of life in it

Ocean movements

- Water in the ocean is never in a state of rest. Ocean water is always in motion. It moves horizontally as well as vertically. The movement of ocean water takes place in three different ways as waves, tides and ocean currents.

Waves

- The waves are oscillating movements in the ocean water which transfer energy from place to place. They are caused by friction of wind on the surface of water or any other disturbances' on the sea bottom.

Parts of Waves

1. **Crest:** The upper or highest part of a wave is called the crest
.
2. **Trough:** The lowest part of a wave is called the trough.
3. **Wave height**: The vertical distance between the crest and the trough is known as wave height.
4. **Wave length**: The horizontal distance between two crests or two troughs is known as wave length.
5. **Wave amplitude**: Wave amplitude is one-half of the wave height.
6. **Fetch:** The distance of open water across which the wind can blow without interruption is called fetch.
7. **Frequency:** The number of wavelengths that pass a fixed point per unit of time is frequency. Example, 100 waves per sec per cm.
8. **Period:** The time taken by one wavelength to pass a fixed point is known as period.
9. **Velocity**: Refers to speed and direction.
10. **Steepness:** Steepness of the wave is equal to the height divided by length.(H/L)

Tides

- The rhythmic rise and fall of the sea water due to gravitational pull of the moon and the sun is called a Tide. Isaac Newton (1642– 1727) was the first person to explain tides scientifically. The rise of seawater towards the land is known as High tide or flow tide. The fall of seawater more towards sea is known as 'Low tide water' or ebb tide. On any day there will be two high tides and two low tides. The highest high tide occurs on full moon day and new moon day. It is known as spring tide (Figure 5.17). Spring tide happens when the sun, earth and moon aligned in straight line. The lowest low tide is known as neap tide. It happens when the sun, earth and moon are positioned at right angles.

- The movement of ocean water as a result of tidal action is known as a tidal current. In places of narrow coastal inlet these tidal currents flow rapidly through the mouth with greater height and velocity. For example in the Bay of Fundy, between Nova Scotia and New Brunswick of Canada, the difference between high and low tides is as high as 14m. Ports which utilize the tidal current for entry and exit of ships from

the harbour are known as tidal ports. In India Kolkatta and Kandla are examples of tidal harbours.

- The Gulf of Cambay and the Gulf of Kutch in Gujarat on the west coast have the maximum tidal range of 11m and 8m with average tidal range of 6.77m and 5.23m respectively. Tides help to clear the sediments deposited by rivers on their bed and thus prevent siltation of harbours. The energy of the tides is used to generate electricity. Tidal power stations have been set up in UK, Canada, France and Japan. In India Gulf of Khambhat, Gulf of Kutch and Sundarbans have scope for tidal energy production.

A harbour is a sheltered water body where ships are anchored. A port is the area at the edge of a water body where boats and ships are docked, where transfer of goods and passengers take place and where trading is facilitated.

Ocean currents

- Large mass of moving water from one part of the ocean to another in a definite direction is called as ocean current. The movement is produced due to earth's rotation, temperature difference of ocean water, salinity, density and some extentdue to air pressure and winds. Ocean currents can be classified on the basis of mode of origin, volume and velocity and boundaries.

- In the order of velocity ocean currents can be classified as drifts, currents and streams. Drifts are movement of surface water of low velocity influenced by prevailing winds, currents are movement of oceanic water in definite direction and greater velocity and streams are larger mass of water moving in a definite direction and much greater velocity than the drifts and currents. Ocean currents are distinguished by the temperature they possess. When ocean currents originate f rom equator it is ter med as warm current. Likewise when a current starts from polar region it is termed as cold current.

- Vertical circulation of ocean water takes place due to difference in salinity and temperature between the surface and the water deep below. Upwelling is an oceanographic phenomenon that involves movement of dense, cooler, and usually nutrient-rich water towards the ocean surface, replacing the warmer, usually nutrient-depleted surface water. Down welling is the process of accumulation and sinking of cold high saline water beneath warmer or fresher water.

Major ocean currents of the world

- In every ocean, there is circulation of ocean water from Equator to pole and from pole to equator. The warm currents from the equator flows over the surface of ocean towards the pole and sink to the bottom of the ocean floor in the higher latitudes due to high density and flow towards the equator to complete the circulation. This large scale circulation is known as gyre.

- The gyre circulates is clockwise in the northern hemisphere and anti-clockwise in the southern hemisphere.

a. Ocean currents of the Pacific Ocean

1. North Equatorial current.

North equatorial current originates from Revilla Gigedo island west of Mexico and flows towards the Philippines Island covering a distance of about 12,000 km from east west. It is a warm current. It derives from its water from the Californian current and the South east Monsoon drift which flows north along the Mexican coast. The volume of water increases from east to west as many small currents join it from right. It gets divided into two and the northern branch joins the Kuroshio Current and the southern branch abruptly turns and forms the Pacific counter current.

2. South equatorial current.

South equatorial current is originated due the action of the trade winds from east to west. It is a warm current. It extends for about 13,600km from east to west. It is stronger than the North equatorial current. It is further divided into many branches due to the presence of many islands and uneven surface topography.

3. Kuroshio current (Black Tide)

It is a warm ocean current flowing in north easterly direction up to 30o N latitude and it carries warm water off the Formosa coast. It flows towards north and meets Oyashiocold current off the Kuril Islands. It is also called as Japan current.

4. Oyashio Current(Parental Tide)

It originates from the Bering Strait and flows towards south carrying cold water. It is a cold current. It meets with Kuroshio warm current and Aleutian current.

5. Californian Current.

Californian current is flowing towards south along the west coast of U.S.A between 48o N and 23o N latitudes. It is cold current which exhibits great amount of up welled water. When it enters the region of Trade winds, it is deflected to the right and joins the equatorial current.

6. Peru Current.

Peru Current is perhaps the best studied ocean current of the Pacific Ocean. Alexander Von Humboldt in 1802 noted the details of the Peru Current. Hence, it is also known as Humboldt Current. It is a cold current. It is flowing towards north along the west coast of South America carrying cold water from northerly deflection of the Sub-Antarctica water moving in 40° S.

7. El Nino or Counter current.

It is a warm counter ocean current of the pacific equatorial waters flowing south ward at 400 m depth to a distance about 180 km.

8. West Wind Drift.

It is an easterly moving drift in the Pacific Ocean extending from Tasmania to the South American coast. It is a cold current. The speed of the drift is greater underthe influence of Roaring Forties. It splits into two branches and one moves south around the Cape Horn into the Atlantic Ocean and the Other one moves northward along the Peruvian coast due to deflection and joins the Peru Current.

b. Currents of the Atlantic Ocean

1. North equatorial current.

North equatorial current is flowing from east to west. It is a warm current. It is situated between 5o – 20o N latitudes. After leaving the west coast of Africa, it attains its main characteristics. When it reaches the east coast of South America, it splits into two branches and one branch called Antilles current is moving along the coast of West Indies and other branch is diverted into the Caribbean sea.

2. South Equatorial current.

It is flowing south of equator within 0o – 12o S latitude in between the coast of Africa and South America. It is a warm current. It is a northern

continuation of Benguela current. It is stronger than the North equatorial ocean current. It is caused by the action of Trade winds.

3. Gulf Stream.

Gulf Stream starts from the Gulf of Mexico and carries warm waters into the colder latitudes. It is a warm current. It bends with the coastline up to 40th parallel after which the direction is almost to the east, due to the force and the direction of the westerlies and the deflective forceof the earth. It joins the labrador cold current near New Found land, Canada after passing through the strait of Florida. The Gulf Stream was discovered by Ponce de Leon in 1513.

4. Canaries Current.

The ocean current flowing along the Western coast of North Africa between Maderia and Cape verde is known as the Canaries Current. It is a cold current. It is flowing towards south and merging with the North equatorial current.

5. Labrador Current.

In the north Atlantic, a cold current flows from the Baffin Bay and Davis Strait towards south. It brings cold waters from polar zone and moves along the coast of green land.

6. Benguela current.

It is a cold current flowing northward along the western coast of Africa is known as the Benguela current. It carries cold waters from sub-Antarctica surface water and mixes with south equatorial current.

The Sargasso Sea - Sea with landless border

The Sargasso Sea occupies about two thirds of the North Atlantic Ocean, stretching seven hundred miles wide and two thousand miles long. The only "sea" with absolutely no land around it, the Sargasso Sea got its name from common brown seaweed called Sargassum that floats in vast mats in its waters. The Sargasso Sea is surrounded only by ocean currents. It lies within the Northern Atlantic Subtropical Gyre. The Gulf Stream establishes the Sargasso Sea's western boundary, while the Sea is further defined to the north by the North Atlantic Current, to the east by the Canary Current, and to the south by the North Atlantic Equatorial Current. Since this area is defined by boundary currents, its borders are dynamic

c. Currents of the Indian Ocean

- The south Indian gyre is formed by south equatorial current, Madagascar current west wind drift and west Australian current. To the north of equator the currents in the Arabian Sea and Bay of Bengal flow in the clockwisedirection as southwest monsoon drift and in the anti-clockwise direction as northeast monsoon drift due to the influence of monsoon winds.

- The Antarctic circumpolar current flows between 40 to 60° S latitude. It flows from west to east influenced by the westerly and circles around entire Antarctica. There is a counter west ward current within this circum polar current.

d. Currents of the Southern ocean

- The southern ocean surrounds the continent of Antarctica. The large oceans, the pacific, the Atlantic and the Indian Ocean merge into this circum-global zone of water to their south. The movement of water in the southern ocean is in one sense a relatively simple, generally west-east circum-polar drift caused under the influence of northwesterly winds. This general flow sends offshoots to the three major oceans to its north. The Peru or Humboldt Current in the Pacific Ocean, the Falkland Current and the Benguela Current in the Atlantic Ocean and the West Australian Current in the

- Indian Ocean receive a part of their cold waters from the Southern Ocean. Besides the surface currents, there is also a very complex system of subsurface currents between the southern Ocean and the oceans to its north.

- Generally the water moves from this ocean towards the equator on the surface and at great depths but at in remediate depth, thereis a movement of water from the equatorial areas towards the Southern Ocean.

The significance of Ocean Currents

1. Ocean currents play an important role in the earth's climate. They distribute energy and nutrients within the ocean.
2. Fog is formed where warm current and cold current meet. For example, when the Gulf Stream and Labrador Current meet near New Found land one of the densest fogs is formed.
3. The warm ocean current increases the temperature of an area where it flows to and Cold Ocean current decreases the temperature of the area.
4. The warm current brings heavy rainfall when the wind blows over it becomes warm while the cold current brings drought when the wind blows over it becomes cold and dry. For example, the wind blowing over the Peru Current is cold and dry causing the formation of the Atacama Desert located on the west coast of Peru.

5. It regulates the global temperature. It gives free navigation. The Gulf Stream keeps ports & harbours of Russia and Scandinavia navigable throughout the year. The Kuroshio Current makes ports on Japan navigable during winter.
6. It distributes minerals and pollution added to it becomes highly diluted and later negligible.
7. It helps in growth of juveniles of certain fish and its distribution to other countries - from its place of origin. Some up welling and down welling are due to currents which bring minerals to photic zone used by phytoplankton. Major fishing grounds are located in the zones where cold current and warm current meet.

Normal Situation	El Nino Situation
• Near equator the water of the Pacific Ocean is warmer in the western side and cooler in the eastern side due to upwelling of the cold current. • Air (Walker) circulation is dominant in the western Pacific Ocean. The air ascends in the western side and descends over the cooler eastern side • Heavy rain is experienced in the western warmer region and dry conditions prevail in the cooler region. • The Southeast Asia and Australia receive heavy rain on normal years. • West coast of South America experiences dry weather.	• Near equator the warm water in the Pacific Ocean extends from western side to eastern side suppressing the • upwelling of the cold water. • Air (Walker) circulation is dominant in the eastern part of Pacific Ocean. The air ascends in the warm eastern Pacific Ocean. • Heavy rain is experienced in the eastern warmer region and dry condition prevails in the western part. • Southeast Asia and Australia experience dry weather conditions. • West coast of South America receives heavy rainfall.

El Nino

- El Nino is a phenomenon that occurs in the equatorial Pacific Ocean characterized by a positive sea surface temperature departure from normal (1971-2000 base period) in the region lying within the latitude 5°N to 5°S and longitudes 120° W to 170°W . This phenomenon occurs every two to seven years (Figure 5.19).

El Nino happens when

- Sea surface temperature increases between the central and eastern equatorial Pacific Ocean between the country Ecuador and the International Date Line
- The increase in temperature is sustained for a period of eighteen months to Two years.
- The temperature increase is up to 30 m beneath the ocean surface.

- When there is a modified vertical air circulation above the Pacific Ocean

Global influence of El Nino

- El Nino effect is experienced at Global level. The change in air circulation affects the economy of different countries also. Global weather patterns are altered to such an extent that they affect eco system, agriculture, tropical cyclone, drought, forest fire, floods and flood related health hazards. El Nino influences the jet streams. Due to this phenomenon California experiences heavy rainfall, northern Europe experiences dry winter, Southern Europe experiences mild wet winters, there are less number of cyclones in Sea of Japan, and heavy rain in East Africa. South East Asia experiences severe drought and forest fire. Peru in South America receives heavy rainfall during El Nino.

- Increase of temperature in the east Pacific Ocean is correlated with normal monsoon conditions in India while the increase of temperature in the central Pacific has high correlation with drought conditions in India. When temperature increases further to the west it suppresses the Indian Monsoon.

La Nina

- La Nina is just the opposite to the condition of El Nino. When trade winds are strong, colder water up wells on the East Pacific Ocean, walker air circulation is confined to the west Pacific, wet condition in Southeast Asia and dry weather in South America is observed.

- The difference in the atmospheric pressure between the west and east tropical Southern Pacific Ocean is referred to as Southern Oscillation. Meteorologists have established a close inter link between Southern Oscillation and occurrences of El Nino and La Nina events. The acronym 'ENSO'(El Nino Southern Oscillation) is often used to study both the phenomena.

Peruvian fishermen named the weather phenomenon El Nino meaning 'little boy' or 'New born Christ' and La Nina meaning 'Little girl' as the phenomenon was first noticed during Christmas time.

Thermohaline circulation

- As the name indicates there is a large scale churning of ocean water due to difference in temperature and salinity. The down welling of ocean water occurs in the extreme ends of Atlantic Ocean one near the Norwegian coast and another at Weddell Sea. Upwelling of cold water occurs in the North Pacific Ocean and in the Indian Ocean. This cycle of water movement within the Global Ocean is also known as Conveyor Belt (Figure 5.20). The slow, steady and three dimensional flow of water in the conveyor belt distributes dissolved gases and solids, mixes nutrients and carries it to various ocean basins. This cycle provides a stabilizing

effect on climate of the earth. If it is disturbed, it is capable of causing sudden climatic change within the period of a few decades. The conveyor belt is a simplified version of actual circulation in the oceans.

Glossary

1. **Abyssal plains:** An extremely large, flat, under water plain on the deep ocean floor.
2. **Continental rise:** is area between the continental slope and the sea floor.
3. **Exclusive Economic Zone (EEZ):** extends from the base line to a maximum of 200 nautical miles (370.4 km).
4. **Isthmus:** A narrow steep of land that connects two large land masses and separates two bodies of water.
5. **Hot spot:** An area is the mantle from where rocks melt and magma rises through circular to form volcano.
6. **Permafrost:** is the condition prevailing when water freezes above and below the ground, (including rock or soil) for more than two consecutive years
7. **Trace elements**: A chemical element present in minute amount in a particular sample or environment.
8. **Isohaline:** is an imaginary line drawn to join places having equal salinity
9. **Swell:** is a type of wind-generated waves that is not affected by the local wind.
10. **Thermohaline circulation**: is large circulation of ocean water due to difference in temperature and salinity.

Unit 6
Atmosphere

Introduction

You must have heard people, in the countryside, saying

"When sheep collect and huddle,
Tomorrow will puddle!"
"If ants march in a straight line,
expect rain"

- Phrases like 'a cold morning', 'sunny day', 'cloudy day' and rainy day refer to the weather. Weather refers to the state of atmosphere at a particular place at any given time denoting the short term variations of atmosphere in terms of temperature, pressure, wind,moisture, cloudiness, precipitation and other elements. Weather is highly variable from time to time, day to day and place to place. Weather is not constant. It is always changing within hours or a day.

- On the other hand, climate is the average weather conditions of an area for a long period of time. The World Meteorological Organisation (WMO) has suggested data for a period of 30 consecutive years to be referred for calculating the climatic averages of various weather elements. Climate is constant. It is a permanent condition of a place.

- The ancient Greeks called the tilt of latitude as 'klima', literally meaning 'slope' or 'inclination'. Then the earth was divided into seven latitudinal regions, called 'klimata'. The word came into modern European languages as clime or 'climate', denoting the average weather condition.

Composition of the Atmosphere

- The atmosphere is essential for the survival of all the organisms on the earth. The atmosphere is a blanket of gases and suspended particles that entirely envelope the earth. It extends outward over thousands of kilometres from the earth's surface. Water vapour, aerosols and tiny solid particles occur in varying quantities as suspended material. Tese are responsible for weather phenomena as they have ability to absorb and release heat energy.

- The atmosphere is composed of mixture of many gases, water vapour and other solid particles. The major components are nitrogen (78%), oxygen (21%) and other gases (1%). Argon, Carbon dioxide, Neon and the other gases found in the atmosphere (Figure 6.1).

Layers of the Atmosphere

- The atmosphere is divided into five distinct layers (Figure.6.2) based on the temperature variations. They are,

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Ionosphere(Thermosphere) and
5. Exosphere

Troposphere

- The troposphere(Figure 6.2) is the lower most layer of the atmosphere. It extendsapproximately to a height of 8 km from the poles and 18 km from the equator. The height of the troposphere changes seasonally also. It increases during summer and decreases during winter.

- All weather phenomena occur in this layer as it has dust particles and water vapour. This layer has clouds which produce precipitation on the earth. The Sun's rays directly fall on the earth and then they are reflected back into the atmosphere. The temperature decreases in the troposphere with increase in altitude at the rate of 1 °C for 165 metre or 6.5 °C for every 1000 metres of ascent. This is known as lapse rate of temperature. This is the densest layer as it contains 70 to 80 percent of gases. The outer boundary of the troposphere is called tropopause, which is about 1.5 kilometre thick.

Stratosphere

- It is the second layer of the atmosphere found above the troposphere. It approximately extends up to a height of 50 km from the earth's surface. Temperature is constant up to a height of 20 km and increases gradually up to the stratopause where temperature is nearly -4°C. The lower part of this layer is highly concentrated with ozone gas which is called as 'ozonosphere'. It prevents the ultra-violet rays from the Sun to enter into the lower part of the atmosphere as the rays are highly harmful it causes skin cancer and other ill effects to living organisms. But the ozone layer safeguards the life on the earth.

Mesosphere

- The mesosphere is the third layer of the atmosphere found approximately up to a height of 85 km above the surface of the earth. It is the coldest layer of the atmosphere. The temperature decreases with increase of altitude due to the absence of ozone. Its upper boundary is called mesopause where temperature reaches — 90°C. Luminous noctilucent clouds form here due to the presence of cosmic dust. Meteors falling from the space get burned in this layer. It is because when meteors hit the air, the air gets compressed and heated up causing meteors to burn out.

Ionosphere (Thermosphere)

- The ionosphere is the fourth layer of the atmosphere extending approximately up to a height of 400 km. The temperature increases rapidly up to 1,000°C. It is due to the absorption of very short wave and high energy solar radiation by the atoms of hydrogen and oxygen gases. When light energy is transformed into heat energy some gas molecules lose or gain electrons and become the charged particles called ions. The charged particles forming the lower part of the thermosphere as a zone, is called Ionosphere (Figure 6.4). These ionised particles create auroras at higher latitudes. Ionosphere can reflect radio waves back to the earth. This facilitates long distance wireless satellite communication. The credit of discovering ionosphere goes to Kennelly and Heaviside.

Exosphere

- The upper most layer of the atmosphere which extends into the outer space from above 400 km up to 1600km. It has rarefied contents. It contains mainly oxygen and hydrogen atoms. These atoms can travel hundreds of kilometres without colliding with one another. Thus, the exosphere has no longer behaves like a gas. The temperature increases with increase of altitude and it ranges as high as 1650 °C. The gravitational pull is minimal in this layer. Tis layer gradually merges with the space.

Ozone and Ozone Depletion

- Ozone (O3) is form of oxygen that combines three atoms into each molecule. It absorbs and filters the harmful ultraviolet B radiation coming from the sun. This way the ozone layer protects all life on earth. However, ozone is harmful when it develops near the ground. It causes health problems like asthma and other respiratory illness.

Ozone Depletion: A steady decline in the concentration of ozone in the earth's stratosphere (the ozone layer) is called ozone depletion.

- **Ozone depletion** occurs when chlorofluoro carbon (CFC) and halon gases, formerly found in aerosol spray cans and refrigerants are released into theatmosphere and they cause chemical reactions that break down ozone molecules and reduce the concentration of them. Nitrogen oxide released by emitted by supersonic aircrafts can also destroy the ozone molecules to break down. Ozone-depleting substances are present throughout the stratospheric ozone layer because they are transported great distances by atmospheric air motions. The severe depletion of the Antarctic ozone layer known as the "ozone hole" occurs because of the special atmospheric and chemical conditions that exist there and nowhere else on the globe. The very low winter temperatures in the Antarctic stratosphere cause polar stratospheric clouds (PSCs) to form. Special reactions that

occur on PSCs, combined with the relative isolation of polar stratospheric air, allow chlorine and bromine reactions
to produce the ozone hole in Antarctic springtime.

- Satellite images of the earth over last decades observed that the atmospheric ozone layer is getting thinner. On October 2, 2015, the ozone hole was recorded to its maximum size of 28.2 million sq.km over Antarctica (Figure 6.5). The size of the ozone hole is larger than the size of continent of North America. The ozone holes over Antarctica allow the ultraviolet radiation to enter and cause global warming, skin cancer, eye cataract and even blindness.

- Depletion of the ozone layer has consequences on human, animal, plants and micro-organisms. This typically results from higher UV levels reaching us on earth. Research confirms that high levels of UV rays cause non-melanoma skin cancer.
- To protect the ozone layer for our future generation, avoid using products which are emitting pollutants such as aerosol sprays, blowing agents for foams and packing materials, as solvents and as refrigerants.

The Dobson Unit (DU) is the unit of measurement for total ozone

Temperature and Heat Budget

- Air temperature of a particular place denotes the degree of hotness or coldness of air at a given place. It is measured in Celsius. Let us understand how the earth is heated. The surface of the earth is heated by the sun's rays in the form of short wave radiation. The heat received by the earth is called 'Solar Radiation' or 'Insolation'. Heating of atmosphere is an indirect process. The processes are:

a. Terrestrial radiation

- The solar radiation reflected by the earth's surface is called 'Terrestrial radiation'.Terrestrial radiation supplies more heat energy to the atmosphere due to its long wave length.

b. Conduction

- The heat energy from the earth's surface is transferred to the lower atmosphere which is directly in contact with the surface by the process of conduction.

c. Convection and advection

- The movement of air molecules in vertical and horizontal direction is called as 'convection and advection' respectively. Tis movement carries heat energy to the various parts of the earth and at different altitudes.

Heat budget

- The heat energy reflected, absorbed and radiated back into the space equals the energy received by the earth. Incoming radiation and the outgoing radiation pass through the atmosphere. The earth maintains its optimum temperature.

- When 100% solar radiation reaches the earth's atmosphere, 35% is reflected back to space by clouds, water bodies and ice covered areas. This heat does not heat either the earth or atmosphere.

- Of the remaining 65% of heat, 14% are absorbed by the atmosphere and 51% are absorbed by the earth's surface (34% of direct solar radiation and 17% from scattered radiation). 51% received by the earth are radiated back to the space directly as terrestrial radiation.

- In total, 17% are radiated to space directly and 48% are absorbed by the atmosphere (14% from insolation and 34% from terrestrial radiation) are radiated back to space gradually. Therefore, 65% heat received from the sun is balancedby the 65% radiated by the earth. This balance between the incoming and the outgoing heat energy is called the global heat energy balance.

Distribution of Temperature

Distribution of temperature varies both horizontally and vertically. Let us study it under

a. HorizontalDistribution of Temperature
b. Vertical Distribution of Temperature

a. Horizontal Distribution of Temperature

- Distribution of temperature across the latitudes over the surface of the earth is called horizontal distribution of temperature. On maps, the horizontal distribution of temperature is commonly shown by isotherms. Isotherms are line connecting points that have an equal temperature at mean sea level.

The average time taken by the solar radiation to reach the earth's surface is 8 minutes 20 seconds.

Factors Affecting the Horizontal Distribution of Temperature

- The horizontal distribution of temperature on the earth's surface varies from place to place. Following are the factors affecting the horizontal distribution of temperature of the earth:

a. **Latitude:** The angle formed by the solar radiation to the ground is called 'angle of incidence'. The solar radiation passes vertically along the equator. The angle of incidence decreases from equator towards the poles. The area heated by the solar radiation increases towards the poles and therefore, temperature decreases from the equator to the poles.

b. **Distribution of land and water**: Land is heated and cooled at a faster rate due the conduction process whereas water is heated and cooled at slower rate due to convection process. Water takes 2.5 times of heat energy to heat a unit area compared to land. Thus, the land will have higher temperature than the water in summer and vice versa during the winter. So more land mass in northern hemisphere (15.28C) leads to higher average temperature than the southern hemisphere (13.38C).

c. **Ocean currents**: Warm ocean currents carry warm water from the tropical region towards the poles and increase the temperature while cold ocean currents carry cold water from Polar Regions and reduce the temperature along the coasts.

d. **Prevailing winds**: Warm winds like trade wind and westerly, that carry higher heat energy, increase the temperature while cold polar easterlies carry lower heat energy from polar region reduces the temperature.

e. **Cloudiness:** The cloudy sky obstructs the solar radiation from the sun to earth and reduces the temperature. But the clear sky during the day allows more solar radiation to reach the earth's surface and increases the temperature. Meanwhile clear sky at night allows more terrestrial radiation to escape. For example, the tropical hot deserts experience higher temperature at day and lower temperature at night.

f. **Nature of the surface**: The reflection from surface varies based on the natureof land cover. The more reflection from the snow surface leads to low temperature accumulation. But the dense forest, which reflects less heat energy and absorbs more heat energy, leads to higher temperature.

g. **Mountain barriers:** If a wind or air mass blows towards the mountain, it influences the distribution of temperature on either side of the mountain.For example, polar easterlies and blizzards are obstructed by Himalayas in Asia and Alps in Europe respectively. This leads to lower temperature in the northern slopes and higher temperature in the southern slopes of the respective mountains.

Factors Affecting the Vertical Distribution of Temperature

- We all know that the temperature decreases with increasing altitude from the surface of the earth. The vertical decrease in temperature of troposphere is called as

'Normal Lapse Rate' or 'vertical temperature (Figure 6.7) gradient' at which the temperature reduces at the rate of 6.5 8C per 1000 meter of ascent. This is influenced by the following factor

a. Amount of terrestrial radiation reaching the altitude and
b. Density of air to absorb the heat energy at higher altitude.

As both the above said factors decrease with altitude, the temperature also decreases (Figure 6.5).

Inversion of Temperature

- The condition at which the temperature increases with altitude is called as 'inversion of temperature'. In this condition, warm air lies over cold air.The conditions for inversion of temperature are:

a. **Long winter nights:**The bottom layer of the atmosphere in contact with the ground is cooled and the upper layer remains relatively warm.

b. **Cloudless sky:** The higher amount of terrestrial radiation reaches the higher altitude which leads to lower temperature at low level due to clear sky.

c. **Dry airnear the surface:** the dry air absorbs less terrestrial radiation and allows them to escape into space.

d. **Snow covered ground:** During night, due to terrestrial radiation and higher albedo, most of the heat is lost to the atmosphere and the surface is cooled.

e. **Formation of fronts:** the movement of warm air over the cold air during the formation of the various fronts leads to inversion condition.

f. **Mountain wind:** The subsidence of cold mountain wind at the early morning leads to the displacement of warm air from the valley to higher altitude. This type of inversion is called as 'valley inversion'.

Albedo is the amount of solar radiation reflected from the surface. The variation is based on the nature of the earth's surface. Snow has higher albedo compared to forest.

Measurements of Temperature

Unit of Temperature	Scientist	Year
Fahrenheit	Gabriel Fahrenheit	1714
Celsius	Andrew Celsius	1742
Kelvin	Lord Kelvin	1848

Conversion of Units	
Celsius to Fahrenheit Ex. 20°C, F = (C × 1.8) + 32 F = (20×1.8) + 32, F = 36 + 32, F = 68	**Celsius to Kelvin Ex.20°C,** K = C + 273.15 k K = 20° + 273.15k, K = 293.150k

Heat Zones of the World

- The earth has been divided into three heat zones according the amount of insolation received. These are the Torrid Zone, the Temperate zone and the Frigid Zone.

Torrid Zone (23 ½ °N to 23 ½ °S)

- The zone lying between the Tropic of cancer and Tropic of Capricorn is called'Torrid zone' (Figure 6.8). The sun's rays are vertical throughout the year and it receives maximum insolation. Thus, this is the hottest zone.

Temperate Zone (23 ½ °N to 66 ½ °N and 23 ½ °S to 66 ½ °S)

- The temperate zone lies between the Tropic of Cancer and Arctic Circle in the northern hemisphere and the Tropic of Capricorn and Antarctic circle in the southern hemisphere. This region never experiences over-head sun light but experiences longer days and shorter nights during summer and vice versa during winter. This region experiences moderate temperature and is therefore called as Temperate zone'.

Polar Zone (Frigid Zone - 66 ½ °N to 90°N and 66 ½ S to 90°S)

- The region between North pole and Arctic Circle in the northern hemisphere and South pole and Antarctic Circle in the southern hemisphere is called 'Polar Zone'. This region always receives more oblique rays of the sun and so the temperature is very low. It is the coldest zone. This region experiences 24 hours of day and night during peak summer and winter respectively.

- **Annual Temperature:**The average annual temperature of a region for a year.
- **Mean Annual Temperature:** The average of 30 years of annual temperature of the region.
- **Range of Temperature**: Difference between highest and lowest temperature of a place.
- **Annual Range of Temperature:** The difference between highest and lowest temperature of a place in a year.
- **Diurnal range of Temperature**: The difference between highest temperature

and lowest temperature of a place in a day.

From the above discussion, it is clear that the energy for the earth is from the sun.

Green House Effect: As seen in the heat budget, the longer wavelengths are absorbed by greenhouse gases in the atmosphere, increases the temperature of atmosphere. These greenhouse gases act like a green-house and retains some of the heat energy would otherwise be lost to space. The retaining of heat energy by the atmosphere is called the 'greenhouse effect'.

Global Warming

- Global warming is observed in a centuryscale. The temperature increase over the years has been due tothe greenhouse gas concentration such as carbon dioxide (CO2), water vapour, methane and ozone. Greenhouse gases are those gases that contribute to the greenhouse effect. The largest contributing source of greenhouse gas is the burning of fossil fuels leading to the emission of carbon dioxide from industries, automobiles and domestic.

Urban Heat Island (UHI)

- An urban heat island is an urban area or metropolitan area that is significantly warmer than its surrounding rural area due to high concentration of high rise concrete buildings, metal roads, sparse vegetation cover and less exposure of soil. These factors cause urban regions to become warmer than their rural surroundings, forming an "island" of higher temperatures (Figure. 6.9).

Ways to reduce the impact of urban heat island:

1. Increase shade around your home: Planting trees and other vegetation, provides shade and cooling effect through evapotranspiration and it lowers the surface and air temperature.
2. Install green and cool roofs.
3. Use energy-efficient appliances and equipments.
4. Shift all industries away from the urban area.
5. Reduce emission from automobiles.

Atmospheric Pressure and Winds

- Atmospheric pressure is defined as the force per unit area exerted against a surface by the weight of the air molecules above the earth surface. In the Figure below (Figure 6.10), the pressure at point 'X' increases as the weight of the air increases. The atmospheric pressure is not distributed uniformly over the earth. Theamount of pressure increases or decreases, according to the amount of molecules that exerts the force on the surface.

- When temperature of the air increases, the air expands and reduces the number of molecules over the unit area. It leads to reduction in pressure. Similarly, when the temperature falls, the air contracts and the pressure increase. Therefore, the temperature and atmospheric pressure are inversely related.

Atmospheric pressure is measured by an instrument called 'Barometer'

Vertical Distribution of Atmospheric Pressure

- The relationship analysis between altitude and atmospheric pressure is very peculiar. The upper atmosphere is thin and less dense. The pressure at sea level is highest and keeps decreasing rapidly with increasing altitude because of the progressive reduction of the massIsobar is an imaginary line connecting the places of uniform atmospheric pressure reduced to mean sea level above the point where it is measured (Figure 6.12). Relationship between Standard Pressure and Altitude

Altitude in m	Atmospheric pressure in m b
Sea level	1013.25
1,000	898.76
2,000	795.01
3,000	701.01
4,000	616.60
5,000	540.48
10,000	264.0

Horizontal Distribution of the Atmospheric Pressure

- When the air gets heated it expands, becomes light and rises vertically. As air rises, the pressure it exerts on the earth surface is reduced, causing a low pressure area (Figure 6.13).

- On the other hand, cool air is dense and heavy. As a consequence it sinksvertically. It results in additional weight and pressure which cause a high pressure area to occur on the ground.

The rotation of the earth affects the moving objects on the earth surface. Free moving objects, affected by the rotation of the earth, do not follow a straight line. In the northern hemisphere they drift towards right and towards left in the southern hemisphere. A car travelling down a straight road at 95 km/hr in northern hemisphere would drift to the right of the path if the friction between surface and tyre is absent. The tendency is called as Coriolis Effect as it was discovered by G.G. Coriolis. This is the reason why racket launching stations are located on the east coastal areas. Example: Sriharihota, French Guyana.

Pressure Belts of the Earth

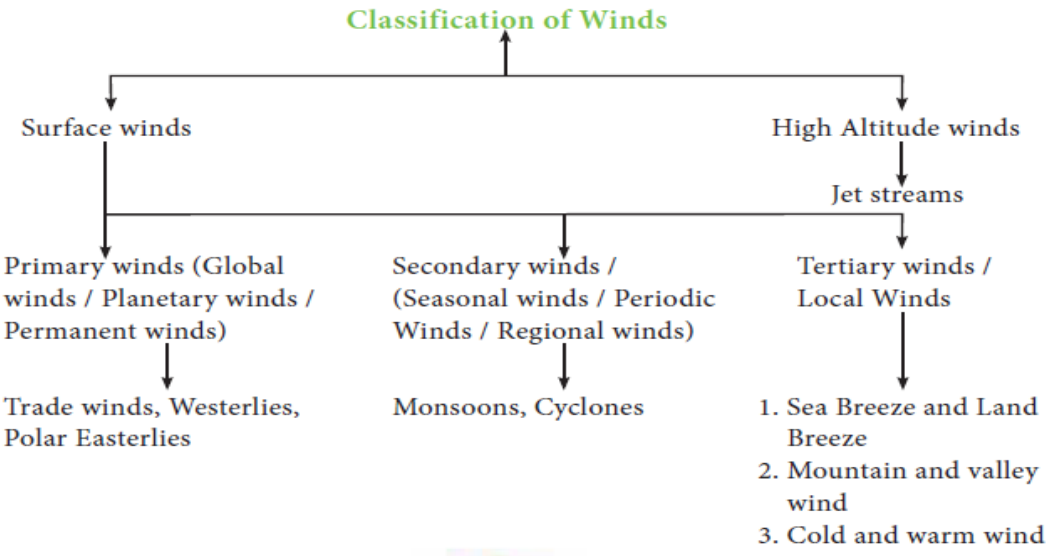
- The atmospheric pressure belts envelope on the surface of the earth. They are equatorial low pressure belt, sub-tropical high pressure belts, sub polar low pressure belts and polar high pressure belts

Wind Systems

- Wind is the horizontal movement of air molecules from areas of high pressure to areas of low pressure to maintain the atmospheric equilibrium. The wind always moves perpendicular to isobars. If the earth did not rotate, the winds would blow in a straight path. Then the rotation of the earth results in corilois effect and it deflects the direction of the wind. Wind direction is identified by an instrument called Wind Vane and wind speed is measured by Anemometer.

Types of Winds

Winds are classified based on the nature and area of influence as follows;



General Atmospheric Circulation, Pressure Belts and Primary Wind System

- Fromtheequator to the poles,each hemisphere has four pressure belts andtotally there are seven belts on the globe. The pressure belts lead to formation of primary wind system as follows (Figure 6.14):

a. The equatorial low pressure belt (between 58°N and 58°S):

- Thisis the region of calm, weak and changeable winds. Due to the high temperature over this region, the air gets heated expands and become lighter and rises upward and creates low pressure over the region. This region is a belt of calm and referred to as the 'Doldrums'. The winds blow from the sub-tropical high pressure belt towards the equatorial low pressure belt. Due to Coriolis Effect these

winds are deflected to the right in the northern hemisphere and to the left in the southern hemisphere. As winds are named after the direction from which they originate they are called as the North East and South east trade winds. As the winds favoured trading ships they are called as 'Trade winds'.

b. The sub-tropical high pressure belt (25° to 35° N and S):

- Air begins to cool when it reaches higher altitude over equatorial region and flows towards the poles. This wind collides with the wind coming from the polar region at higher altitude and subsides down over sub-tropical latitudes. This leads to formation of high pressure belt along the sub-tropical region. It is said that to avoid the slowing down of ship due to high pressure the horses were thrown into the sea. So this belt is called as 'Horse latitude'. The sinking air bifurcated in to two branches towards the equator and poles, they are called as trade winds and westerly respectively. Westerlies flow towards the pole from sub tropics and turn towards right andleftin northern hemisphere and southern hemisphere respectively.

c. The sub polar low pressure belt (50° to 60° N and S):

- The warm westerly wind from sub-tropical region moves towards the pole and collide with the cold polar easterly wind from polar high pressure region and raises up to form sub polar low pressure belt.

d. Polar high pressure belt (80° N and S to pole):

- The constant low temperature at the poles due to inclined solar radiation and reduced insolation leads to the formation of polar high pressure belt on both poles.

Ocean is dominant in the southern hemisphere between the latitudes 40ºand60ºS. Hence the westerlies are so powerful and persistent that the sailors used such expressions as "Roaring Forties", "Furious Fifties" and "Screeching Sixties" for these high velocity winds in the latitudes of 40º, 50º and 60º respectively.

- The high pressure on the surface always coincide with the low pressure at higher altitude while the low pressure on the surface always coincide with higher pressure on the higher altitude. High pressure always has divergence of air masses from the centre but low pressure has convergence of air.

Basis of Formation of Pressure Belts

There are two important bases on which the pressure belts are formed. They are;

a. **Temperature:** The equatorial low pressure and polar high pressure belts are formed due to high and low temperature respectively. So they are called as 'Thermally formed pressure belts!
b. **Dynamism:** The sub-tropical high and sub polar low pressure belts are formed due to movement and collision of wind system. So they are called as 'Dynamically formed pressure belt system'.

Meridional Cell System

- The cell along with trade winds, equatorial low and sub-tropical high pressure belts is called as 'Hadley cell", meanwhile the cell formed by westerly wind along with sub-tropical high and sub polar low pressure belt is called Terrell's cell'. The cell at polar formed by polar easterlies with polar high and sub polar low pressure belt is called as 'Polar cell'(Figure 6.15).

ITCZ - Inter Tropical Convergent Zone

- The region where both trade wind systems meet is known as 'Inter Tropical Convergent Zone'

Shifting of Pressure Belts and Primary Wind System

- These pressure belts and primary wind systems are dynamic in character asthey shift 58 north and 58 south from their position along with the apparent movement of the sun.

Secondary Wind System

- Both monsoon and cyclonesareconsidered as secondary or regional wind systems.

Monsoons

- The word 'Monsoon' is derived from the Arabic word, 'Mausin, which means 'Season'. Monsoons are seasonal winds which reverse their direction due to unequal heating and cooling of the land and the water.

Mechanism of Monsoon

- The land absorbs more heat energy during summer, which leads to the formation of low pressure over continent. But the ocean will have relatively lower temperature than the continent leading to the formation of high pressure system over ocean. So, the wind blows from sea to land during summer season. Meanwhile the land reradiatesmore heat energy to space during winter leading to the formation of high pressure above the continent. But the ocean will have relatively higher temperature than the continent leading to formation of low

pressure system over ocean. So, wind blows from land to sea during the winter season. T is mechanism has an important effect on rainfall received over the region.

Nature of Monsoon System

- There are three distinct characteristics related to monsoon wind system which differentiates it from other wind systems. They are;
  1. Minimum 1608 reversal of wind direction between seasons.
  2. They affect a large part of the continents and oceans.
  3. The formation of low and high pressure systems over land and water and their interchange between the seasons.

- Monsoon system is classified into two groups based on the location. They are;
  a. Asian Monsoon
  b. South Asian Monsoon

a. Asian Monsoon

- The Asian monsoon system is divided into two components based on season it flows. The presence of high temperature with low pressure in the lake Baikal region and low temperature with high pressure in the Aleutian islands region leading to flow of wind from Pacific Ocean to interior part of Asia during summer is called 'Summer

- Monsoon of Asia'. This leads to rainfall in the east coast of Asia.Meanwhile, in winter the low temperature and high pressure in the Lake Baikal region and high temperature and low pressure in the Aleutian Island region leading to flow of wind from Central Asia to Pacific Ocean is known as 'Winter Monsoon of Asia'. As the wind system flows off shore, the rainfall does not occur in the continent of Asia except western coast of Japan.

b. South Asian Monsoon

- South Asian Monsoon includes the countries in the southern part of Himalayas, that is India, Pakistan, Bangladesh, Sri lanka, Maldives, Nepal and Bhutan. This monsoon system has been classified into two groups based on the direction of origin of wind namely south west monsoon and north east monsoon (Figure 6.16).

South West Monsoon

- During summer the Indian peninsula is heated more than the sea around it. Intense low pressure is formed in the region of Peshawar of Pakistan. At the same time, the Indian Ocean has higher pressure due to relatively low temperature. So the wind blows from Indian Ocean towards South Asia as Southeast Winds. The wind turns towards right due to Coriolis Effect and blows as south west winds

which bring heavy rains around four months of the year. This is known as south west monsoon in Indian Sub-continent. This wind system bifurcates into two branches as Arabian Sea branch and Bay of Bengal branch.

Arabian Sea Branch

- The Arabian Sea branch strikes the Western Ghats at perpendicular direction and rises over it. The orographic effect by the Western Ghats results in heavy rainfall in the windward side and low rainfall in the leeward side. So the west coast of India receives high rainfall when compared to the eastern side of the Western Ghats. Kerala is the first state to receive rainfall from the south west monsoon in India, which occurs during first week of June. Ten, the wind gradually moves towards the north of the western coast and leads to gradual development of the monsoon in parts of Karnataka, Goa, Maharashtra, Gujarat and Rajasthan. The wind further advances towards foot hill of the Himalayas and creates orographic rainfall in the Himalayan states, Punjab and Haryana. The other part of the Arabian Sea branch moves towards the east and results in onset of monsoon in Uttar Pradesh and Bihar. Here, it unites with the Bay of Bengal branch and leads to heavy rainfall and food.

Bay of Bengal Branch

- Bay of Bengal branch flows from south west which results in orographic rainfall in Sri Lanka and reaches Andaman and Nicobar Islands and results in orographic rainfall. Indira point in the Great Nicobar is the first place which receives rainfall during south west monsoon in India during middle of May. The wind flows parallel to the east coast of India and Eastern Ghats. So Coromandel Coast of India doesn't get enough rainfall during south west monsoon. The wind strikes Arakanyoma Mountain in Myanmar and results in heavy rainfall in western coast of Myanmar. The wind funnels towards north eastern part of India after defected by the Arakanyoma Mountain in Myanmar. This wind strikes Meghalaya plateau which leads to heavy rainfall in Bangladesh andNorth eastern part of India. Mawsynram, the wettest place (highest annual rainfall) in the world, is located in the windward side of Meghalaya plateau.

- The wind further advances towards the Himalayas where it creates heavy rainfall in the southern slopes. This leads to flood in River Brahmaputra. The wind gradually moves towards the west and results in onset of monsoon in Bhutan, Sikkim, West Bengal, Nepal and Bihar. It joins with Arabian Sea branch in Bihar and results in heavy rainfall and flood.

- The south west monsoon gradually withdraws from south Asian continent due to apparent movement of the Sun towards the southern hemisphere. This is called as 'Withdrawal of South West Monsoon'.

North East Monsoon

- During winter the Indian Subcontinent becomes colder than the Indian Ocean. As a result the wind blows from Northeast to South West direction. This is dry wind system and it does not produce rainfall in the coastal region of south Asia except the Coromandel Coast of India and Sri Lanka.

Mawsynram, world's wettest place!

''It was the kind of rain you wouldn't see anywhere else. We could barely see four feet ahead of us. We could touch the clouds, smell the clouds, and taste the clouds'' said a local resident. Yes, it is about Mawsynram which is located in Meghalaya's East Khasi Hills, with the cluster of about 1,000 homes. It holds the Guinness Record for "the wettest place on earth". The average annual rainfall is 11,861mm, according to the Guinness website.

However, the soil in the limestone plateau doesn't absorb water. "There is barely any forest cover, so a lot of erosion of top soil happens. All of it flows down into Bangladesh. The irony is that "the wettest place on earth" grapples with an acute water shortage after monsoon ends around October. Hence, people call world's rainiest place Mawsynram, which is also world's wettest desert.

- This is known as North East Monsoon or Retreating Monsoon in South Asia. Agriculture in India mostly depends on the rainfall brought by the monsoons.

- During the El Nino year the temperature of the ocean water increases. Tis weakens the high pressure over Indian Ocean thereby reduces the strength of south west monsoon over south Asia. However during winter, it induces the low pressure over the ocean resulting in severe depressions and cyclones.

Tertiary Winds

- The tertiary winds are formed due to pressure gradients which may develop on a local scale because of differences in the heating and cooling of the earth's surface.

Sea and Land Breezes

- During daytime, land heats up much faster than water. The air over the land warms and expands leading to form low pressure. At the same time, the air over the ocean becomes cool because of water's slower rate of heating and results in formation of high pressure. Air begins to blow from high pressure over ocean to the low pressure over the land. This is called as 'Sea breeze'. During night time, the wind blows from land to sea and it is called as 'Land breeze' (Figure 6.17).

Sea breeze and land breeze influence the movement of boats near the

coastal region and fisher men use these winds for their daily fish catching. Fishermen go for fishing at early morning along the land breeze and return to the shore in the evening with the sea breeze.

Mountain and Valley Breezes

- A valley breeze develops during the day as the sun heats the land surface and air at the valley bottom and sides. As the air getsMountain and valley wind systems influence the weather pattern of the mountain top and valley bottom. Mountain top can be seen clearly at early morning and valley bottom at evening. But mountain top will be covered with clouds at evening due to rising of valley wind system and valley bottom would be covered by clouds at early morning due to arrival of mountain wind system. These clouds are sometimes called as 'fog' which is used for cultivation in the dry regions like Yemen.heated it becomes less dense and begins to blow gently up the valley sides. This is called as 'valley wind'. Tis process reverses at night leading to blow of wind from mountain top to valley bottom referred to as 'mountain wind' (Figure 6.18).

Local Winds

Local wind systems influence the weather pattern where ever they blow (Figure 6.19). Some important local winds are;

1. **Bora**: North easterly from eastern Europe to north eastern Italy
2. **Chinook:** Warm dry westerly off the Rocky Mountains
3. **Fohn:** Warm dry southerly off the northern side of the Alps and Switzerland.
4. **Harmattan:** Dry northerly wind across central Africa
5. **Karaburan:** 'Black storm' a spring and summer katabatic wind of central Asia
6. **Khamsin**: South easterly from North Africa to the eastern Mediterranean
7. **Loo:** Hot and dry wind which blows over plains of India and Pakistan.
8. **Mistral:**Cold northerly from central France and the Alps to Mediterranean.
9. **Nor'easter:** Strong winds from **the** northeast **in** the eastern United States, especially New England
10. **NorVester:** Wind that brings rain to the West Coast, and warm dry winds to the East Coast of New Zealand's South Island, caused by **the** moist prevailing winds being uplifted over the Southern Alps, often accompanied by a distinctive arched cloud pattern.
11. **Pampero:** Argentina, very strong wind which blows in the Pampa.
12. **Simoom:** Strong, dry, desert wind that blows in the Sahara, Israel, Jordan, Syria, and the desert of Arabia.
13. **Sirocco**: Southerly from North Africa to southern Europe.
14. **Zonda wind:** On the eastern slope of the Andes in Argentina.

Jet Streams

- Jet streams are high altitude westerly wind system blows at a height of 6 to 14 km, with very high speed up to 450 km/h in wavy form at both hemispheres. As they encircle the polesthey are called as 'Circum polar wind system' (Figure 6.20).

The wavy structure of the Jet stream **is** represented as 'Ross by waves'.

- Although the jet streams flow at higher altitude they also influences the surface weather pattern of the Earth.

Jet streams were discovered during the Second World War as the jet pilots felt the strong obstruction in the higher altitudes.

The Major impacts of Jet streams

1. **Creation of Polar vortex:**
   Polar westerly jet stream will carry cold polar air masses towards temperate region which creates severe cold waves in North America and Eurasia during winter.

2. **Sudden burst of South west monsoon:**
   Sudden withdrawal of polar westerly jet stream from Indian sub-continent to northern part of Pamir, leads to sudden burst of South west monsoon into Indian Sub-continent.

3. **Late and early monsoon in South Asia:**
   Rate of with drawl of polar westerly jet stream decides the onset of south west monsoon. Slower and faster rate of with drawl leads to late and early onset of south west monsoon.

4. **Intensity of monsoon rainfall:**
   The arrival of tropical easterly jet stream influences the intensity of south west monsoon. This leads to increasing intensity of rainfall during south west monsoon.

5. **Bringing rainfall to India by western disturbances:**
   Polar westerly jet stream carries rainy clouds from cyclones formed over Mediterranean Sea during winter towards India. These clouds piles up on the Himalayas and results in rainfall over the states of Punjab and Haryana. This assists in the cultivation of wheat in India.

6. **Development of super cyclone**:
   The condition at which the speed of the jet stream is transferred to tropical cyclone may leads to development of super cyclone.

Humidity, Condensation and Clouds

- Humidity is the amount of water vapour in the atmosphere. Temperature of the air controls the capacity of the air to hold moisture. The maximum amount of moisture that can be hold by the air in the particular temperature is called as Humidity Capacity. As the volume increases with the temperature of the air, it can hold more moisture. So, humidity capacity increases with temperature. It is measured as weight of humidity or volume of the air.

Humidity of the air can be expressed in the following ways.

a. **Absolute Humidity:** This measures the total amount of water vapour present in the air at particular time. It is highly variable based on the surface on which the air moves. It is measured as weight of humidity volume of the air. Hygrometer is used to measure the relative humidity of a region.

b. **Relative Humidity (RH%):** This is the ratio of Absolute humidity and humidity capacity in term of percentage. It reveals the condition of air to get saturated. This is controlled by both temperature and moisture content of the air. The condition is that when the temperature increases RH% decreases. But when absolute humidity increases RH% increases.

Process of Condensation

- Condensation is the change of the physical state of water vapour (gas state) into water (liquid state). The following process explains mechanism of condensation in the atmosphere.

- If an air reaches 100% relative humidity, it means that the air is completely filled with moisture content. It indicates that both the absolute humidity and the humidity capacity of the air are in same level. This condition is called 'saturation of air' which can be attained by reducing the temperature of the air or increasing the moisture content. The temperature at which the air gets saturated is called as 'dew point'. The RH crosses the 100% when the temperature of the air drops below its dew point. This condition is called as 'super saturation' of the air. In this condition the air releases the excess moisture out of it in the form of tiny water droplets which floats and form clouds in the atmosphere.

- If the same process occurs on the surface of the earth, it is called as 'fog' or cloud on the ground.

The moisture in the atmosphere is based on the following processes:

a. Evaporation - Water changes from liquid state to gaseous (vapour) state.
b. Transpiration - Water state changes from liquid in to (gas) vapour state due to the activity of plants.
c. Evapotranspiration - This denotes that the total amount of (liquid) water state changed in to (gas) vapour state due to evaporation and the activity of plants

transpiration.

Clouds and its Types

Clouds are tiny water droplets suspended in the air formed due to the condensation.

Isonephs - The imaginary line connecting the places having equal amount of cloudiness.

- The clouds can be classified based on their form, height and appearance as follows: (Figure 6.22)

a. **High clouds:**

- Mainly cirrus (Ci) which are feathery form at 6 km above the ground.

i. Cirrus (Ci) – This looks fibrous and appears as wisps cotton in the blue sky. It indicates fair weather and gives brilliant sun set.
ii. Cirro Cumulus (Cc) – This appears as white globular masses, forming a mackerel sky.
iii. Cirro Stratus (Cs) – Tis resembles a thin white sheet. The sky looks milky and the sun and moon shines through this clouds and form a 'halo'.

b. **Middle Clouds:**

- Mainly Alto (Alt) clouds at 2 km to 6 km above the ground.

i. Altocumulus (Alt-Cu): These are woolly, bumpy clouds arranged in layers appearing like waves in the blue sky. They indicate fine weather.
ii. Altostratus (Alt-St): These are denser and have watery look.

c. **Low Clouds:**

- Mainly Stratus or sheet clouds below 2 km height.

i. Stratocumulus (St-Cu): This is rough and bumpy clouds with wavy structure.
ii. Stratus (St): This is very low cloud, uniformly grey and thick, appears like highland fog. It brings dull weather and light drizzle. It reduces the visibility and is a hindrance to air transportation.
iii. Nimbostratus (Ni-St): This is dark dull cloud, clearly layered, as it brings rain, snow and sleet and it is called as rainy cloud.

d. Clouds with vertical extent:

These are mainly cumulus clouds whoseheights extend from 2 km to 10 km approximately.

i. Cumulus (Cu): This is vertical cloud with rounded top and horizontal base, associated with convectional process in the tropical region. It also called as 'fair weather cloud'.
ii. Cumulonimbus (Cu-Ni): This is over grown cumulus cloud with great vertical extent, with black and white globular mass. The cauliflower top spreads like an anvil. This is formed due to heavy convection in the tropical regions. It is accompanied by lightning, thunder and heavy rainfall.

Fog, Mist and Smog

- **'Fog'** is defined as almost microscopic droplets of water condensed from super saturated air and suspended over or near the surface of the earth. Fogs reduce the visibility to less than 1 km. Fog occurs during calm or light wind conditions. It is more common in the areas near to the ocean due to the supply of more moisture by sea breeze. In the interior of the continents fog is formed due to reduction of temperature to extreme low during the winter nights.

- If the fog has higher visibility due to lesser water drops near the surface it is termed as 'mist'.

- In large industrial areas the air is more polluted. If the fog forms in that area it mixes with the pollutants and turns into smog (smoke 1 fog 5 smog) which is more hazardous to the health of the people.

Hydrological Cycle

- Continuous movement of water among the three spheres is known as Hydrological Cycle.Hydrological cycle involves evaporation, condensation, precipitation, advection, interception, evapotranspiration, infiltration, percolation and runoff to the ocean (Figure 6.24).

Evaporation is the process by which water in liquid state changes into vapour state using heat energy from Sun. Evaporation is maximum when the temperature is high, on the large expanse of water and when dry winds blow over water surface.

Condensation is the process by which water vapour cools to form water droplet by lossing temperature. The condensation occurs when dew point is reached in the atmosphere.

Precipitation is the process by which all forms of water particles fall from the atmosphere and reach the ground.

The rain drop that falls may get evaporated before it reaches the ground in an extremely arid region.

Air Masses and Fronts

- The study of air mass is very important part of Meteorology. Air always takes some of the properties of the area over which it lies. This parcel of air may remain stationary for several days and develops its own characteristics. Under this situation, the air becomes recognisable as an air mass.

- An air mass is defined as 'an immense body of air several kilometres in length and breadth and thickness which is characterised by homogeneous physical properties (like temperature, moisture) in horizontal direction at any level'.

- Such an extensive portion of the surface area over which air mass has acquired its qualities is called as 'Air mass source region'. The source region may be land or water body. For example,Sahara desert, Siberia, the Great Plain of North America, Northern Plain of Europe, Western Australia, Antarctica, Green Land, Arctic Ocean, Northern and Southern Pacific, Atlantic Oceans are favourable locations as source region for air masses.

The air masses can be classified based on the following factors;

a. Latitude - Tropical(T) and Polar (P) air masses
b. Nature of the surface – Continent (c) and marine (m) air masses
c. Temperature – warm (w) and Cold (k) air masses
d. Stability – stable (s) and unstable (u) air masses

- Air masses normally migrate from their source region to other regions, which have different surface properties, mostly along with primary winds. As the air masses move out from their source regions, they not only modify the weather of the areas they occupy, but also modify themselves according to the surface over which it moves.

Fronts

- When two air masses with different physical characters meet, there is usuallyUtile mixing of the air. The zone of transition between two contrasting air masses is called as 'Fronts*. As heavier air mass always tends to push up the lighter air mass, the front always slopes over the cold air mass.

- If cold air mass moves forward rapidly and causes the warm air to rise vertically, it leads to the formation of steep slope called as 'Cold front*. Cold fronts result in the formation of cumulo nimbus clouds with heavy rainfall associated with lightning and thunder.

- If warm air is moving over cold air mass, it produces a gentle slope called as 'Warm front*. Warm fronts result in the formation of stratus and nimbo stratus clouds and cover over large areas, leading to moderate rainfall (Figure 6.26).

Condition for Formation of Fronts:

1. There must be two air masses with contrasting physical characters.
2. There must be collision of air masses.

At the equatorial low pressure belt although two trade wind systems meet, they do not form any front, because the air masses are of similar physical characteristics (both warm) and they do not collide with each other. Whereas the sub polar low pressure belt contrasting air masses collide with each other forming fronts.

Precipitation

- Precipitation is theproductofcondensation of atmospheric water vapour that falls under gravity and reaches the surface ofthe earth. In order to fall as rain drop or snow, the tiny drop lets in a cloud must grow larger. The droplets accumulate over the nuclei and combine to grow large enough to fall and reach the surface of the earth due to gravity.

Acid Rain

Acid rain is a rain that is unusually acidic, it has elevated levels of hydrogen ions. It is caused by a chemical reaction of compounds like sulphur dioxide and nitrogen oxides that are released into the air from anthropogenic activities and from volcanic eruptions. These substances can rise very high into the atmosphere, where they mix as hygroscopic nuclei and react with water vapour, oxygen, and other gases to form more acidic water which falls to the ground as acid rain. It is harmful for plants, animals, human and environment. Normally the rainfall is slightly acidic because of the presence of dissolved carbonic acid. The pH of normal rain has been given a value of 5.6. Acid rain has the pH value of less than 5.6. A great way to reduce acid rain is by using renewable energy resources, such as solar and wind power and reducing the use of fossil fuels.

- If the drop is smaller it falls slowly so that it evaporates before it reaches the ground. Ice crystals in cloud also cause precipitation. Each ice crystal grows by cooling so that they become large in size and fall to the ground. They melt on the way due to friction with the atmosphere and fall as rain.

Forms of Precipitation

- The precipitation has various forms based on the condition of occurrence (Figure 6.27). The various forms are;

Rainfall: When water droplets of more than 0.5 mm diameter falls from the atmosphere to the ground it is called as 'Rainfall'. If the diameter is less than 0.5mm, it is called as 'Drizzle'.

Hail: When precipitation occurs at sub zero temperature, the water droplets crystallise and fall as ice pellets with the size of 5 to 50 mm or some times more. This is called as 'Hail'.

Sleet: Precipitation occurs as falling of raindrop along with ice pellets less than 5 mm diameter or snow, called as 'Sleet'.

Snow: Precipitation occurs at below freezing point and falls as thin ice flakes or powdery ice, called as 'Snow'.

Dew: Condensation of water droplets on the objects at the surface of the earth such as leaves and grasses are called as 'Dew'.

Cloud Seeding or Artificial Rainfall

People have always wanted to create rain, so that they would not suffer from drought. Modern science has been successful in causing rain in a limited way through cloud seeding. This method is based on the knowledge of growing ice crystals in clouds.

One method to cause rainfall from clouds is to introduce particles of dry ice (solid CO2) into the cloud from an air plane. The dry ice causes ice crystals to form in the cloud. These ice crystals coalesce, grow, melt and fall as rain. Cloud seeding will not be successful unless the cloud is already saturated with water vapour.

Types of Precipitation (Rainfall):

- Precipitation can be classified based on the causes for the rising up of air,

1. Convectional rainfall
2. Orographic or Relief rainfall
3. Cyclonic or Frontal rainfall

Convectional Rainfall:

- As a result of heating of the surface air, the warm moist air expands and is forced to rise to a great height. As the air rises, it cools, reaches dew point and condenses toform clouds. This process influences the upper tropospheric circulation. By further cooling, precipitation takes place as rainfall. This rainfall occurs throughout the year near the equator in the afternoon. It is called as 4 'O' clock rainfall region. In middle latitudes, convectional rainfall occurs in early summer in the continental interiors (Figure 6.29).

Orographic or Relief Rainfall

- It occurs when large mass of air is forced to rise across land barriers, such as high mountain ranges, plateaus, escarpments, or over high hills. On the windward side of the region the warm moist air raises, temperature of the air falls below its dew point, forming clouds which give subsequent rainfall. As the wind moves to the leeward side it has emptied itself of moisture and thus descends the slope as warm dry winds. The leeward side of the mountain therefore is called as the rain shadow region (Figure 6.30).

Cyclonic or Frontal Rainfall

- This type of precipitation is associated with a cyclonic activity (Tropical and Temperate) and also occurs along the frontal zone. Cyclonic rainfall is associated with Cumulo Nimbus (CuNi) clouds. The rainfall is very heavy and accompanied with lightning and thunder and high speed winds which has the potential to cause damage.

- 'Frontal rainfall' is associated with fronts which form due to collision of different air masses. Warm front is formed due to advent of warm air masses which leads to moderate rainfall. In the same way coldfront is formed due to advent of cold air mass which leads to heavy rainfall with lightning and thunder.

An isohyets or isohyetal line is a line joining points of equal rainfall on a map in a given period. A map with isohyets is called an isohyetal map.

When altitude increases, the rainfall also increases in orographic pattern. But the rainfall decreases with altitude, once the amount of moisture reduces in the air after a point where it reaches maximum rainfall which is called as 'Maximum Rainfall Line'. This condition where the rainfall decreases with altitude is called 'Inversion of Rainfall'.

Cloud Burst

- A 'cloud burst' is a sudden aggressive rainstorm falling in a short period of time limited to a small geographical area. Meteorologists say that the rain from a cloud burst is usually of the heavier rain with a fall rate equal to or greater than 100 mm (3.94 inches) per hour. Generally cloudbursts are associated with thunderstorms. The air currents rushing up words in a rain storm hold up a large amount of water. For example cloud bursts in the region of Uttarkhand (2013) and Chennai (2015).

Lightning and Thunder are caused by differences in the electrical charge of different parts of the cloud. The top of the cloud becomes positively charged and the bottom is mostly negatively charged. When the difference is great lightning occurs. Differences in the charge between cloud and the earth surface also cause lightning. Thunder is caused by rapid expansion of the air that is heated as the lightning passes through it.

Atmospheric Disturbances (Cyclone and Anti Cyclone)

- The atmospheric disturbances which involve a closed circulation of air around a low pressure at centre and high pressure at periphery, rotating anticlockwise in northern hemisphere and clockwise in southern hemisphere is called 'Cyclones' (Figure 6.31). Cyclones may be classified into two types based on latitude of its origin.

They are: a. Tropical cyclone b. Temperate cyclone

A. Tropical Cyclone

- Cyclone formed in the low latitudes is called as Tropical cyclone. They form over warm ocean waters in the tropical regions. The warm air rises, and causes an area of low air pressure.

6.8.1 Stages of Development of Tropical Cyclone

- As per the criteria adopted by the World Meteorological Organisation (W.M.O.), India Meteorological Departmentclassifies the low pressure systems in to vary classes based on wind speed

1. Tropical Disturbances
2. Tropical depressions Low winds with a speed between 31 and 61 km ph.
3. Tropical cyclone wind speed from 62 to 88 km ph and it is assigned a name.
4. Severe Cyclonic Storm (SCS) wind speed is between 89 to 118 km ph
5. Very SCS wind speed between 119 to 221 km ph and
6. Super Cyclonic Storm when wind exceeds 221 km ph.

Origin of Tropical Cyclone

- Tropical cyclones have certain mechanism for their formation. These are

A source of warm, moist air derived from tropical oceans with sea surface temperature normally near to or in excess of 27 °C (Figure 6.32)

Wind near the ocean surface is blowing from different directions converging and causing air to rise and storm clouds to form. Winds which do not vary greatly with height are known as low wind shear. This allows the storm clouds to rise vertically to high level;Coriolis force is induced by the rotation of the Earth. The mechanisms of formation vary across the world, but once a cluster of storm clouds starts to rotate, it becomes a tropical depression. If it continues to develop it becomes a tropical storm, and later a cyclone/ super cyclone.

Characteristics of the Tropical Cyclone

- The centre of the cyclone where the wind system converges and vertically rises is called as Eye. The eye is a Calm region with no rainfall and experiences highest temperature and lowest pressure within the cyclonic system (Figure 6.32).

- Cyclone wall is made up of Cumulo Nimbus clouds with no visibility, higher wind velocity and heavy rain fall with lightning and thunder.

- Tropical cyclones mostly move along with the direction of trade wind system. So they travel from east to west and make land fall on the eastern coast of the continents (Figure 6.33).

Landfall: The condition at which the eye of the tropical cyclone crosses the land is called 'Land fall' of the cyclone (Figure 6.34).

Naming of Tropical Cyclones

- The practice of naming storms (tropical cyclones) began years ago, in order to help in the quick identification of storms in warning messages because names are presumed to be far easier to remember than numbers and technical terms (Figure 6.35).

- In the pursuit of a more organized and efficient naming system, meteorologists later decided to identify storms using names from a list arranged alphabetically. Since 1953, Atlantic tropical storms have been named from lists originated by the National Hurricane Centre. They are now maintained and updated by an international committee of the World Meteorological Organization (WMO).

- Large scale destruction caused by Odisha cyclone in 1999, triggered the issue of naming tropical cyclones developed in the North Indian ocean. As a result, naming conventions for storms that develop in the Indian Ocean began in 2004. WMO (World Meteorological Organisation)had informed each of the eight South Asianmember countries to submit a list of their own eight names for the cyclones.

Condition of Super Cyclone Formation
1. Longer travel or stay of low pressure system over warm ocean water.
2. The speed of jet stream may influence the formation of super cyclone.

Tornado and Water Spouts

It is a very small intense, funnel shaped very speed whirl wind system. Its speed and direction of the movement are erratic (Figure 6.36). The winds are always as fast as 500 km ph. The fast moving air converges in the middle and rises up. The

uplift is capable of rising dust, trees andother weaker objects in its path. South and western part of Gulf States of USA experiences frequent tornados.

- Water spouts are formed over water body similar to tornados in the formation and structure. This sometimes leads to fish rain, if the mass of fish comes under the water spout.

B. Temperate Cyclone

- The cyclone formed in the mid-latitudes is called as temperate cyclone. As they are formed due to movement of air masses and front, they are called as 'Dynamic cyclone' and 'Wave cyclone'. This cyclone is characterised by the four different sectors, which are varied with their weather patterns (Figure 6.37).

Stages in the Formation of Temperate Cyclone

a. Frontogenesis –Formation of front due to collision of two contrasting air masses (Figure 6.38).
b. Cyclone genesis – Formation of cyclone due to conversion of fronts into various sectors.
c. Advancing Stage – The stage where cold front advances towards warm front.
d. Occlusion stage - The stage where the cold front over takes warm front
e. Frontalysis – The last stage where fronts disappear and cyclone ends its life.

Characters

- Unlike tropical cyclone, temperate cyclone forms over both land and water in all seasons. It covers larger area than tropical cyclone and stays for a longer period.

Track

- Temperate cyclone moves along with the westerly wind system from west to east.

Anti-Cyclones

- Anti-cyclone is a whirlwind system in which high pressure area at the centre and surrounded by low pressure at periphery rotating clockwise in northern hemisphere and anti-clock wise in southern hemisphere(Figure 6.39).

- This is the largest among the whirl wind systems. Normally, they are associated with high pressure belts of sub-tropical and polar region.

Anti-cyclones are classified as warm core and cold core, based on their temperature, which are resulted in aridity and cold waves respectively.

Glossary

1. **Buoyant**: Able to keep afoot on the top of air or liquid.
2. **Collision:** Hit by accident when moving.
3. **Equilibrium:** A balanced state of molecules where the acting forces are equal.
4. **Escarpment:** A long, steep slope especially one of the edge of a plateau or surface.
5. **Expansion:** The action of becoming larger or more extensive.
6. **Funnelling:** Guided through the area that has widening at front and narrow at the end.
7. **Hygroscopic:** Tending to observe moisture from air.
8. **Insolation:** Amount of solar radiation reaching a given area.
9. **Meteorology:** is a branch of the atmospheric sciences which includes atmospheric physics and chemistry, with a major focus on weather forecasting.
10. **Molecules:** A group of atoms bonded together.
11. **Permeable:** Allowing liquids or gases to pass through it.
12. **Subsistence:** The gradual movement of air molecules from higher altitude to lower altitude.
13. **Torrid:** Region of Very hot and dry condition.
14. **Vortex:** A whirling or rotating mass of fluid or air.

Unit - 7
The Biosphere

- "Man's attitude towards nature is today critically important simply because we have now acquired a fateful power to alter and destroy nature is inevitably a war against himself".

-Rachel Carson

Introduction

- The earth was formed 4.6 billion years ago. Geographers are concerned about the earth and its various spheres. These spheres did not exist on the primitive earth as they are today. They evolved over a long period of time after the earth was formed. There was no life on earth for a very long time. Scientists believe that the first life forms on earth came into existence about 3.5 billion years ago. Which marked, 'The birth of the biosphere'.

- Since then life has multiplied in numbers and varieties and evolved to the present biosphere that we are part of and which we are gifted with.

- In the last 100 years, man has had used, overused and misused the natural resources of the earth. This has disturbed the ecological balance of the earth. The realization about the damage caused to earth by our action came when we began to experience global warming, desertification, increase in disease and distress and recurrence of severe natural disasters.
- It was in 1962 that Rachel Carson published the book 'Silent Spring' which inspired an environmental movement thatled International agencies to focus their attention on protecting and sustaining the biosphere.

- In 1971, UNESCO launched the Man and the Biosphere Programme to study our impact on nature and how it could be minimized. Even after several decades the programme still continues to shape the future of sustainability of the earth.

Biosphere

- The word Biosphere originates from the Greek words bios = life and sphaira = sphere. Earth is the only planet in the solar system that supports life. There are many reasons that contribute to this and the most important being the earth's distance from the sun, the presence of oxygen in the atmosphere and the presence of water. The above factors, alongwith the existence and interaction of the three spheres of the earth (the lithosphere, hydrosphere and atmosphere) gives rise to the fourth sphere which is the life sphere or biosphere (Figure 7.1). The term Biosphere was coined by Eduard Suess in 1875. Later contributions to the study of biosphere were from, Charles Darwin and many other scientists.

- Thus, in the biosphere, life exists on land, water and air and life forms range from microorganisms to plants, animals, birds, amphibians, reptiles and mammals including human beings.The biosphere is formed of biotic components. It consists of organisms, population, community and ecosystem.

Ecosystem

Organism - includes animals, plants and micro-organisms. **Population** - is a group of similar plants or animals living in anarea. **Community** - refers to all the plants and animals living in an area. **Ecosystem**- all living and non-living things and their interaction within an area.

- Life cannot exist in isolation. It flourishes in an environment which supplies and fulfills its material and energy requirements. A biotic community and its physical environment in which matter and energy flow and cycle is called as ecosystem.

- The term ecosystem was first proposed by Arthur George Tansley in 1935. Tansley defined ecosystem as, 'the system resulting from the integration of all living and non-living factors of the environment'. The ecosystems can vary in size. It can be very small, extending to about a few square centimeters or it can extend over many square kilometres. Example; tropical forests.

Major components of an ecosystem

- The ecosystem is made up of two main components:
  A. Abiotic Component and
  B. Biotic Component

A. **Abiotic Component:** This component of the ecosystem includes the non-living substance of the environment. Example; light, air, soil, water, climate, minerals, etc. Sun is the main source of energy for the earth.

B. **Biotic Component:** This includes a variety of living organisms such as microorganisms, plants and animals. The biotic component of an ecosystem can be further divided into producers, consumers and decomposers based on their capacity to sustain themselves (Figure 7.2).

   a. **Producers:** Organisms that can produce or manufacture their own food are known as producers. Plants that have green pigments or chlorophyll, produce their own food in the presence of CO^2 in the atmosphere, water from the soil and sunlight through a process called 'photosynthesis'. These green plants are called as 'autotrophs' (auto – self; trophs – nourishing) as they manufacture their own food.

b. **Consumers:** Consumers are organisms that cannot manufacture their own food and get their food and nutrients from producers directly or from other organisms. They are called as 'heterotrophs' (hetero – others; trophs – nourishing).

- Consumers can be divided into primary, secondary and tertiary consumers.

1. Primary Consumers

- Organisms that feed on producers (green plants) are called primary consumers. They are also called as 'herbivores' or plant eating organisms. Examples of terrestrial herbivoreare grasshopper,sheep, goats, cow, rabbit, deer, elephant etc. Examples of aquatic herbivores are zoo plankton, krill, squid, small fish, sea urchin, etc.

2. Secondary Consumers

- Animals that kill and eat the herbivores or plant eating animals are called secondary consumers. They are also called as 'carnivores', Example; lion, tiger, foxes, frogs, snakes, spider, crocodiles, etc.

3. Tertiary Consumers

- They are top predators in a food chain. They are carnivores at the topmost level in a food chain that feed on other carnivores or secondary consumers. Example: an owl eats a snake but an owl is eaten by a hawk, therefore a hawk is a tertiary consumer. Tertiary consumers that occupy the top trophic level, and are not predated by any other animals are called 'apex predators'. However, when they die their bodies will be consumed by scavengers besides the decomposers Example; alligator andhawk.

- Some organisms eat both plants and animals. These animals are called as 'omnivores. Example; cockroach, foxes, seagull and human.Some omnivores are 'scavengers', which eat food that other animals have left behind Example; hyena and vultures.

- Plants and animals that live on or inside other plants or animals are called as Parasites. Example; mistletoe lives on other plants. Other examples are tapeworms, round worms, lice, ticks, flea etc.'Detritivores' are consumers that feed on detritus. Detritus includes fallen leaves, parts of dead trees and faecal wastes of animals. Ants, termites, earthworms, millipedes, dung beetle, fiddler crabs and sea cucumbers are detritivores.

4. **Decomposers:**

- Decomposers are organisms that help decompose dead or decaying organisms. Decomposers are also heterotrophs. Decomposers are nature's built-in recycling system. By breaking down materials – decomposers return nutrients to the soil. They, in turn, create another food source for producers within the ecosystem. Mushrooms, yeast, mould, fungi and bacteria are common decomposers.

The earthworm is called as the friend of the farmer. Find out the reason why?

Food Chain and Food Web

- Every living creature in an ecosystem has a role to play. Without producers, the consumers and decomposers would not survive because they would have no food to eat.Without consumers, the populations of producers and decomposers would grow out of control. And without decomposers, dead producers and consumers would accumulate as wastes and pollute the environment.

- All organisms of an ecosystem depend on one another for their survival. Each organism living in an ecosystem plays an important role in the flow of energy within the system. Organisms need energy for respiration, growth, locomotion, and reproduction. This movement of energy is usually understood through food chains or food webs. While a food chain shows one path along which energy can move through an ecosystem, food webs show all the overlapping ways that organisms live with and depend upon one another.

A. Food Chain

- A food chain describes the flow of food in an ecosystem. This flow or feeding structure in an ecosystem is called 'trophic structure'. Each level in this structure is called a trophic level. A food chain starts the movement of energy from one trophic level to the next (Figure 7.3). Example; Plant (primary producer) is eaten by a rabbit (herbivores, primary consumer), rabbit is eaten by a snake (carnivores, consumer or primary carnivore)and the snake is eaten by a hawk (tertiary consumer).

Food Web

- A Food Web is a complex network of interconnected food chains. Food chains show a direct transfer of energy between organisms. A chain might involve a mouse eating some seeds on the forest floor, a snake eating the mouse and later an eagle eating the snake. With each step, some of the energy from the sun, which is trapped within the seeds, is getting passed on.

- In a food web, the mouse might eat seeds, but it also might eat some grains, or maybe even some grass. The mouse might be eaten by a snake, or the eagle, or even a fox. The snake could be eaten by the eagle, but also might be eaten by a fox in the forest.Since each organism can eat multiple organisms and be eaten by multiple organisms, a food web is a much more realistic scheme of the transfer of energy within an ecosystem (Figure 7.4).Food chains and food webs are found in both terrestrial and aquatic ecosystems.

- Organisms in a food chain or food web are linked and dependent on one another for survival. If organisms in one trophic level become threatened, it impacts the organisms in other trophic levels. Primary consumers get less food due to loss or destruction of habitat.This in turn means less primary consumers for secondary and tertiaryconsumers to feed on. The plant and animal species in such an environment could become endangered or even extinct. For this reason, it is vital that an ecosystem remains balanced containing an appropriate proportion of producers and consumers.

Energy Flow in an Ecosystem

- Energy in an ecosystem flows from producers to consumers. The available energy in a food chain decreases with each step or trophic levels up in the food chain. As such, there is less energy available to support organisms at the top of the food chain. That is why the tertiary and quaternary consumers are far less in number in an ecosystem than organisms at lower trophic levels.

Energy Pyramids

- Energy pyramids are another tool that ecologists use to understand the role of organisms within an ecosystem. As you can see, most of the energy in an ecosystem is available at the producer level. As you move up on the pyramid, the amount of available energy decreases significantly. It is estimated that only about 10% of the energy available at one trophic level gets transferred to the next level of the energy pyramid. The remaining 90 percent of energy is either utilized by the organisms within that level for respiration and other metabolic activities or lost to the environment as heat.The energy pyramid shows how ecosystems naturally limit the number of each type of organism it can sustain (Figure 7.5).

Cycles in an Ecosystem

- Nutrients move through the ecosystem in cycles is called 'biogeochemical cycles'. A biogeochemical cycle is a circuit or pathway by which a chemical element moves through the biotic and the abiotic components of an ecosystem. All life processes are associated with the atmosphere by important cycles such as the Carbon, Oxygen, Nitrogen cycles etc. Through these cycles energy and materials are transferred, stored and released into various ecosystems. Let us discuss one of biogeochemical cycles in detail - the Carbon cycle.

The Carbon Cycle

- Carbon is exchanged, or cycled among all the spheres of the earth. All living organisms are built of carbon compounds. It is the fundamental building block of life and an important component of many chemical processes. Living things need carbon to live, grow and reproduce. Carbon is a finite resource that cycle through the earth in many forms.

- Carbon is an essential element in all organic compounds and since there is only a limited amount available it must be recycled continuously. This takes place in the biosphere. Atmospheric carbon is fixed in green plants through photosynthesis.

- This carbon is passed on to other living organisms through the food chain. The carbon food compound is utilized and later released to the atmosphere through the process of respiration.By-products of respiration are carbon-dioxide and water which are returned to the air.

A carbon cycle is completed by decomposers like bacteria and fungi which break down dead plants and animal tissues there by releasing some carbon to the air, water and soil.

- All producers and consumers are not decomposed. The organic matter of some of them is preserved in fossil fuels such as coal and petroleum for millions of years.In a carbon cycle (Figure 7.6), carbon moves between reservoirs. Carbon reservoirs include the atmosphere, the oceans, vegetation, rocks, and soil.

- Today, the carbon cycle is changing. Human activities have added more carbon into the atmosphere. More carbon is moving to the atmosphere when fossil fuels, like coal and oil, are burned. More carbon is moving to the atmosphere as humans destroy the forest. This increase in carbon in the atmosphere causes the earth to warm up more than the normal level, leading to climate change and many problems connected with it.

- A carbon sinkis a natural or artificial reservoir that accumulates andstores carbon for an indefinite period. The process by which carbon sinks remove carbon dioxide (CO^2) from the atmosphere is known as carbon sequestration. The main natural carbon sinks are plants, the ocean and soil.

Biomes

- An ecosystem as already explained consists of a biological community and an abiotic environment. Ecosystem may be broadly divided into land or terrestrial ecosystem and water or aquatic ecosystem. The aquatic ecosystem can be further divided into freshwater and marine ecosystem.An ecosystem becomes a biome when it extends over a large area. According toI.G. Simmons (1982) the most extensive ecosystem unit which is convenient to designate is called a 'Biome'. It

may be concluded that a biome is in fact a large ecosystem where we study the total assemblage of plant and animal communities. Since vegetation is the most dominant component of a biome and as vegetation and climate are very intimately related, the world is divided into a number of biomes based on major world climatic types (Figure 7.7).

Types of Biomes

- World Biomes are mega ecosystems existing and operating over large areas. These divisions are based on climate pattern, soil types, and the animals and plants that inhabit an area. Basically, biomes are classified into two major groups such as Aquatic biomes and Terrestrial biomes.Wetlands are transition zones between aquatic and terrestrial biomesTo understand the earth biomes, it is necessary to understand the following:

1. The characteristics of regional climates.
2. Aspects of the physical environment.
3. The type of soil and the processes contributing to soil development.
4. The distribution of flora in the area.
5. The distribution of fauna in the area and their adaptation to the environment.

A. Aquatic Biomes

- The aquatic biomes are the most important of all the biomes as, the water forms the vital resource and is essential for any life form. Since many types of species live in the water, it is one of the most important natural resources that need to be protected.

Aquatic Biome is further divided into:

a. Fresh Water Biome and
b. Marine Biome

a. Fresh Water Biome

- These biomes are spread over all parts of the earth and have different set of species depending on their location and climate. Fresh water biomes include areas of ponds, lakes, streams, rivers and wetlands. Lakes and ponds are stagnant water bodies and are smaller in their area. The diversity of life forms in river changes with increasing water volume. For example, Dolphins are found in theriver Ganges, Brahmaputra and the Indus which carry huge volumes of water.

b. Marine Biome

- Marine biome is an aquatic biome which is salt water biome occupying seas and oceans of the world. Marine biome plants have various roles, plants such as sea grasses and macro algae give shelter and nutrient for many animals.

- Marine plants are sources of nutrients for the corals and help corals to build up reefs. The reefs are kept intact by plants like coralline algae.

- Corals are marine invertebrates which live in compact colonies. They inhabit tropical oceans and seas. Corals cannot survive in waters below 20°C but grow optimally in temperatures between 23°–29° Celsius. Coral reefs are marine ecosystems which are held together by structures made of calcium carbonate secreted by the corals. Coral reefs are mainly classified into three types – Fringing reef, Barrier reef and Atoll.

Sea grasses are plants that live in saltwater. There are over 50 species of sea grasses. Sea grasses have flowers, roots, and specialized cells to transport nutrients within a plant. This makes them similar to land plants and different from algae or seaweeds.

Fringing reefs grow seaward from the shore along the coast forming a fringe. They are the common type of reefs.

Barrier reefs also border the shoreline but are separated from the coast by an expanse of water or lagoon.

Atolls are coral reefs that are circular in shape enclosing a lagoon with absence of an island in the center.

Marine biome includes fishes, whales, crustaceans, molluscs, sea anemones, fungi and bacteria. Marine species are continuously impacted by change in climatic condition and the oceans are frequently disturbed by ocean waves and currents.

c. Wetlands:

- A wetland is an area of land which is permanently or periodically saturated with water and exists as a distinct ecosystem. Wetlands play many roles in the environment, such as water purification, flood control, carbon sink and shoreline stability. Wetlands are home to a wide range of aquatic plants and animal life. Wetlands can be freshwater, brackish, or saltwater. Examples of aquatic vegetation that thrive in wetlands are milkweed, bald cypress trees, mangroves and cattails.

- **Crustaceans** are chiefly aquatic arthropods having a body covered with a hard shell or crust and several pairs of legs. Example: crab, lobsters, crayfish,

barnacles shrimps, krill etc.

- **Molluscs** are organisms with soft bodies. Often their bodies are covered by hard shells. Example: snail, slug, squid, cuttlefish, mussel, clams, oysters, octopuses etc.

B. Terrestrial Biome

Terrestrial biomes are very large ecosystems over land and they vary according to latitude and climate. They can be divided into numerous sub-types. In this lesson they are broadly divided into eight types.

- **A Bog** is a type of wetland ecosystem characterized by wet, spongy, poorly drained peaty soil formed from dead plants specially moss. Bogs have moss, sedges, grasses, such as cotton grass; insectivorous plants like pitcher plants; and many orchids. The gradual accumulation of decayed plant material in a bog functions as a carbon sink.

- **A Fen** is a low land that is covered wholly or partly with water. They receive nutrients from ground water and have peaty alkaline soil. Their characteristic floras are sedges and reeds.

- **Mangrove swamps** are coastal wetlands found in tropical and subtropical regions. These wetlands are often found in estuaries, where fresh water meets salt water. Mangrove trees dominate this wetland ecosystem due to their ability to survive in both salt and fresh water. The Sundarbans is the largest Mangrove region in the world and a UNESCO World Heritage Site.

- **Mangrove forests of Tamil Nadu:**Mangrove forests are found along the coast of Tamil Nadu in Pichavaram, Muthupet, Ramnad, Gulf of Mannar and Punnakayal.

i. Tropical Evergreen Rain Forest Biome

- Tropical Evergreen Rain Forest Biome extends between 10° North and Southof the equator (Figure 7.8). This biome is seen in the Amazon Basin of South America, Congo Basin of Africa and the Indo Malaysian Region of Southeast Asia (Java, Sumatra, Borneo, Malaysia and Guinea)

This biome receives direct sunlight throughout the year and so temperatures are high year round. The average annual temperature is 20°C to 30°C. The average annual rainfall of the tropical evergreen rain forest is 200cm.

- The Tropical Evergreen Rain Forest Biome has the largest number of plant and animal species. Broad leaved, tall evergreen hard wood trees are found in this biome. Trees grow up to 20 to 35 meters high. The forest is characterized by thick undergrowth and creepers. The main trees in this biome are mahogany, rose wood, ebony, cinchona, rubber, coconut palm, cane, bamboo etc.This forest biome has

innumerable insects, birds, reptiles and furless animals. At the edge of the forest animals like gorilla, and monkey are found.

- Important tribes inhabit this biome, for example the Pygmies in the jungles of Africa and the Yanomani and Tikuna tribes of the Amazon region. Traditionally they live by hunting and gathering food. In the recent years in South East Asia, the tropical evergreen rainforest has been slowly replaced by rubber and sugarcane plantations. The human settlements in this biome are small and scattered.

The forests of the Silent Valley National Park in Kerala on the Western Ghats arethe last remaining tropical evergreen forests in India. It is part of the Nilgiris Biosphere Reserve

ii Tropical deciduous Forest/Monsoon Forest

- Tropical deciduous forest is found in the regions experiencing monsoon climate. This biome is also called as the dry forest or monsoon forest biome.

- This is found in South and South East Asia in parts of India, Myanmar, Vietnam, Thailand, Cambodia and southern coastal China. It is also found in eastern Brazil and in smaller areas in South and Central America, the West Indies, southeastern Africa, and northern Australia.

- In this biome, the temperature varies from one season to another season. In summer the maximum temperature ranges from 38°C to 48°C. Summer season is warm and humid. In the dry winter season temperature ranges between 10°C to 27°C. The total amount of precipitation is 75 to 150 cm/year and this affects the natural vegetation of the tropical deciduous forest biome.

- The plants shed their leaves during the dry season. Trees here have huge trunks with thick rough barks. The plants grow at three different levels. The common trees are teak, sal, sandalwood,mahua (illupai), Mango, Wattle, Bamboo, semal (Illavamaram), sheesham (Karuvellamaram) and banyan.

- The animals of this biome are elephant, lion, tiger, leopards, bison, tapier, hippopotamus, wild boar, flying squirrel along with a wide variety of bird species. This biome faces rapid rate of deforestation and is, therefore, one of the most disturbed ecosystem in the world. Large tracts of forests have been destroyed for agriculture and urban development. Several species of precious animals have now become endangered Example: lions, tigers, leopards, etc.

iii. Temperate Deciduous Forest Biome

- The temperate deciduous forest is a biome that is always changing. This biome lies in the mid- latitude areas of the earth, between the tropics and Arctic Circle i.e., between 30° and 50° north and south of the equator. The temperate

deciduous forest biome can be seen in the eastern United States, most parts of Europe, China, Japan, North and South Korea (Figure 7.9). The average annual temperature is 10°C.

- These biomes have four seasons such as winter, spring, summer and fall. Winters are cold and summers are warm. As winter approaches, the duration of day light decreases. In this biome, deciduous trees shed their leaves in the fall. The production of chlorophyll in the leaves slows and eventually stops revealing leaves having bright red, yellow and orange colors. These forests are also known as broad leaved forest, because the trees have wide flat leaves. Some important trees found here are oak, maple, beech, hickory, cedar and chestnut. On the forest floorsthat receive very little sunlight are found mosses, azaleas and mountain laurels.

- Inhabiting the temperate deciduous forest are ants, insects, flies, bees, wasps, cicadas, walking sticks, moths, butterfly, dragon flies, mosquitoes and praying mantises.

- Frogs, toads, snakes and salamanders are some of the reptiles in this biome. Common birds found in this biome are woodpecker, robin, jays, cardinals, owls, turkeys, hawks and eagles. Small mammals like rabbits, otters, monkeys, beavers, squirrels and porcupine are also seen in this biome along with bears, grey fox, wolves, white tailed deer and moose. Animals that live in this biome adapt to the changing seasons. Some animals migrate or hibernate in winter.

- Most of these forests on the earth are cleared for agriculture. The soil here is very fertile. This is one of the most important agricultural regions of the world.

Grasslands

- Grasslands are found bordering the deserts and make up for one fourth of the natural vegetation of the earth. Those that lie in the low latitudes are called tropical grasslands and the ones which lie in the mid-latitudes are called temperate grasslands.

iv. Tropical Grassland BiomeorSavanna Biome

- The tropical grass land biome is generally referred to as the Savanna biome. A savanna is a rolling topography that features vast open grasslands scattered with small shrubs and isolated trees. It is found between the tropical rainforest and desert biome. Tropical grassland biomes are mainly found in Africa, South America and Australia. Tropical grasslands in Africa is known as the savannas. Tropical grasslands are called as llanos in Columbia and Venezuela and as Campos in Brazil of South America.

- Savanna biomes experience warm temperature year around. It has very long and dry winter season and a very wet summer season. The grass here is very tall

often one or two metres tall scattered with small shrubs and isolated umbrella shaped trees like the acacia and the baobab trees which store water in their trunks.

- Most of the animals in the savanna have long legs, like the giraffe and kangaroo. The carnivorous animals like lions, leopards, cheetahs, jackal and hyenas live in this biome. Zebras and elephants are also found in this biome.

- In many parts of the savannas of Africa people have started using the grassland for grazing their cattle and goats. Due to overgrazing in this region most of the tropical grasslands here are lost to the Sahara desert year after year.

v. Temperate Grassland Biome or Steppe

- The temperate grassland biomes are generally found in the interior of the continents in the mid-latitudes. These grassland biomes are found in the transitional zone between the humid coastal areas and the mid latitude deserts.

- The temperate grasslands are known as Steppes in Europe and Asia, Prairies in North America (Canada and USA), Pampas in South America, Veldts in South Africa, Downs in Australia and Puszta in Hungary. The annual range of temperature is quite large with summer temperature reaching as high as 38°C and winter temperatures falling down to -40° C. The rainfall is moderate from 25 cm to 50 cm. Grasses form a major part of the vegetation in the temperate grasslands.

- The height of the grasses depends upon the amount and distribution of rainfall.The animals in this area include the bison, wolves of the Prairies of North America. The other animals and birds are coyotes, prairie dog, foxes, mice, rabbits, badgers, rattle snakes, pocket gophers, weasel, grasshoppers, quails and hawks.

vi. Tropical Desert Biome

- A tropical desert is the hottest and driest place on earth where rainfall is very scanty and irregular. This biome is typically found in the western parts of the continents within the tropics.

- In the northern hemisphere, the Afro – Asian deserts form the longest belt which includes the Sahara desert, Arabian desert and the That deserts. In North America the tropical deserts cover, California, Arizona and New Mexico states of USA and it further extends to Mexico. The deserts in the southern hemisphere are, the Atacama desert west of Andes mountains in South America, the Namibian and the Kalahari deserts in southern Africa and the Great Australian desert in the central and southern parts of Australia.

- The tropical deserts are not conducive for the growth of vegetation due to shortage of water. The plants found here are the xerophytes which have their own

moisture conserving methods such as long- roots, thick barks, waxy leaves,thorns and small leaves so as to avoid evapotranspiration.

- The main trees and bushes found in this region are acacia, cacti, date palm, kikar, babul etc.The animals in this biome are limited in number. They are able to bear the drought and the heat of the desert. Animals like the camel, antelopes, fox, spotted hyena, fallow deer, cape hare, hedgehog etc., live in the desert.

- The tropical desert biomes are agriculturally unproductive except in and near the oasis. In the oasis, cultivation is carried through irrigation either from streams or from underground sources. Date palms are widely grown here.

- The people in the deserts are generally nomads living in tents and moving from place to place. They are the Berbers of North Africa, the Bedouins of the Arabian deserts, the Damara in Namibia, the Bushman of the Kalahari Desert and the Aborigines of Australia. They practice food gathering and hunting while some herd cattle, goats and camel and some of them practice very simple subsistence farming.

- One of the toughest foot races in the world is held in Sahara every year in April. This race is called The Marathon des Sables (MDS) and participants have to cover a distance of 250km over Sahara desert in southern Morocco in a span of 7 days. About 1500 participants aged between 16 to 79 from all over the world participate in this race.

Source: Morocco World News

vii. Taiga or Boreal Forest Biome

- The taiga biome is the largest terrestrial biome and extends across Europe, North America and Asia. The taiga biome is also known as coniferous forest or boreal forest biome. It extends from about 50° to 55° North to 65 ° to 70° North latitudes. This region lies between the temperate grassland in the south and the polar tundra in the north. The taiga region is absent in the southern hemisphere mainly because of the narrowing of continents towards the South Pole.

- This biome has short wet summer and long cold winters. The taiga region has low mean annual precipitation ranging between 35 cm and 60 cm and the rainfall occurs mostly in summer. It receives plenty of snow during winter.The taiga or boreal forest biome consists mainly of evergreen coniferous forests. The important coniferous trees in this biome are pines, spruces, firs, maples and cedars. During the short summer season snow melts and this helps lichens, mosses and short grasses to grow and cover the ground. These are called 'meadows'.

- Taiga is the home of some larger animals like moose, deer, and bears, while smaller animals like bobcats, squirrels, chipmunks, ermine, and moles are also found. Animals of the taiga have specialised adaptation including lot of thick fur

or feathers and the ability to change colours during different seasons example ermine.The ermine is a small mammal, which is covered with thick dark brown fur in summer. This changes to white in the winter, an adaptation which helps the ermine to blend into its surroundings and makes it more difficult for the predators to spot them.

- Lumbering is the main occupation of the people in areas which are easily accessible. The softwood from the coniferous forests is widely used in the manufacture of wood pulp and paper, newsprint, matches, furniture and building materials.

- The hunting of fur bearing animals like musk rats, ermine, and silver fox are important economic activities. The taiga forest is endangered due to logging and mining by humans. When trees are cut down in the taiga it takes a very long time to restore itself because of the very short growing season.

viii Tundra Biome

- Tundra is a Finnish word which means barren land. The tundra region is a vast bowl lying beyond the Arctic Circle (66.5° North latitude) in the northern hemisphere along the shores of the Arctic Ocean. TheArctic tundra extends southwards from North Pole to the Taiga forest. Tundra is also found in the high altitudes especially in the Alpine region.Due to long and severe cold winters, this region is treeless and has very little vegetation. The growing season for plants is very short. Natural vegetation mainly consists of shrubs, sedges, grasses, mosses and lichens.

- The main features of this climate in the tundra region are the general absence of insolation and presence of very low temperature throughout the year. The average annual temperature is about -12°C. The ground surface is covered with snow for at least 8 to 9 months in a year. In this biome, the sub soil remains permanently frozen and is known as permafrost. Permafrost tundra covers vast barren areas of northern Russia and Canada. Algae and fungi are found on the rocky cliffs and rosette plants grow in rock and gravel beds. Spongy turf and lichen develop in the drier inland tundra.

- Animals common to Arctic tundra are the polar bear, arctic wolf, arctic fox, arctic hare and arctic weasel. Large herbivores such as musk oxen, caribou and reindeer are found. Lemmings are also found in this Biome. Insects like moths, butterflies, beetles, mosquitoes and black flies are common in the Arctic tundra. Migratory birds include tundra swans, harlequin ducks, sand pipers, plovers, geese and gulls.

- The Antarctic region is covered with ice sheets. It is too cold and dry to support vegetation. However, some portions of the continent have areas of rocky soil that support plant life. Vegetation comprises of mosses, lichens and liver

worts. This area is referred to as Antarctic tundra. Seals and Penguins inhabit the shore areas of Antarctica.

Biodiversity

- The term biological diversity was used as early as 1968 by wildlife conservationist Raymond F. Dasmann. Latter in 1988,entomologist E.O. Wilson used the term Biodiversity and this term has been used since then. Biodiversity refers to the variety of life on Earth. This includes the number of species of plants, animals and microorganisms along with the diversity of genes in these species. Moreover, it embodies the different ecosystems on the planet, for example forests, deserts, coral reefs and wetlands.

- Biodiversity is the variability among living organisms. This includes diversity within species, between species, and between ecosystems. The variety of biodiversity or the number of species in a given area is referred to as species richness. Normally variety of life increases with size of area.

Biodiversity can be identified at three levels:

A. Genetic diversity
B. Species diversity
C. Ecosystem diversity

A. **Genetic diversity** refers to the total number of genetic characteristics in the genetic makeup of a species. Example: Each human being is very different from others. Genetic diversity helps the population to adapt to changes in the environment or adapt to different environments. Domestication of dogs can be taken as a common example.

B. **Species diversity** is the number of different species of plants and animals that are present in a region. A community with more number of species enjoys species richness. Naturally undisturbed forests have greater species richness than reforested areas or plantations.There are three types of Species:

   a. **Endemic species** - is one whose habitat is restricted only to a particular area because of which it is often endangered. It differs from "indigenous," or "native," which although it occurs naturally in an area, is also found in other areas.
   b. **Exotic Species** - is any species intentionally or accidentally transported and released by man into an environment outside its original range. These are often the most severe agents of habitat alteration and degradation, and a major cause of the continuing loss of biological diversity throughout the world.

c. **Cosmopolitan Species –** It is a species that is found to be distributed over most regions of the earth example: cats, dogs, human beings. The killer whale is considered as the most cosmopolitan species in the world.

C. **Ecosystem diversity** refers to the variety of life forms in a prescribed ecosystem. Ecosystems may be both terrestrial and aquatic. Distinctive terrestrial ecosystems include forests, grasslands, deserts, etc. while aquatic ecosystems are rivers, lakes, oceans etc.

- In understanding biodiversity, the most common question that arises in our mind is how many different plant and animal species are there on earth? There can be no definite answer to this question. At presentthe conservationscientists have identified over 8.7 million species worldwide. Of this only about 2 million are known to us ranging from microorganisms to giant mammals and reptiles. New species are being discovered while many species are also disappearing from the face of the earth.

Biodiversity hotspots

- Areas that are rich in species diversity are called as "Hotspots". The hottest spots for species diversity are the tropical rainforests. Tropical rainforests comprise of only 7% of all land on earth, yet are home to nearly 50% of all the species on Earth! India is among the World's 17 nations that are exceptionally rich in species diversity.

- The British biologist Norman Myers coined the term 'biodiversity hotspot' in 1988. According to him, a biodiversity hotspot is a biogeographic region characterised both by exceptional levels of plant endemism and by serious levels of habitat loss. Conservation International (CI) adopted Myers concept of 'hotspots' and it made an extensive global study of hotspots in 1999. According to CI, to qualify as a hotspot a region must meet two strict criteria: (i) It must contain at least 1,500 species of endemic plants, and (ii) It must have lost at least 70% of its original habitat. In 1999, CI's book 'Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions', identified 34 biodiversity hotspots in the different countries of the world.

- Currently there are 34 biodiversity hotspots that have been identified and, most of them occur in tropical forests (Figure 7.10). They represent just 2.3% of Earth's land surface, but between themthey contain around 50% of the world's endemic plant species and 42% of all terrestrial vertebrates. India has 4 biodiversity hotspots: the Western Ghats, the Himalayas, the Indo-Burma region and the Sundaland [includes Nicobar group of Islands].

Norman Myers (born 24 August 1934) is a British environmentalist specialising in Biodiversity hotspots. Professor Norman Myers was the first to alert global community to tropical deforestation, the mass extinction underway and

environmental security.

- Endemism is an ecological word meaning that a plant or animal lives only in a particular geographical location, such as a specific island, habitat type, country or any defined zone. For example, The Asiatic Lion of the Gir forest of Gujarat. The Kashmir Stag known as Hangul, which is found in the riverine forests of Kashmir Valley and Chamba in Himachal Pradesh. The Lion Tailed Macaque is India's most threatened monkey which is endemic to the Western Ghats of South India.

The 34 biodiversity hotspots of the World	
1. The Tropical Andes	18. The Philippines
2. Mesoamerica	19. Indo-Burma
3. The Caribbean Islands	20. The Mountains of Southwest China
4. The Atlantic Forest	21. Western Ghats and Sri Lanka
5. Tumbes-Chocó-Magdalena	22. Southwest Australia
6. The Cerrado	23. New Caledonia
7. Chilean Winter Rainfall-Valdivian Forests	24. New Zealand
8. Chilean Winter Rainfall-Valdivian Forests	25. Polynesia and Micronesia
9. Madagascar and the Indian Ocean Islands	26. The Madrean Pine-Oak Woodlands
10. The Coastal Forests of Eastern Africa	27. Maputaland-Pondoland-Albany
11. The Guinean Forests of West Africa	28. The Eastern Afromontane
12. The Cape Floristic Region	29. The Horn of Africa
13. The Succulent Karoo	30. The Irano-Anatolian
14.The Mediterranean Basin	31. The Mountains of Central Asia
15. The Caucasus	32. Eastern Himalaya
16. Sundaland	33. Japan
17. Wallacea	34. East Melanesian Islands

- **Conservation International** (CI) is an American non-profit environmentalorganization founded in 1987 in Virginia. Its goal is to protect nature as a source for food, fresh water, livelihood and a stable climate.
- CI has helped to support 1,200 protected areas across 77 countries, safeguarding more than 601 million hectares of marine and coastal areas.

Endangered species

- Rare, endangered or threatened plants and animals are elements of our natural heritage that are declining rapidly. If we cherish these species, like we do other rare and beautiful objects, these living organisms become treasures of the highest magnitude.

- The International Union for the Conservation of Nature (IUCN) has identified and classified species based on the nature of their depleting numbers. The IUCN's Red List of Threatened Species, identified in 1964, is the world'smost important inventory of the global conservation status of biological species.Species are

classified by the IUCN Red List into nine groups specified through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (Figure 7.11).

- Extinct (EX) – The species has disappeared and no known individuals remaining
- Extinct in the wild (EW) – Known only to survive in captivity, or as a naturalized population outside its historic range
- Critically Endangered (CR) – Species that have drastically dwindled and are at extremely high risk of extinction in the wild
- Endangered (EN) – High risk of extinction in the wild
- Vulnerable (VU) – High risk of endangerment in the wild
- Near threatened (nt) – Likely to become endangered in the near future.
- Least concern (lc) – Lowest risk widespread and abundant
- Conservation dependent (cd) – This group has now merged with near threatened.
- Data deficient (dd) – Not enough data to assess the risk of extinction of the species.
- Not evaluated (ne) – Species not yet been evaluated against the criteria.

- In the context of the IUCN Red List, 'threatened' embraces the three categories of Critically Endangered, Endangered, and Vulnerable.
- According to the IUCN those species that have dwindled drastically are called as Critically Endangered and are included as Red List. Species that have disappeared are called as extinct species. In the Red List of 2012 that was released on 19 July 2012 at Rio+20 Earth Summit 19,817 species were threatened with extinction.

The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1964, is the world's most comprehensive inventory of the global conservation status of biological species. The International Union for Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. A series of Regional Red Lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit.

- A Hawaiian plant species called Alula locally referred to as cabbage on a stick has moved from Critically Endangered to Extinct in the Wild. It is one of the 38 Red Listed Hawaiian plant species with less than five wild individuals remaining. It used to grow on the windy sea cliffs of Kauai. Alula was destroyed by hurricanes Iwa and Inki in 1982 and 1992 leaving only less than 10 plants alive.

- The majority of the great ape species are now Critically Endangered. The Eastern Gorilla the largest living primate is endemic to the Eastern Democratic Republic of Congo, south western Uganda and Rwanda. This species which was listed as Endangered has moved to Critically Endangered in 2016 due to an on-

going population decline. This decline is due to illegal hunting and destruction of forests for agriculture. If this trend continues, around 93% of Eastern Gorillas will be eliminated by 2054.

- The Pygmy Hog: It is the smallest and rarest wild pig on earth and itis a Critically Endangered species previously spread across Bangladesh, Bhutan, India and Nepal. but now only found in Assam, India. In 1995, the Pygmy Hog Conservation Programme was started by Goutam Narayan of Ecosystems-India, with the help of the Assam government and now their numbers have increased to about 150.There are many other critically endangered species in India and some of them are listed below

Critically Endangered species in India 2016

Arthropod

- Rameshwaram parachute spider
- Peacock tarantula

Birds

- White-bellied heron
- Great Indian bustard
- Forest owlet
- Spoon-billed sandpiper
- Siberian crane
- Indian vulture
- Himalayan quail
- Pink-headed duck

Fish

- Wayanadmahseer
- Pondicherry shark
- Ganges shark
- Pookode Lake barb
- Common sawfish

Insects

- Pygmy Hog Sucking Louse

Reptiles and amphibians

- Madras spotted skink
- Gharial

- Toad-skinned frog
- Charles Darwin's frog
- White-spotted bush frog
- Munnar bush frog
- Ponmudi bush frog
- Anaimalai flying frog

Mammals

- Asiatic cheetah
- Namdapha flying squirrel
- Himalayan wolf
- Andaman shrew
- Nicobar shrew
- Northern Sumatran rhinoceros
- Chinese pangolin
- Pygmy hog
- Indian Javan rhinoceros
- Malabar large-spotted civet

- The plant Alliumiatrouinum of the Mediterranean, belonging to the onion family was added to the IUCN Red List as Critically Endangered (CR) in 2017. Currently this plant is known to exist only on Mount Ochi in the southern part of Evvia Island, Greece. It is understood that the threat was from the numerous wind parks and wind turbines developed in the area.An endemic species of small trees growing at low altitudes in New Caledonia called Pittosporumbrevispinium has declined causing it to move from Endangered to Critically Endangered in 2017. The species decline has been attributed to conversion of dry forests to pasture land and degradation of forest by the Rusa deer.

- The Red-legged FireMillipede is found in the rainforests of Madagascar. It entered the IUCN Red List in 2017 as, Critically Endangered (CR).The degradation of its habitat due to slash and burn agriculture and cutting of trees for firewood by local communities has caused its decline.The IUCN Red List in 2017 declared the Christmas Island Whiptail-skink endemic to Christmas Island as Extinct. The last known individual died in captivity in 2014. This dramatic decline and extinction was due to the impact of the introduction of Yellow Crazy Ant, Indian Wolf Snake and other new species on Christmas Island along with deforestation due to mining.

The status of the Rodrigues Flying Fox moved from Critically Endangered to Endangered in 2017. This was due to a number of conservation measures taken, such as, captive breeding programme involving 46 zoos around the world, restoration of natural habitat, watershed protection, and awareness rising through education programmes. Its population has increased from 4,000 in 2003 to about 20,000 individuals in 2016. The future survival of this species will depend on continued conservation efforts.

Causes of Extinction of Species

- Extinction is defined as the permanent disappearance of an organism from the face of the earth. In other words, all members of a species have died. This means a loss of biodiversity. Extinction of species may take place (Figure 7.12) due to a variety of causes as given below:

- Sudden and rapid changes of environmental conditions

1. The sudden outbreak of disease and pest infections.
2. Some sudden events like forest fires, volcanic eruption etc.
3. Direct hunting and persecution of species leading to 'selective mass extinction.
4. Ecological substitution by other species of large carnivorous animals which compete for the same food resources.
5. Climatic change accelerates the competition between large mammals for shelter and food.
6. Extinction of weak species during the course of competition with more powerful and stronger species.
7. Man-induced environmental changes also cause species extinctions.

Between 1600 and 1900 it is estimated that one species went extinct every four years. In modern times, the rate is soaring. The graph below (Figure 7.12.) shows how the rate of extinction of species has increased over the past 50 years. This could be attributed to the rapid increase in population during the same period of time.According to IUCN the rate of extinction of mammals and birds had started much earlier by 1700 itself at a much faster rate as shown in the graph below (Figure 7.13).

Major Threats to Biodiversity

- The following are some of the major threats to biodiversity:

a. Habitat destruction and degradation
b. Invasive alien species-these can destroy native species Example, lantana Camera plant in India.
c. Climate Change- Example, bleaching and loss of coral reefs due to global warming
d. Pollution of air, water and soil – Pollution can alter the growth and life of organisms in a great way.
e. Over exploitation of one resource – Over exploitation through Hunting or Poaching, Deforestation etc., can influence the life of all the interdependent species.

- Despite rapid efforts in protecting terrestrial and marine habitats, world's diversity of species is still dwindling. Since the 1960's over 100,000 'protected areas' have been established. This represents 11,265,408 sq.km of land and 1,609,344 sq.km of ocean. Yet, terrestrial and marine species have declined over the same period. This suggests that the common conservation strategy of protecting areas of land and sea is inadequate.

Conservation of Biodiversity

- Conservation of bio-diversity is the proper management of the biosphere by human beings in such a way that it gives maximum benefits for the present generation and also develops its potential to meet the needs of the future generations.

- The three basic objectives of biodiversity conservation are :

a. To maintain essential ecological processes and life supporting systems.
b. To preserve the diversity of species.
c. To make sustainable utilization of species and ecosystems.

- There are two types of conservation methods (Figure 7.15) namely in-situ and ex-situ conservations.In-situ conservation means the conservation of species within their natural habitats. This strategy involves identification of species rich areas and adopting methods to protect it in the form of National Park or Wildlife Sanctuary or Biosphere Reserve etc. In this way biodiversity can be conserved in their natural habitat from human activities.

- Ex-situ conservation involves maintenance and breeding of endangered plants and animals under partially or wholly controlled conditions in specific areas like zoo, gardens, nurseries etc.Other examples of ex-situ conservation include:

i. Seed gene bank
ii. Field gene bank
iii. Botanical gardens

Biodiversity conservation in India

- India is one of the 17 mega bio-diverse countries of the world (according to Conservation International). With only 2.4% of the world's land area, 16.7% of the world's human population and 18% of livestock, it contributes about 8% of the known global biodiversity. India has a number of globally important endangered species like Asiatic lion, Asian elephant, one-horned rhinoceros, Gangetic river dolphin, snow leopard, Kashmir stag, dugong, gharial, great Indian bustard, lion tailed macaque etc. The following steps have thus been taken to protect and manage the wildlife of the country.

1. The Government of India enacted the Wild Life (Protection) Act 1972 with the objective of effectively protecting the wild life of this country and to control poaching, smuggling and illegal trade in wildlife and its derivatives.

2. The National Board for Wildlife (NBWL) chaired by the Prime Minister of Indiaprovides for policy framework for wildlife conservation in the country.

3. The National Wildlife Action Plan (2002–2016) was adopted in 2002, emphasizing the people's participation and their support for wildlife conservation.

4. The Indian Constitution lays the subject of forests and wildlife in the Concurrent list thus laying the responsibility of wildlife conservation on both the Centre and the State.

5. Specialised projects: To save the endangered species of animals, specialised projects are being implemented with international cooperation (WWF, UNDP, UNEP, IUCN) as well as on a stand-alone basis like the following: (Table 7.1)More recently, the Black Buck (chinkara) the Great Indian Bustard and the snow leopard have been given full or partial legal protection against hunting and trade throughout India.

6. **The Protected Areas of India**Protected areas are those in which human occupation is small and exploitation of resources is limited. These are defined according to the categorization (Table 7.2).

There are 4 categories of the Protected Areas in India.

- National Parks,
- Wildlife Sanctuaries,
- Conservation Reserves, and
- Community Reserves.

Protected Areas	Number	Total Area in sq Km	% of the Country
National Parks (NPs)	103	40500	1.2
Wild life Sanctuaries (WLSs)	537	118005	3.6
Conservation Reserves (CRs)	67	2350	0.1
Community Reserves	26	47	0.01
Total Protected Areas (PAs)	733	160902	4.91
Source: ENVIS Centre on Wildlife & Protected Areas (http://www.wiienvis.nic.in/Database/ConservationAreas_844.aspx)			

National Park

1. National parks in India are IUCN category II protected areas.
2. A National park is an area with ecological, geomorphological and natural significance with rich fauna and flora, designed to protect and to develop wildlife or its environment.
3. Activities like grazing, hunting, forestry or cultivation etc. are strictly prohibited.
4. No human activity is permitted inside the national park.
5. India's first national park was established in 1936 as Hailey National Park, now known as Jim Corbett National Park, Uttarkhand.
6. There are 103 national parks in India (National Wildlife Database, April 2015).

Wildlife Sanctuary

1. The difference between a Sanctuary and a national park lies mainly in the rights of people living inside. In a Sanctuary, certain rights are allowed but in a national park, no rights are allowed for grazing of any livestock. In a wildlife Sanctuary, the Chief Wildlife Warden may regulate, control or prohibit certain activities.
2. There are a total of 537 wildlife sanctuaries in India.

Conservation reserves and community reserves in India:

1. These terms denote the protected areas of India which typically act asbuffer zones between established national parks, wildlife sanctuaries and reserved and protected forests of India.
2. They are called as 'Conservation Reserves' if they are uninhabited and completely owned by the Government of India but used for subsistence by communities.

They are called 'Community Reserves' if a part of the land is privately owned.

7. **Biosphere Reserves**: A biosphere reserve is an area of land or water that is protected by law in order to support, sustain and conserve ecosystems.Biosphere Reserves of India protect very large areas of natural habitat that are much bigger than national parks or wildlife sanctuaries. Biosphere reserves may cover multiple national parks, sanctuaries and reserves which are contiguous.example, the Nilgiri Biosphere covers: Bandipur National Park, Mudumalai Tiger Reserve, Silent Valley National Park, Nagarhole National Park and Mukurthi National Park.(Figure 7.16)

- Biosphere reserves are traditionally organized into 3 interrelated zones, known as: Core area, Buffer zone, and Transition zone.
- Presently, there are 18 notified biosphere reserves in India. Ten out of the eighteen biosphere reserves are a part of the World Network of Biosphere

Reserves, based on UNESCO's Man and the Biosphere (MAB) Programmed list.

8. Some Other Important Conservation Sites

1. Tiger Reserves – Project Tiger was launched by the Government of India in the year 1973 to save the endangered species of tiger in the country. Starting from nine (9) reserves in 1973 the number has now grown to fifty (50) in 2016. Table 7.2. gives a list of conservation sites and their numbers in India.

9. **Role of communities:** Communities are playing a vital role in the conservation and protection of wildlife in India, example:
    1. **Sariska Tiger Reserve:** In Sariska tiger reserve Rajasthan villagers have fought against mining by citing the wildlife protection act. In many areas, villagers themselves are protecting habitats and explicitly rejecting government involvement.
    2. **BhairodevDakavSonchuri:** The inhabitants of five villages in the Alwar district of Rajasthan have declared 1200 hectares of forests as theBhairodevDakavSonchuri declaring their own set of rules and regulation which do not allow hunting, and are protecting the wildlife against any outside encroachments.
    3. **Bishnoi villages:** In and around Bishnoi villages in Rajasthan, herds of blackbuck, nilgai and peacocks can be seen as an integral part of the community and nobody harms them.

The Role of GIS in Conservation of Nature

- Recently Geographic Information System (GIS) has been used as a tool to identify new areas that need to be conserved. In the last 15 years Remote Sensing and GIS has been used to developed gap analysis as a method to identify biodiversity (i.e., species, ecosystems and ecological processes) that is not adequately conserved within a protected area network or through other effective and long-term conservation measures. Gap analysis is a method of comparison of actual performance with potential or desired performance. It was thus developed in response to recognition that protectedareas of all types and in all parts of the world do not fully protect biodiversity. Gap analysis is usually applied to fairly large areas of study.

Reserves/Conservation Sites	Numbers	Total Area in Sq km
Tiger Reserves	50	71027
Elephant Reserves	32	69583
Biosphere Reserves	18	87492
RAMSAR Wetland Sites	26	12119
Natural World Heritage Sites	07	11756
Important Coastal and Marine	107	10773

Biodiversity Areas		
Marine Protected Areas	131	9801
Potential/ Important Bird Areas	563	-
Source: ENVIS Centre on Wildlife & Protected Areas (http://www.wiienvis.nic.in/Database/ ConservationAreas_844.aspx)		

Highlight: In 1798, in a small village called Vedanthangal near Chennai, theBritish soldiers shot some storks in the local wetland. The villagers stormed the Collector's office and made him issue an order not to harm the nesting birds. This took place long before the concept of conservation of biosphere entered our thoughts. India has experienced many such incidents only some of which have been recorded.

- Biodiversity is necessary for our existence as well as valuable in its own right. This is because it provides the fundamental building blocks for the goods and services that provide us with a healthy environment. Biodiversity includesfundamental things to our health like fresh water clean air and food products, as well as many other products like timber, medicine and fibre.

- Biodiversity also includes various other important things and services such as cultural, recreational and spiritual nourishment that play an important role in maintaining our personal life and social life.

It is therefore the duty of every citizen to conserve this valuable life on earth, the most precious gift we can pass on to the future generations.

The Asiatic Cheetah of India Becomes Extinct

- Cheetah is found in Africa and Asia. It is the fastest land animal on Earth. The Asiatic cheetah, is slightly smaller than the African cheetah. It has a fawn-coloured body with black spots and distinctive black "tear marks" running from the corner of each eye down the side of its nose.
- The Asiatic cheetah also known as the Iranian cheetah is a Critically Endangered subspecies surviving today only in Iran. It was once found in the Arabian Peninsula, Near East, Kyzyl-Kum desert, Caspian region, Pakistan and India.
- Asiatic cheetahs were once widespread across the continent but were eradicated in India, where they were hunted for sport. The spread of farming also greatly reduced their numbers in the 19th and 20th centuries. Eventually the animal was wiped out in Asia to which it was once native.
- Cheetah has been known to exist in India for a very long time. They were kept by Kings and princes, but hunting led to their extinction in the country. In 1948, Maharajah RamanujPratap Singh Deo shot three of the last cheetahs in India, in Surguja, State of Madhya Pradesh which is present day Northern Chhattisgarh.
- The Indian government had plans to reintroduce cheetahs back in India in 2009 but this project has not yet been taken up.

Monsoon, rainfall,Weather, Climate

8TH Term I	**Unit - 2**	**Weather And Climate**
10th book	**Unit - 2**	**Climate & Natural Vegetation of India**
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8TH Term I
Unit - 2 - Weather And Climate

Introduction

- Climate is one of the basic elements in the natural environment. It affects landforms, soil types, fauna and flora. It influences man to a large extent.

- Weather and climate influence man's activities like what we eat, wear, the house in which we live and work, farming, sailing, fishing, modern transport and even our play time etc. Hence one should have knowledge about the weather and climate. So, in this chapter we are going to learn about weather and climate, its elements and how they influence our lifestyle

Weather

- Weather is the day today conditions(state) of the atmosphere at any place as regards sunshine, temperature, cloud cover, Wind fog condition, air pressure, humidity, precipitation and such other elements. It refers to short periods like a day, a week, a month or a little longer and as such the weather changes from time to time in a day and one period to the other in an year.

Earth's atmosphere is a layer of gases surrounding the planet earth and retained by the earth's gravity. It contains about 78% nitrogen, 21% oxygen, 0.97% argon, 0.03% carbon dioxide and 0.04% trace amounts of other gases and water vapour

Climate

Climate is generally defined as the average conditions (state) of the weather of a place or a region. The average atmospheric conditions are determined by measuring the weather elements for a long period of time which is usually for 35 years. The elements of weather and climate are the same. The climate does not change often like weather.

The word Climate is derived from the ancient Greek word "Klimo" which means "Inclination".

Controlling factors of weather and climate

Angle of the sun's rays, the length of daytime, altitude, distribution of land and water bodies, location and direction of mountain ranges, air pressure, winds and ocean currents are the major factors which affect the weather and climate of a region.

The earth is spherical in shape. So, the sun's rays fall unevenly on the earth's surface. The Polar regions receive slanting sun's rays. Hence there is little or no sunlight, thus there is an extreme cold winters. Vertical sun's ray's fall directly on regions around the equator,hence the climate is very hot and almost no winters. The difference in temperature makes the air and water move in currents. Warm air rises and creates more space for air beneath, while cool air settles down.

Scientific study of weather is called Meteorology and the scientific study of climate is called climatology

Elements of weather and climate

Temperature, rainfall, pressure, humidity and wind are the major elements of weather and climate.

Temperature

- Temperature is one of the key elements of weather and climate. The earth and its atmosphere get heated from the sun through insolation. The degree of heat present in the air is termed as temperature. Apart from sun's rays, the heat in air also depends the atmospheric mass to a small extent.

Distribution of weather elements are shown by means of Isolines on maps. Isolines are those which join the places of equal values. Isolines are given different names based on the weather element they represent.

Isotherm	Equal Temperature
Isocryme	Equal Lowest mean temperature for a specified period
Isohel	Equal Sunshine
Isollobar	Equal Pressure tendency showing similar changes over a given time
Isobar	Equal atmospheric pressure
Isohyet	Equal amount of rainfall.

- Temperature varies with time due to changes in the level of radiation which reach the earth surface. This is due to motions of the earth (The rotation and revolution) and inclination of the earth's axis.

- The temperature influences the level of humidity, the process of evaporation, condensation and precipitation.

- Heat energy from solar radiation is received by the earth through three mechanisms. They are radiation, conduction and convection. The Earth's atmosphere is heated more by terriestrial radiation than insolation.

Temperature varies both horizontally and vertically. Temperature decreases with increasing height is known as Lapse rate which is 6.5 degree celsius per 1000 meters in troposphere

Factors affecting the distribution of temperature

Latitude, altitude, nature of land, ocean currents, prevaling winds, slope, shelter and distance from the sea, natural vegetation and soil are the major factors which affect the distribution of temperature.

Measuring Temperature

- The temperature of a unit volume of air at a given time is measured in scales like Celsius, Fahrenheit, and Kelvin. Meteorologist measures the temperature by the Thermometer, Stevenson screen and minimum and maximum Thermometer. The energy received by the earth through insolation is lost by outgoing radiation. Atmosphere is mainly heated by outgoing radiation from 2 to 4pm .So the maximum temperature is recorded between 2 and 4 pm regularly and minimum temperature is recorded around 4 am before sunrise.

Mean Temperature

- The average of maximum and minimum temperatures within 24 hours is called mean daily temperature [(87oF+73oF)/2=80oF]. Diurnal range of temperature is the difference between the maximum and minimum temperatures of a day. Annual range of temperature is the difference between the highest and lowest mean monthly temperatures of a year. The distribution of temperature is shown by means of Isotherms. Isotherms are imaginary lines which connect the same temperatures of different places.

Heat zones of the earth

- The fact that the earth is spherical in shape results in different parts of the earthgetting heated differently.Based on the heat received from the sun, Earth is divided into three heat zones. They are

Torrid Zone

- It is a region between the tropic of cancer and the tropic of Capricorn. This region receives the direct rays of the sun and gets the maximum heat from the sun.This zone known as the torrid or the tropical zone

Temperate zone

- This zone lies between the Tropic of cancer and the Arctic circle in the Northern Hemisphere and between the Tropic of Capricorn and the Antartic circle in the southern Hemisphere.This zone gets the slanting rays of the sun and the angle of the sun's rays goes on decreasing towards ds the poles.Thus this zone experiences moderate temperature.

Frigid Zone

- The frigid zone lies between the Arctic circle and the North Pole and between the Antartic circle and the South Pole.This region also known as Polar region.Since it receives the extremely low temperature throughout the year,these regions are covered with snow.

Highest Temperature ever recorded

- The highest temperature ever recorded on the earth is 56.7°C (134°F). It was recorded on 10th July 1913 at Greenland Ranch of Death Valley, California, USA.

Lowest Temperature ever recorded

- The lowest temperature ever recorded on the earth is −89.2 °C (−128.6 °F; 184.0 K). It was recorded on 21st July, 1983 at Soviet Vostok Station in Antarctica.

Rainfall

- Rain is a liquid water in the form of droplets that have condensed from atmospheric water vapour and then become heavy enough to fall under gravity. Rain is a major component of the water cycle and is responsible for depositing most of the fresh water on the Earth. It is the source of water for all purposes. There is a close relationship between the temperature and rainfall distribution. Generally rainfall is high in the equatorial region and decreases gradually towards poles. Rainfall is measured by Raingauge.

- The weight of air above a given area on the earth's surface is called atmospheric pressure or air pressure. The air pressure is measured by Barometer. The standard air pressure at sea level is 1013.25mb. At the earth's surface the pressure is 1.03kg.per sq cm. The variation in standard atmospheric pressure is found both horizontally and vertically. Based on the level of pressure, it is categorised into low pressure and high pressure. Low pressure area is an area in the atmosphere where the pressure is lower than its surrounding areas. In this situation, the wind from the surroundings blow towards the centre of low pressure. High pressure is an area of atmosphere where the barometric pressure is higher than its surrounding areas. In this case, the wind from the centre of high pressure blows towards the surrounding low pressure areas. Low pressure system is marked as

"L" on weather map, where as the high pressure system is marked as "H". Low pressure systems are also called as a depression and cyclones. High pressure system is called anti cyclones. Low pressure leads to cloudiness, wind, and precipitation. High pressure leads to fair and calm weather. Isobar is used to show the distribution of air pressure.

Highest pressure ever recorded.

The highest ever air pressure at sea level was recorded at Agata, Russia on 31st December, 1968. The pressure was1083.8mb

Lowest pressure ever recorded

The lowest pressure of 870mb was recorded at Typhoon Tip, near Guam, Mariana Island in Pacific Ocean on 12th October, 1979.

- Humans are not sensitive to small variation in air pressure. But the small variations in pressure that do exist largely determine the wind and storm patterns of the earth. The distribution of atmospheric pressure is controlled by altitude, atmospheric temperature, air circulation, earth rotation, water vapour, atmospheric storms etc.

Measuring air pressure

- Meteorologist uses barometer/aneroid barometer to measure the air pressure. Barograms are used for recording continuous variation in atmospheric pressure.

Humidity

- Humidity refers to the degree of water vapour present in the atmosphere in gaseous form in particular time and place. It ranges from 0-5 percent by volume in atmosphere. Climatically it is an important constituent of the atmosphere and its quantity depends on the level of temperature. So, the level of humidity decreases towards poles from equator. Humidity is expressed in different ways.

- **Specific humidity** is a ratio of the water vapor content of the mixture to the total air content on a mass basis. It is expressed in grams of vapour per kilogram of air

- Absolute **Humidity** is the mass or weight of water vapour present per unit volume of air. It is expressed usually in grams per cubic meter of air.

- **Relative humidity** is a ratio between the actual amount of water vapour present in the air and the maximum amount of water vapour it can hold at a given temperature. It is expressed as a percentage.

- Generally, warm air holds more water vapour than the cold air. When relative humidity reaches 100%, the air gets saturated. In this condition the temperature is said to be at dew-point. Further cooling will condense the water vapour into the clouds and rain. Relative humidity affects human health and comfortness.

Very high and very low humidity are injurious to health. It also affects the stability of different objects, buildings and electrical applications.

Measurement of Humidity

- Hygrometer is used to measure the humidity. (which comprises wet and dry bulb-plate side by side in the Stevenson screen)

With decreasing air pressure,the availability of oxygen to breath also decreases. At very high altitudes, atmospheric pressure and available oxygen get so low that people can become sick and even die. Mountain climbers use bottled oxygen when they ascend very high peaks. They also take time to get used to the altitude as the quick move from high pressure to low pressure can cause decompression sickness. Aircraft create artificial pressure in the cabin which makes the passengers remain comfortable while flying.

Wind

- The horizontal movement of air is called wind. Vertical movement of air is said as air current. The winds move from high pressure to low pressure. Unlike other elements a wind is made up of a series of gusts and eddies which can only be felt and not seen. Winds get their name from the direction from which they blow i.e, wind blows from south west is called southwest wind.

The wind systems are broadly categorized into three as follows.

- Planetary winds
- Seasonal winds
- Local winds

- Planetary Winds are the ones which blow almost in the same direction throughout the year. So, they are called as Permanent or planetary winds. Trade winds, Westerlies and polar easterlies are the types of prevailing winds.

- Seasonal winds are those which change their direction according to season in a year. They are called as monsoon winds. These winds blow from sea to land during summer and land to sea during winter. Local winds are the winds blow over a small area only during a particular time of a day or a short period of a year. Land and sea breezes are example of these winds.

- The Beaufort scale is a scale for measuring wind speed. It is based on observation rather than accurate measurement. It is the most widely used system to measure wind speed today. The scale was developed in 1805 by Francis Beaufort, an officer of the Royal Navy and first officially used by HMS Beagle.

Al-Balakhi, an Arab Geographer collected climatic data from the Arab travellers and

prepared the First climatic Atlas of the world

Measuring wind direction and speed

- Meteorologist measures wind direction using wind vane or weather cock. Wind speed is measured by anemometer. Wind rose is a diagram used to depict the direction and periods (No. of days) of prevailing winds on map. Meteorograph or triple register is an instrument which records wind speed and direction, sunshine and precipitation. It also provides graphic representation.

Brazil has a large area where the average wind speed is low. Gabon, Congo and DR Congo in Africa, Sumatra, Indonesia and Malaysia are the least windy places on earth.

10th Full Book

Unit 2- Climate & Natural Vegetation of India

Equable climate is also called as the British climate, Which is neither too hot nor too cold

The factors affecting the climate

- Climate of India is affected by the factors of latitude, distance from the seas, monsoon wind, relief features and jet stream.

Latitude

- Latitudinally, India lies between 8°4'N and 37°6'N latitudes. The Tropic of cancer divides the country into two equal halves. The area located to the south of Tropic of cancer experiences high temperature and no severe cold season throughout the year whereas, the areas to the north of this parallel enjoys sub-tropical climate. Here, summer temperature may rise above 40°C and it is close to freezing point during winter.

Altitude

- When the altitude increases, The temperatures decreases. Temperature decreases at the rate of 6.50C for every 1000 metres of ascent. It is called normal lapse rate.

- Hence, places in the mountains are cooler than the places on the plains. That is why the places located at higher altitudes even in south India have cool climate. Ooty and several other hill stations of south India and of the Himalayan ranges like Mussourie, Shimla etc., are much cooler than the places located on the Great Plains.

Distance from the Sea

- Distance from the sea does not cause only temperature and pressure variations but also affects the amount of rainfall. A large area of India, especially the peninsular region, is not very far from the sea and this entire area has a clear maritime influence on climate. This part of the country does not have a very clearly marked winter and the temperature is equable almost throughout the year. Areas of central and north India experience much seasonal variation in temperature due to the absence of influence of seas. Here, summers are hot and winters are cold. The annual temperature at Kochi does not exceed 30°C as its location is on the coast while it is as high as 40°C at Delhi, since it is located in the interior part. Air near the coast has more moisture and greater potential to

produce precipitation. Due to this fact, the amount of rainfall at Kolkata located near the coast is 119 cm and it decreases to just 24 cm at Bikaner which is located in the interior part.

Monsoon Wind

- The most dominant factor which affects the climate of India is the monsoon winds. These are seasonal reversal winds and India remains in the influence of these winds for a considerable part of a year. Though, the sun's rays are vertical over the central part of India during the mid-June, the summer season ends in India by the end of May. It is because theonset of southwest monsoon brings down the temperature of the entire India and causes moderate to heavy rainfall in many parts of the country. Similarly, the climate of southeast India is also influenced by northeast monsoon.

Relief

- Relief of India has a great bearing on major elements of climate such as temperature, atmospheric pressure, direction of winds and the amount of rainfall. The Himalayas acts as a barrier to the freezing cold wind blows from central Asia and keep the Indian subcontinent warm. As such the north India experiences tropical climate even during winter. During southwest monsoon, areas on the western slope of the Western Ghats receive heavy rainfall. On the contrary, vast areas of Maharashtra, Karnataka, Telangana, Andhra Pradesh and Tamil nadu lie in rain shadow or leeward side of the Western Ghats receive very little rainfall. During this season, Mangalore, located on the coast gets the rainfall of about 280 cm whereas the Bengaluru located on the leeward side receives only about 50 cm rainfall.

Jet Streams

- Jet streams are the fast moving winds blowing in a narrow zone in the upper atmosphere. According to the Jet stream theory, the onset of southwest monsoon is driven by the shift of the sub tropical westerly jet from the plains of India towards the Tibetan plateau. The easterly jet streams cause tropical depressions both during southwest monsoon and retreating monsoon.

Monsoon

- The word 'monsoon' has been derived from the Arabic word 'Mausim' which means 'season'. Originally, the word 'monsoon' was used by Arab navigators several centuries ago, to describe a system of seasonal reversal of winds along the shores of the Indian Ocean, especially over the Arabian Sea. It blows from the south-west to north-east during summer and from the north-east to south-west during winter.

- Monsoons are a complex meteorological phenomenon. Meteorologists have developed a number of concepts about the origin of monsoons. According to the Dynamic concept, Monsoon wind originates due to the seasonal migration of planetary winds and pressure belts following the position of the sun. During summer solstice, the sun's rays fall vertically over the Tropic of cancer. Therefore, all the pressure and wind belts of the globe shift northwards. At this time, Inter - Tropical Convergence Zone (ITCZ) also moves northward, and a major part of Indian landmass comes under the influence of southeast trade winds. While crossing equator this wind gets deflected and takes the direction of southwest and becomes south-west monsoon. During the winter season, the pressure and wind belts shift southward, thereby establishing the north-east monsoon (trade winds) over this region. Such systematic change in the direction of planetary winds is known as monsoon.

Atacama desert is the driest place on the earth.

Seasons

The meteorologists recognize the four distinct seasons in India. They are;

- Winter or cold weather season (January - February).
- Pre Monsoon or summer or hot weather season (March - May).
- Southwest monsoon or rainy season (June - September).
- Northeast monsoon season (October - December).

Winter or cold weather season

- During this period, the vertical rays of the sun falls over tropic of capricorn which is far away from India. Hence, India receives the slanting sun's rays which results in low temperature. The cold weather season is characterized by clear skies, fine weather, light northerly winds, low humidity and large day time variations of temperature. During this season a high pressure develops over north India and a north-westerly wind blows down the Indus and Ganges valleys. In south India, the general direction of wind is from east to west. The mean temperature increases from north to south, the decrease being sharp as one moves northwards in the north-western part of the country. The mean daily minimum temperatures range from 22°C in the extreme south, to 10°C in the northern plains and 6°C in Punjab. The rain during this season generally occurs over the Western Himalayas, Tamil nadu and Kerala. Western disturbances and associated trough in westerlies are main rain bearing system in northern part of the country. The jet stream plays a dominant role in bringing these disturbances to India. These disturbances cause rainfall in Punjab, Haryana and Himachal

Pradesh, and snowfall in the hills of Jammu and Kashmir. This rainfall is very useful for the cultivation of winter wheat.

Pre Monsoon or summer or hot weather season

- During this season, the vertical rays of the sun falls over the peninsular India. Hence, there is a steady increase in temperature from south to north. It is practically hot and dry in the entire country in the initial part of this season. Weather over the land areas of the country is influenced by thunderstorms associated with rain and sometimes with hail mostly in the middle and later part. During this season, temperature starts increasing all over the country and by April, the interior parts of south India record mean daily temperatures of 30°C–35°C. Central Indian land mass becomes hot with day-time maximum temperature reaching about 40°C at many locations. Many stations in Gujarat, North Maharashtra, Rajasthan and North Madhya Pradesh exhibit high day-time and low night-time temperatures during this season.

- Because of the atmospheric pressure conditions, the winds blow from southwest to northeast direction in Arabian Sea and Bay of Bengal. They bring pre monsoon showers to the west coast during the month of May. There are few thunder showers called "Mango Showers" which helps in quick ripening of mangoes along the coast of Kerala and Karnataka. "Norwesters" or "Kalbaisakhis" are the local severe storms or violent thunderstorms associated with strong winds and rain lasting for short durations. It occurs over the eastern and north eastern parts over Bihar, West Bengal and Assam during April and May. They approach the stations from the northwesterly direction.

Southwest monsoon or Rainy Season

- The southwest monsoon is the most significant feature of the Indian climate. The onset of the southwest monsoon takes place normally over the southern tip of the country by the first week of June, advances along the Konkan coast in early June and covers the whole country by 15th July. The monsoon is influenced by global phenomenon like ElNino.

- Prior to the onset of the southwest monsoon, the temperature in north India reaches upto 46°C. The sudden approach of monsoon wind over south India with lightning and thunder is termed as the 'break' or 'burst of monsoon'. It lowers the temperature of India to a large extent. The monsoon wind strikes against the southern tip of Indian land mass and gets divided into two branches. One branch starts from Arabian sea and the other from Bay of Bengal. The Arabian sea branch of southwest monsoon gives heavy rainfall to the west coast of India as it is located in the windward side of the Western Ghats. The other part which advances towards north is obstructed by Himalayan Mountains and results in heavy rainfall in north. As Aravalli Mountain is located parallel to the wind direction, Rajasthan and western part do not get much rainfall from this branch.

The wind from Bay of Bengal branch moves towards northeast India and Myanmar. This wind is trapped by a chain of mountains namely Garo, Khasi and Jaintia are mainly responsible for the heaviest rainfall caused at Mawsynram located in Meghalaya. Later on, this wind travel towards west which results in decrease in rainfall from east to west. Over all about 75% of Indian rainfall is received from this monsoon. Tamil nadu which is located in the leeward side receives only a meagre rainfall.

Post monsoon or Retreating or Northeast monsoon season

- The southwest monsoon begins to retreat from north India by the end of September due to the southward shifting pressure belts. The southwest monsoon wind returns from Indian landmass and blows towards Bay of Bengal. The coriolis force deflects this wind and makes itto blow from northeast. Hence, it is known as Northeast monsoon or Post-monsoon season. The season is associated with the establishment of the north-easterly wind system over the Indian subcontinent. Andhra Pradesh, Tamil nadu, Kerala and south interior Karnataka receive good amount of rainfall accounted for 35% of their annual total. Many parts of Tamil nadu and some parts of Andhra Pradesh and Karnataka receive rainfall during this season due to the storms forming in the Bay of Bengal. Large scale losses to life and property occur due to heavy rainfall, strong winds and storm surge in the coastal regions. The day time temperatures start falling sharply all over the country. The mean temperature over north-western parts of the country shows a decline from about 38°C in October to 28°C in November.

Mawsynram, the place which receives highest rainfall (1141 cm) in the world. It is located in Meghalaya.

Distribution of rainfall

- The average annual rainfall of India is 118 cm. However, spatial distribution of rainfall in the country is highly uneven. About 11% area receives over 200 cm of annual rainfall, 21% area receives 125 to 200 cm, 37% area receives 75 to 125 cm, 24% area gets 35 to 75 cm and 7% area gets less than 35 cm. The Western coast, Assam, South Meghalaya, Tripura, Nagaland and Arunachal Pradesh are the heavy rainfall areas which get more than 200 cm rainfall. The whole of Rajasthan, Punjab, Haryana, Western and Southwestern parts of Uttar Pradesh, Western Madhya Pradesh, the entire Deccan Trap or Plateau region east of Western Ghats except for a narrow strip along Tamil nadu coast receive a low rainfall of less than 100 cm. The rest of the areas receive a rainfall ranging between 100 and 200 cm.

12th book
Unit 7 - Sustainable Development

- United Nations and Sustainable Development Sustainability was fi rst featured in the principles adopted by the United Nations Conference on the Human Environment held at Stockholm on 16 June 1972. It was now realized that development needed to be sustainable – it should not only focus on economic and social matters, but also on matters related to the use of natural resources. The United Nations commissioned a group of 22 people from both developed and developing countries to identify long-term environmental strategies for the international community. This World Commission on Environment and Development (WCED), was headed by Gro Harlem Brundtland, then the Prime Minister of Norway. This commission cameto be known as the Brundtland Commission, which submitted its report, entitled Our common future, to the UN in 1987.

- The Brundtland Report focused on the needs and interests of humans. It was concerned with securing a global equity for future generations by redistributing resources towards poorer nations to encourage their economic growth in order to enable all human beings to achieve their basic needs. The report highlighted the three fundamental components of sustainable development, the environment, the economy, and society, which later became known as the triple bottom line.

- The 1992 and 2002 Earth Summits held at Rio de Janeiro and Johannesburg were the United Nations Conference on Environment and Development (UNCED), a direct result of the Brundtland Commission. An important achievement of the Rio summit was an agreement on the Climate Change Convention which led to the Kyoto Protocol which you have learned about earlier.

- The United Nations Conference on Sustainable Development (UNCSD), also known as Rio 2012, Rio+20 or Earth Summit 2012 was the third and recent International conference on sustainable development. It was hosted by Brazil in Rio de Janeiro from 13 to 22 June 2012.

Concept and Goals of Sustainable Development

- In 1980 the International Union for the Conservation of Nature introduced the term "sustainable development". Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

- A primary goal of sustainable development is to achieve a reasonable and equitably distributed level of economic wellbeing that can be continued for many human generations.

Sustainable Development Goals (SDGs)

- In 1992, the UN Conference on Environment and Development published the Earth Charter, which outlined the building of a just, sustainable, and peaceful global society in the 21st century. The action plan was known as 'Agenda 21' for sustainable development.

- In September 2015, the United Nations General Assembly formally adopted the "Universal, integrated and transformative"2030 Agenda for Sustainable Development, a set of 17 Sustainable Development Goals (SDGs). The goals are to be implemented and achieved in every country from the year 2016 to 2030.

- Countries adopted a set of goals to end poverty, protect the planet and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years.

- For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and people.

End poverty in all its forms everywhere

- One in five people in developing countries still live on less than $1.90 a day, many people risk slipping back into poverty. Economic growth must be inclusive to provide sustainable jobs and promote equality.

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

- Agriculture, forestry and fisheries can provide nutritious food for all and generate decent incomes, while supporting people-centred rural development and protecting the environment. A profound change of the global food and agriculture system is needed if we are to nourish today's 815 million hungry and the additional 2 billion people expected by 2050.

Ensure healthy lives and promote well-being for all at all ages

- Significant strides have been made in increasing life expectancy and reducing some of the common killers associated with child and maternal mortality. Major progress has been made on increasing access to clean water and sanitation, reducing malaria, tuberculosis, polio and the spread of HIV/AIDS.

Ensure inclusive and quality education for all and promote lifelong learning

- Major progress has been made towards increasing access to education at all levels and increasing enrolment rates in schools particularly for women and girls. For

example, the world has achieved equality in primary education between girls and boys, but few countries have achieved that target at all levels of education.

Achieve gender equality and empower all women and girls

- Gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world.

Ensure access to water and sanitation for all

- Clean, accessible water for all is an essential part of the world we want to live in. There is sufficient fresh water on the planet to achieve this. But due to bad economics or poor infrastructure, every year millions of people, most of them children, die from diseases associated with inadequate water supply, sanitation and hygiene. By 2050, at least one in four people is likely to live in a country affected by chronic or recurring shortages of fresh water.

Ensure access to affordable, reliable, sustainable and modern energy for all

- Energy is central to nearly every major challenge and opportunity the world faces today. Sustainable energy is opportunity – it transforms lives, economies and the planet.

Promote inclusive and sustainable economic growth, employment and decent work for all

- Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs that stimulate the economy while not harming the environment. Job opportunities and decent working conditions are also required for the whole working age population.

Build resilient infrastructure, promote sustainable industrialization and foster innovation

- Inclusive and sustainable industrial development is the primary source of income generation, allows for rapid and sustained increases in living standards for all people, and provides the technological solutions to environmentally sound industrialization.

Reduce inequality within and among countries

- To reduce inequality, policies should be universal in principle paying attention to the needs of disadvantaged and marginalized populations

Make cities inclusive, safe, resilient and sustainable

- Cities are hubs for ideas, commerce, culture, science, productivity, social development and much more. At their best, cities have enabled people to advance socially and economically Common urban challenges include congestion, lack of funds to provide basic services, a shortage of adequate housing and declining infrastructure.

Ensure sustainable consumption and production patterns

- Sustainable consumption and production is about promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. Its implementation helps to achieve overall development plans, reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty.

Take urgent action to combat climate change and its impacts

- Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and may be even more tomorrow.

Conserve and sustainably use the oceans, seas and marine resources

- The world's oceans – their temperature, currents and life – drive global systems that make the earth habitable for humankind. Careful management of this essential global resource is a key feature of a sustainable future.

Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

- Forests cover 30 per cent of the Earth's surface and in addition to providing food security and shelter, forests are key to combating climate change, protecting biodiversity and the homes of the indigenous population. Thirteen million hectares of forests are being lost every year while the persistent degradation of dry lands has led to the desertification of 3.6 billion hectares.

Promote just, peaceful and inclusive societies

- This Goal is dedicated to the promotion of peaceful and inclusive societies for sustainable development, the provision of access to justice for all, and building effective, accountable institutions at all levels.

Revitalize the global partnership for sustainable development

- A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, are needed at the global, regional, national and local level.

Paris Agreement
To address climate change, countries adopted the Paris Agreement at the COP21 in Paris on 12 December 2015. The Agreement entered into force shortly thereafter, on 4 November 2016. In the agreement, all countries agreed to work to limit global temperature rise to well below 2°C, and given the grave risks, to strive for 1.5°C.

Climate Change and Sustainability

- The Earth's climate has changed throughout history. In the last 650,000 years there have been several cycles of glacial and warm periods each lasting thousands or millions of years. Most of these climate changes are attributed to very small variations in earth's orbit that changes the amount of solar energy our planet receives. It is understood that at present the Earth's climate is getting warmer which is referred to as 'Global Warming'. Earth's temperature has gone up about one degree Fahrenheit in the last 100 years. This is a very small change but small changes in earth's temperature can have big effects. Some effects are already happening such as melting of glaciers, rise in the level of oceans, prolonged droughts, excessive rain and floods, etc.

Reasons for Climate change

- Burning fossil fuels emits gases into the atmosphere. Burning fossil fuel to provide energy, coupled with the effects of major transportation and deforestation causes a rapid increase in global temperatures. This can change the climate of a place.

- Effects **of climate change** – Scientists had predicted in the past that the result from global climate change are now occurring, loss of sea ice, accelerated sea level rise and longer, more intense heat waves.

- Temperatures **will continue to rise** - Experts agree that greenhouse gases which trap heat and prevent it from leaving the earth's atmosphere are mostly responsible for the temperature spike.

- Frost**-free season (and growing season) will lengthen -** it could actually have detrimental effects on the crops we grow. Warmer weather helps pests survive longer which can destroy crops. Rising temperatures are also expected to

contribute to a shift in areas which are agriculturally most productive and the crops that grow there.

- Changes **in precipitation patterns -** The contrast between wet and dry areas will increase globally. In other words, the wet areas will get wetter and the dry areas will get drier.

- More **droughts and heat waves -** With rising temperatures and shifting rainfall patterns, heat waves and droughts are increasing in frequency and intensity.

- **Sea level rise -** Scientists have determined that global sea level has been steadily rising since 1900 at a rate of at least 0.1 to 0.25 centimeter per year. Sea level can rise by two different mechanisms with respect to climate change.

- Arctic **likely to become ice-free -** The Arctic Ocean is expected to become essentially ice free in summer before mid-century.

UNFCCC Process for Climate Change Adaptation, On17, May 2017: Policy makers, implementers, supporters and investors from all over the world met during the UNFCCC Bonn Climate Change Conference at the Technical Expert Meeting (TEM) on Adaptation to discuss 'Integrating climate change adaptation with the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction.

Response to Climate Change

- There are two main responses to climate change.

- Mitigation **-**which addresses the root causes of climate change, by reducing greenhouse gas emissions.

- **Adaptation -** seeks to lower the risks posed by the consequences of climatic changes. Both approaches will be necessary to deal with the global changes that have already been set in motion.

Mitigation measures:

- It is important that we learn how to reduce climate change, and put them into practice now, before it is too late.

- **Cleaner alternative energy sources:** One important way to fight climate change is to reduce our reliance on and usage of fossil fuels, and depend on alternative renewable and greener sources of energy such as wind energy, solar energy, water or hydropower, biomass, and geothermal energy.

- Energy **saving tips -** we can adopt energy saving tips by investing in more expensive energy-saving appliances like the compact fluorescent light (CFL) bulbs, Air-conditioners, refrigerators etc. Switching off our electrical appliances when not in use.

- **Green driving tips -** The best strategy to reduce toxic gas emissions is definitely to reduce the use of automobiles. Use public transport, carpooling, use of electricity powered cars or two wheelers can be an alternative.

- **Reduce - Reuse - Recycle practices** - Reducing, reusing and recycling helps us conserve resources and energy, and reduce pollution and greenhouse gas emissions produced thereby.

- **Re-forestation** - The cleanest and most efficient remover of carbon dioxide from our atmosphere actually is nothing but green plants and trees. The rate at which we are cutting down our trees and forests to make way for human developments has greatly reduced the earth's ability to remove carbon dioxide from the atmosphere.

- **Organic farming** - Soils are an important sink for atmospheric carbon dioxide. Nevertheless, deforestation making way for conventional agriculture is increasingly depleting this sink. Sustainable and organic agriculture helps to counteract climate change by restoring soil organic matter content as well as reduce soil erosion and improve soil physical structure. Organic farming uses natural fertilizers and helps maintain crop yields.

Watershed management and its importance

- Watershed is a geographical area drained by a stream or a system connecting stream in which water from all over an area flow under gravity to a common drainage channel. A watershed system delivers water through rills, gullies and streams to a larger body of water.

- Watershed management is proper utilization of land and water resource for optimum production with minimum hazards to natural resources. It relates to soil and water conservation proper land uses, promote afforestation and sustainable farming practices, conserve farmland and pastureland, maintaining soil fertility, proper management of local water for farming, drainage, construct small dams for flood protection, improving individuals standard of living and thereby promote ecological balance.

Key steps in watershed management

- Watershed plans should first identify the characteristics of the watershed and inventory the watershed's natural resources. The first steps in watershed management planning are to:

- Delineate and map the watershed's boundaries and the smaller drainage basins within the watershed.
- Map and prepare an Inventory of resources in the watershed
- Prepare an Inventory and map the natural and manmade drainage systems in the watershed.
- Prepare an Inventory and map land use and land cover
- Prepare a soil map of the watershed
- Identify areas of erosion, including stream banks and construction sites.
- Identify the quality of water resources in the watershed as a baseline; and
- Prepare a map and Inventory of pollution sources, both point sources (such as industrial discharge pipes) and nonpoint sources (such as municipal storm water systems, failing septic systems, illicit discharges).

Watershed Management in India:

- Watershed development project in the country has been sponsored and implemented by Government of India from early 1970s onwards. Various watershed development programs like Drought Prone Area Program (DPAP), Desert Development Program (DDP), River Valley Project (RVP), National Watershed Development Project for Rain-fed Areas (NWDPRA) and Integrated Wasteland Development Program (IWDP) were launched subsequently in various hydro-ecological regions. Entire watershed development programs primarily focused on soil conservation and rainwaterharvesting during 1980s and before.

Rain Water Harvesting (RWH)

- Millions of people throughout the world do not have access to clean water for domestic purposes. In many parts of the world conventional piped water is either absent, unreliable or too expensive. One of the biggest challenges of the 21st century is to overcome the growing water shortage. Rain Water Harvesting (RWH) has thus regained its importance as a valuable alternative or supplementary water resource, along with more conventional water supply technologies. Water shortages can be relieved if rain water harvesting is practiced more widely.

Need for Rain Water Harvesting

- To overcome the situation of inadequacy of water supply.
- The most economical way to increase the ground water table.
- To replenish the sub soil of the urban area covered with pavements.
- To recharge the underground water table at places where the availability of rain water is higher or to overcome the situation of water logging.
- Rain water harvesting also improves the quality of underground water through a process called dilution.
- To get water for irrigation of greenbelts, farms, gardens, etc.

Rain Water Harvesting Techniques

- There are two main techniques of rain water harvestings:

- Storage of rain water on surface for future use. Recharge to ground water.

- The storage of rain water on surface is a traditional technique and structures used were underground tanks, ponds, check dams, weirs, etc. Recharge of ground water is a new concept of rain water harvesting and the structures generally used are: Recharge pits filled with boulders, gravels, and coarse-sand, Wells, Trenches etc.

Environmental Impact Assessment

- Every country strives to progress ahead. One aspect of progress is economic development through manufacturing and trading. Every country builds industries which provide employment, serve the consumers needs and help to generate revenue. The dominant pattern of development that humankind hasfollowed in recent decades has brought about large scale changes in the earth systems. We are already feeling the impact of these changes upon our health, livelihoods and safety. On the other hand, the fruits of development are not equally distributed. Some countries and some communities have a high standard of living, while others are not able to meet their basic needs.

- Development projects in the past were undertaken without any consideration about their environmental consequences. As a result rivers and lakes have been polluted, air pollution has reached threatening levels and pilling of domestic and industrial wastes has resulted in land degradation. Industrialization and economic growth provided material comforts but at the same time deteriorated the quality of life.

The Objective of EIA

- To identify, predict and evaluate the economic, environmental and social impact of development activities

- To provide information on the environmental consequences for decision making and
- To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

Steps in the EIA Process

The eight steps of the EIA process:

- Screening**:** First Stage of EIA, which determines whether the proposed project, requires an EIA and if it does, then the level of assessment required.

- **Scoping:** This stage identifies the key impacts that should be investigated. This stage also defines the time limit of the study.

- Impact **analysis:** This stage of EIA identifies and predicts the likely environmental and social impact of the proposed project and evaluates the significance

- Mitigation**:** This step in EIA recommends the actions to reduce and avoid the potential adverse environmental consequences of development activities.

- **Reporting:** This stage presents the result of EIA in a form of a report to the decision-making body and other interested parties.

- **Review of EIA:** It examines the adequacy and effectiveness of the EIA report and provides the information necessary for decision –making.

- **Decision-making**: It decides whether the project is rejected, approved or needs further change.

- **Post monitoring:** This stage comes into play once the project is commissioned. It checks to ensure that the impacts of the project do not exceed the legal standards and implementation of the mitigation measures are in the manner as described in the EIA report.

Environmental Impact Assessment in India

- EIA was introduced in India in 1978, with respect to river valley projects. On 27 January 1994, the Union Ministry of Environment and Forests (MEF), Government of India, under the Environmental (Protection) Act 1986, made Environmental Clearance (EC) mandatory for expansion or modernisation or for setting up new projects listed in Schedule 1 of the notification. Since then there have been 12 amendments made in the EIA notification of 1994. Both central and state authorities share the responsibility of EIA's development and management.

EIA is now mandatory for 30 categories of projects, and these projects get Environmental Clearance (EC) only after the EIA requirements are fulfilled.

- The MoEF recently notified new EIA legislation in September 2006. The notification makes it mandatory for all projects to get environment clearance from the central government under the following categories:

  - Industries
  - Mining
  - Thermal power plants
  - River valley projects
  - Infrastructure and CRZ (Coastal Regulation Zone)
  - Nuclear power projects.

- However, the new legislation has entrusted the decision of clearing projects on the state government depending on the size/ capacity of the project. EIA appraises the environmental health and social implications of planned developmental projects. It thus links environment with development. The goal of EIA is to ensure environmentally safe and sustainable development.

Measures for Promotion of Sustainable Development

- As discussed earlier, the United Nations 17 Sustainable Development Goals and 169 targets are part of the 2030 Agenda for Sustainable Development adopted by 193 Member States at the UN General Assembly Summit in September 2015, and which came into effect on 1 January 2016. These goals are the result of international consultations that brought national governments and millions of citizens from across the globe together to negotiate and adopt the global path to sustainable development for the next 15 year.

- The SDGs and targets will stimulate action in the following critically important areas: poverty, hunger, education, health and well-being, education, gender equality, water and sanitation, energy, economic growth and decent work, infrastructure, industry and innovation, reducing inequalities, sustainable cities, consumption and production, climate action, ecosystems, peace and justice, and partnership. This agenda recognises that it is not enough to focus on economic growth alone but in creating more equal societies, and a safer and more prosperous planet.

Baripada: A hamlet that conserves forest, promotes growth

Baripada, a small hamlet straddling the Maharashtra-Gujarat border, is a collective tribal wisdom which has taken it to the next level. With a population of barely 1,000, the village has not only helped conserve their forest but also meet the United Nations' sustainable development goals, benefiting everyone in the process.

The villagers conserved the forest. And, forest helped in conservation of water. Water enabled agriculture and farming. Farming brought prosperity, which in turn helped improve literacy. And, literacy broadened horizons and led us to total transformation.

Having developed dairy and poultry over the years, the villagers have also evolved a system for marketing their products. This ensured a steady flow of revenue and kept poverty at bay. The villagers share their common land with landless families to ensure 'zero hunger' and 'reduction of inequality'.
Besides, the villagers are game for any experiments involving water, land, forest conservations, biodiversity registration, biogas, solar power, building basic infrastructure through public participation. "Decisions on prohibition, tree plantation were made at the village meeting and immediately implemented. But, to restrict entry of humans and animals in the 445 hectares of village forest was a major task".

Which countries are achieving the UN Sustainable Development Goals fastest?

- The ultimate aim of the Sustainable Development Goals is to end poverty, protect the planet and ensure prosperity for everyone. Each goal has specific targets that need to be met by 2030.

- So how close are countries to meeting them? To find out, non-profit organization Bertelsmann Stiftung and the UN Sustainable Development Solutions Network have created a prototype index that measures their performance.

- Sweden leads the list, followed by Denmark and Finland. Among the G7countries, only Germany and France can be found among the top ten performers. The United States ranks 42nd on the Index, while Russia and China rank 62nd and 71st respectively. Also in the top 20 were Canada (13th), the Czech Republic (15th) and Slovenia (17th). Asia-Pacific's top performers Japan, Singapore and Australia rounded off the list at 18th, 19th and 20th, respectively. The SDG Index underlines that despite achieving high percentages, all countries still have their work cut out to close the remaining gap.

- India ranks 116 out of 157 nations on a global index that assesses the performance of countries towards achieving the ambitious sustainable development goals (SDGs).

NATURAL RESOURCES – RIVERS IN INDIA , WATER, SOIL, MINERALS

GEOGRAPHY

6th term – II	**Unit – 1**	**Resources**
7th term – II	**Unit – 1**	**Resources**
8th term – I	**Unit – 1**	**Rock & Soil**
10th book	**Unit – 4**	**Resources & Industries**
12th Geography	**Unit – 3**	**Resources**

6th term – II
Unit – 1 Resources

- Resource is anything that fulfills human needs. When anything is of some use it becomes valuable. All resources have value. The value can be either commercial or non-commercial. Commercial resources have great economic value. (e.g.) Petroleum. The Non-commercial resources are very abundant in availability (e.g.) Air.

- Resources can be natural, man-made and human resources.

Natural Resources:

- All resources that have been directly provided by nature are called Natural resources. The air, water, soil, minerals, natural vegetation and wild life around us are all natural resources. The use of any natural resource depends on the place it is available, the form in which it is available and the technology necessary to avail it.

Classification of Natural Resources

- Natural resources can be classified into different groups depending on origin, development, renewability, distribution, ownership etc.

A. On the basis of origin: On the basis of origin, resources can be classified into biotic and abiotic resources.

i. All living resources are biotic resources, plants, animals and other microorganisms are biotic resources.
ii. Abiotic resources are non-living things. Land, water, air and minerals are abiotic resources.

- The biotic resources were mere substances till they were recognized by humans. According to the human needs the substances were collected by the ancient men and preserved for use. In the beginning, man had only three basic needs-food, clothing and shelter. He collected things through primary activities such as hunting, food gathering, fishing and forestry. Later when food became scarce, they had to cultivate and that became agriculture and the cattle were also reared on their farms to fulfill their basic needs.

- The abiotic resources were also sought after by the early men. They went in search of better landforms where they had enough water resources for agriculture and their cattle. They were in need of tools right from hunting to agriculture. Primarily the tools were only made of stones. Later man dug the earth for better abiotic resources and found copper first and iron later. He also mined precious metals simultaneously for making ornaments. Later mining became one of the leading primary activities and still holds an important place among the economic activities.

B. On the basis of development: Based on the level of development, resources can be divided into actual and potential resources.

i. Actual resources are resources that are being used and the quantity available is known. (e.g.) Coal at Neyveli.

ii. Potential resources are resources that are not being used in the present and its quantity and location are not known. The technology to extract such resources is also yet to be developed. (e.g.) Marine yeast found in the Bay of Bengal and Arabian Sea.

C. On the basis of exhaustibility: On the basis of renewability resources can be classified as renewable resources and non-renewable resources.

i. Resources once consumed can be renewed with the passage of time are called renewable resources. (e.g.) Air, Water, Sunlight. Misuse of such resources can also limit its available quantity. So, they have to be used wisely.

ii. Natural resources which are limited can be called non-renewable resources. They become exhausted after use and the time they take to replace does not match the life cycle. (e.g.) Coal, petroleum, natural gas and other minerals.

- The resources which cannot renew themselves are either scarce or totally absent. So man is in search of new resources and is conducting several researches. He confirms that a substance is a resource only after research. He tries to harness it and also searches the regions where it may be found in. They are potential

resources. Wind energy is one such example. The places where the wind energy can be utilized are still unknown.

D. On the basis of distribution: On the basis of distribution, resources can be classified into localized resources and universal resources.

i. When resources are present in specific regions they are called localized resources. (e.g.) Minerals.

ii. Some resources are present everywhere such resources are called universal resources. (e.g.) Sunlight and air.

E. On the basis of ownership: Based on ownership resources can be classified into Individual resources, Community-owned resources, National resources and International resources.

i. Individual resources are resources privately owned by individuals. (e.g.) Apartments.

ii. Community-owned resources are resources which can be utilised by all the members of the community. (e.g.) Public parks.

iii. National resources are resources within the political boundaries and oceanic area of a country. (e.g.) Tropical forest regions of India.

iv. International resources are all oceanic resources found in the open ocean. Resources found in this region can be utilized only after an international agreement. (e.g.) Ambergris.

Man-made resources:

- Natural resources are modified or processed by technology into man-made resources. (e.g.) sugarcane processed to get sugar. All structures built by man can also be called man-made resources. (e.g.) Bridges, Houses, Roads.

- This transforming of raw materials into finished goods is called Secondary Activities. Man's skills and ideas are the basic requirements for these activities.

Human resource:

- Human resources are groups of individuals who use nature to create more resources. Though human beings are basically natural resources, we classify human beings separately. Education health, knowledge and skill have made them a valuable resource. (e.g.)Doctors, Teachers, Scientists. Tertiary activities are basically concerned with the distribution of primary and secondary products through a system of transport and trade (e.g) Banking, Trade and

Communications. The quantity and quality of institutions and organizations involved in making the professionals decide the human resource of a country.

Gandhian thought on Resources: There is enough for everybody's need and not for anybody's greed. Mahatma Gandhi blamed "human beings" for depletion of resources because of

i. over exploitation of resources

ii. Unlimited needs of human beings. So, conservation is very important.

Resource planning / Management

- Resource planning is a technique or skill of proper utilization of resources. Resource planning is necessary because

i. Resources are limited, their planning is quite necessary so that we can use them properly and at the same time we can save them for our future generation.
ii. Resources are not only limited but also they are unevenly distributed over the different parts of the World.
iii. It is essential for the production of resource to protect them from over exploitation.

Conservation of resources:

- Careful use of resources is called conservation of resources. Resources are being used at a very fast rate due to the rapid increase in population. So, natural resources are depleting fast; wisely using resources can control the depleting ratios.

- Development is necessary without affecting the needs of the future generations. If the present needs of resources are met and the conserving of resources for the future are balanced, we call it sustainable development. Sustainable development can take place when

i. The reasons of depletion are identified.
ii. Wastage and excess consumption is prevented.
iii. Reusable resources are recycled.
iv. Pollution is prevented.
v. Environment is protected.
vi. Natural vegetation and wild life are preserved.
vii. Alternative resources are used.

- The easiest way to conserve resources is to follow the '3R's: Reduce, Reuse and Recycle.

NOTE

- Anything becomes a resource only when its use is discovered. The needs of human beings are ever changing. According to the ever changing needs, resources keep changing. Time and Technology are two important factors that determine whether a substance is a resource or not. for example: Sun's energy to generate electricity was made possible after the invention of solar panels (technology); and the receding of coal and petrol was in need of an inexhaustible resource (time).
- Marine yeast have greater potential than the terrestrial yeast. They can be used in baking, brewing, wine, bio-ethanol and pharmaceutical protein production.
- Tropical rain forests are called the 'World's largest Pharmacy' as 25% of the natural vegetation are medicinal plants. (e.g.) Cinchona.
- Ambergris is an extract from the sperm whale. A pound (0.454kg) of sweet – smelling ambergris is worth US $63,000 and used in perfume industries.

7th term – II
Unit – 1 Resources

Introduction

- A country's social, economic and political strength lies in the distribution, utilization and conservation of its resources. Anything which can be used for satisfying the human needs is called resource. Natural resources are resources that exist without action of humankind. Natural resources are obtained from environment. Many natural resources are essential for human survival. Resources always cannot be consumed in their original form, but they must be processed into usable commodities and usable things.

Importance of resource

- Natural resources satisfy daily needs of man such as food, clothing and shelter.
- Natural resources also contribute immensely to boost up a nation's economy
- On the basis of origin, resources may be divided into two types. They are:

1. Biotic resources
2. Abiotic resources

1. Biotic resources

- Biotic resources are found in the biosphere which are obtained from living and organic materials. It includes forests, crops, birds, animals, fishes, man and materials that can be obtained from them. Fossil fuels such as coal and petroleum are also included in this category because they are formed from decayed organic matter

2. Abiotic resources

- Abiotic resources are the non-living parts of an environment. Examples of abiotic resources include land, water, air, sunlight and heavy metals including ores such as gold, iron, copper, silver etc.
- On the basis of renewability, resources can be divided into two types. They are:

1. Renewable resources
2. Non - renewable resources

1. Renewable resources

- A renewable resource is a resource which can be used repeatedly and replaced naturally.Renewable resources harvested and used rationally will not produce pollution. The use of renewable resources and energy sources is increasing worldwide.

Example: solar energy, wind energy, and hydropower.

Solar energy

- The sun produces energy in the form of heat and light. Solar energy is not harmful to the environment. Photovoltaic devices or solar cells, directly convert solar energy into electricity. Individual solar cell in group panel can perform small applications from charging calculator, watch batteries, to large such as to power residential dwellings. Photovoltaic power plants and concentrating solar power plants are the largest solar applications covering acres. India, China, Japan, Italy and States of America are major utilizers of solar energy in the world

Kamuthi solar power project is one of the largest solar power projects in the world. It is situated in Ramanathapuram District in Tamilnadu. The Kamuthi solar power project was completed on 21st September 2016. Investment of this project is around 4,550 Crores. The installed capacity of this project is 648 MW.

Major wind farms in India

S. No.	Wind Forms	District	State	Installed Capacity (MW)
1.	Muppandal	Kanyakumari	Tamil Nadu	1,500
2.	Jaisalmer	Jaisalmer	Rajasthan	1,064
3.	Brahmanvel	Dhule	Maharashtra	528
4.	Dhalgaon	Sangli	Maharashtra	278
5.	Damanjodi	Damanjodi	Odisha	99

Hydropower

- Water is considered as a great source of energy. At present, water is used for producing hydroelectric power. Hydroelectricity is generated from moving water with high velocity and great falls with the help of turbines and dynamos. Hydroelectricity power is the cheapest and most versatile source of energy out of all the known energy. Hydroelectric power is a renewable resource. China, Canada, Brazil, United States of America, Russia, India, Norway and Japan are some countries producing hydroelectricity. China is the largest producer of hydro-electricity

Wind energy

- Wind power is clean energy since wind turbines does not produce any emissions. In recent years, wind energy has become one of the most economical and renewable energy technologies. The Classic Dutch windmill harnessed the wind's energy hundreds of years ago. Modern wind turbines with three blades dot the landscape today, turning wind into electricity. Major wind energy producing countries are United States, China, Germany, Spain, India, United Kingdom, Canada and Brazil.

S. No.	Hydro - electricity project	Installed Capacity (MW)	State
1.	Tehri Dam	2,400	Uttarakhand
2.	Srisailam Dam	1,670	Andhra Pradesh
3.	NagarjunaSagar Dam	960	Andhra Pradesh
4.	SardarSarovar Dam	1,450	Gujarat
5.	BhakraNangal Dam	1,325	Punjab
6.	Koyna Dam	1,960	Maharashtra
7.	Mettur dam	120	Tamil Nadu
8.	Idukki dam	780	Kerala

S.No.	Name of the Project	Country	River	Installed Capacity in MW
1.	Three gorges Dam	China	Yangtze	22,500
2.	Itaipu Dam	Brazil and Paraguay	Parana	14,000
3.	Xiluodu Dam	China	Jinsha	13,860
4.	Guri Dam	Venezuela	Caroni	10,235
5.	Tucurui Dam	Brazil	Tocantins	8,370

Three Gorges Dam in China is the largest hydroelectricity project in the world. It's construction started in 1994 and ended in 2012. The installed capacity of the dam is 22,000MW.

Non-renewable resources

- Natural resources that once consumed and cannot be replaced is called non-renewable resources. Continuous consumption of non-renewable resources ultimately leads to exhaustion. Examples of non-renewable resources include fossil fuels such as coal, petroleum, natural gas and mineral resources such as

iron, copper, bauxite, gold, silver and others. Non-renewable resources can be divided into three types. They are:

- Metallic resources
- Non - Metallic resources
- Fossil fuel resources

Metallic resources

- Metallic resources are the type of resources that are composed of metals. These are hard substances, which are the good conductors of heat and electricity. Example for metallic resources are iron, copper, gold, bauxite, silver, manganese, etc.

Iron

- Iron is the fourth most common element in the Earth's crust and the most widely available metal. Magnetite and hematite are the common ore for iron, which occurs normally in the rocks of the crust. Iron ore is the key raw material in making steel and 98% of the iron ore extracted is used to make Steel. Pure iron ore is very soft, but its strength is increased many folds by adding small amount of carbon and manganese. It's low cost and high earth strength makes it usable in engineering applications, such as the construction of machinery and machine tools, automobiles, construction of large ships, structural components of building, bridges etc.

- Iron ore is mined in about 50 countries. Among the iron ore producing countries China, Australia, Brazil, India and Russia are the principal producers accounting for 85% of the world's total output of iron ore. These countries have 70% of the total reserves of the world. Jharkhand, Odisha, Madhya Pradesh, Chhattisgarh, Karnataka and Goa account for over 95 per cent of the total reserves of India. Iron ores found at Kanjamalai in Tamil Nadu.

Copper

- Copper is one of the first metals known and used by man. Copper ranks as the third most consumed industrial metal in the world after Iron and Aluminium. Copper is good conductor of heat and electricity. About three quarters of copper is used to make electrical wires, telecommunication cables and electronics.

- Chile is the world's number one country in the production of copper. Other copper producing countries are Peru, China, United States, Congo and Australia.

Gold

- It is a rare and precious metal. Hence, it has high demand in world markets. Formerly, it was used for minting coins, but now it is used for making ornaments and in dentistry. It is regarded as a symbol of prosperity and a form of wealth.

- China is the world's largest producer of gold. Also, Australia, Russia, United States, South Africa and Canada are the major producers of gold. Among these countries, Australia has 9500 tons reserves of gold ore and it is world's leading country in gold ore reserves. Karnataka is the largest producer of gold in India. Kolar Gold Field is one of the deepest mines of the world.

Bauxite

- Aluminium is produced from bauxite ore. There are several ores that contain aluminium but bauxite contains more aluminium. Aluminium has wide range of uses compared to other metals. Aluminium is light in weight, tough and cheaper, which makes it popular metal for constructional purpose. It is mainly used in the construction of aircrafts, ship, automobiles, railway coaches and etc. Aluminium is a good conductor of electricity and heat, hence, it is used for making electrical cables. It is highly resistant to corrosion. By the addition of small quantities of other metals to aluminium, it creates superior alloy than pure aluminium.

E.g: Duralumin.

- Australia is the world's leading bauxite producer. Apart from that, China, Brazil, India, Guinea, Jamaica and Russia also play an important role in bauxite production. One fourth of the bauxite mineral deposits found in Guinea alone.Odisha, Gujarat, Jharkhand, Maharashtra, Chhattisgarh, Tamil Nadu and Madhya Pradesh are the main bauxite producing states in India. The bauxite deposits are mainly found in the Shervaroy hills of Salem district, Tamil Nadu

Silver

- Silver is also a precious metal like gold. It has a wider variety of uses than gold. It is used in making jewellery, dentistry, photographic goods, electroplating industry and in the manufacture of luxury goods. About two-third of silver is used for monetary purposes. Likegold, silver also resists corrosion.

- Mexico is the world's leading silver producer. Following Mexico, Peru, China, Russia, Australia and Chile produce more silver. More than 50% of silver is found only in South American countries.

Manganese

- Manganese is a steel-greyed, hard, shiny and brittle metal. The common ores of manganese are Pyrolusite Manganese, Psilomelane and Rhodochrosite.

Manganese is essential for the production of good quality Steel. Manganese is used in making electrical batteries. It is also used as colouring material in bricks, pottery, floor tiles. Manganese compounds are used in making disinfecting liquids, bleaching powder, fertilizers etc.

- South Africa is the world's leading producer of manganese. The significant producers of manganese in the world are China, Australia, Gabon, Brazil and India. All these producers have large reserves of manganese and are significant exporters in the world.

Non-metallic resources

- Non-metallic resources can be described as the resources that do not comprise of metals. These are not hard substances, and are not good conductors of heat and electricity. Example for non-metallic resources are mica, limestone, gypsum, dolomite, phosphate, etc.

Mica

- Muscovite and Biotite are the common ores of Mica. It is one of the indispensable minerals used in electrical and electronics industry. It is used as an insulating material in electrical industry. In powder form, it is used for making lubricating oils and decorative wallpapers.

- China is the world's top producer of mica. Russia, Finland, United States, Turkey and Republic of Korea also play a major role in the production of mica. About 95 per cent of India's mica is found in just three states of Andhra Pradesh, Rajasthan and Jharkhand.

Limestone

- Limestone is a sedimentary rock, composed mainly by skeletal fragments of marine organisms such as coral, foraminifera and molluscs. About 10% of sedimentary rocks are limestones. Mostly limestone is made into crushed stone and used as a construction material. It is used for facing stone, floor tiles, stair treads, windows sills and many otherpurposes. Crushed limestone is used in smelting and other metal refining process. Portland cement is made from limestone.

- China produces more than half of limestone production in the world. Beside this, United States, India, Russia, Brazil and Japan also produce more Limestone. Madhya Pradesh, Rajasthan, Andhra Pradesh, Gujarat, Chhattisgarh and Tamil Nadu Produce over three-fourths of the total limestone of India. In Tamil Nadu, Large scale limestone reserve found in Ramanathapuram, Tirunelveli, Ariyalur, Salem, Coimbatore and Madurai districts.

Fossil fuel resources

- Fossil fuel resources are normally formed from the remains of dead plants and animals. They are often referred to as fossil fuels and are formed from hydrocarbon. When fossil fuels are burned, they become a great source of heat energy. Example for fossil fuel resources are coal, petroleum and natural gas.

Coal

- This is the most abundantly found fossil fuel that forms when dead plant matter is converted into peat. It is used as a domestic fuel, in industries such as iron and steel, steam engines to generate electricity. Electricity produced from coal is called Thermal Power.

Coal is classified into four types based on carbon content. They are:

1. Anthracite
2. Bituminous
3. Lignite
4. Peat.

The leading coal producers of the world are China. Beside this, India, USA, Australia, Indonesia and Russia also produce more coal. The coal producing areas of India are Raniganj in West Bengal, Neyveli in Tamil Nadu, Jharia, Dhanbad, and Bokaro in Jharkhand.

Most of the coal deposite that we use now, where formed about 300 million years ago. Much of the earth was covered with steamy swamps. As the plants and trees are dead, their remains were buried underneath the swamps. Eventually, they were transformed into coal beneath the ground due to excessive heat and pressure.

Petroleum

- Petroleum is found between the layers of rocks and is drilled from oil fields located in Offshore and coastal areas. This is sent to refineries which process crude oil and produce variety of products like diesel, petrol, kerosene, wax, plastics and lubricants. Petroleum and its derivatives are called Black Gold as they are very valuable.

- The chief petroleum producing countries are Saudi Arabia, Iran, Iraq and Qatar. The other major producers are USA, Russia, Venezuela, Kuwait, UAE and Algeria. The leading producers in India are Digboi in Assam, Bombay High in Mumbai and the deltas of Krishna and Godavari rivers.

Natural gas

- Natural gas is found with petroleum deposits and is released when crude oil is brought to the surface. It can be used as a domestic and industrial fuel.

- More than 50% of the global natural gas reserves are found in United States of America, Russia, Iran and Qatar.

- In India, Krishna and Godavari Delta, Assam, Gujarat and some areas of offshore in Mumbai have natural gas resources.

8th vol – I
Unit 1 – Rocks and Soil

Rocks

- The rocks are the solid mineral materials forming a part of the surface of the earth and other similar planets. The earth's crust (Lithosphere) is composed of rocks. A rock is an aggregate of one or more minerals. Rock is an important natural resource and is found in solid state. It may be hard or soft in nature. An estimation reveals that there are 2,000 different types of minerals found on the earth surface out of which only 12 are the basic minerals commonly found all over the earth. Minerals are chemical substances which exist in nature. They may occur either in the form of elements or compounds.

Classification of Rocks

- According to the mode of formation the rocks are classified into three types as follows.

  1. Igneous Rocks,
  2. Sedimentary Rocks
  and 3. Metamorphic Rocks

Igneous Rocks

- The igneous rocks are formed by the solidification of molten magma. These rocks are also called as the 'Primary Rocks' or 'Parent Rocks' as all other rocks are formed from these rocks. Characteristics of Igneous Rocks

1. These rocks are hard in nature
2. These are impermeable
3. They do not contain fossils
4. They are associated with the volcanic activities
5. These rocks are useful for construction works

Types of Igneous Rocks

1. Extrusive Igneous Rocks, 2. Intrusive Igneous Rocks

- **Extrusive Igneous Rocks:** Can you visualize the lava comes out from a volcano? Lava is actually a fiery red molten magma comes out from the interior of the earth on its surface. After reaching the earth surface the molten materials get solidified and form rocks. Rocks formed in such a way on the crust are called Extrusive igneous rocks. These rocks are fine grained and glassy in nature due to rapid solidification. Basalt found in the north western part of peninsular India is the example for this type of rock.

1. **Intrusive Igneous rocks**: The molten magma sometimes cools down deep inside the earth's crust and becomes solid. The rocks formed this way is called 'Intrusive Igneous Rocks'. Since they cool down slowly, they form large grains. Intrusive Igneous rocks are of two types. The deep seated rocks are called 'Plutonic rocks' and the ones formed at shallow depths are called 'Hypabysal rocks'. Granite, Diorite and Gabbro are the examples of plutonic rocks and Dolerite is an example of hypabysal rocks. Since the intrusive Igneous rocks consist of large crystals, they are also called as 'Crystalline rocks'.

Sedimentary Rocks

- The word 'Sedimentary' has been derived from Latin word 'Sedimentum' means settling down. The sedimentary rocks are formed by the sediments derived and deposited by various agents. Due to high temperature and pressure, the undisturbed sediments of long period cemented to form sedimentary rocks. Sedimentary rocks consist of many layers which were formed by the sediments deposited at different periods. As it consists of many strata, it is also known as 'Stratified rocks'. Characteristics of Sedimentary rocks

1. They have many layers.
2. They are non-crystalline rocks.
3. They contain fossils.
4. They are soft and get eroded easily

Types of Sedimentary Rocks

1. **Organic Sedimentary Rocks:** These rocks are formed as a result of the decomposition of dead plants and animals. It contains fossils. Chalk, Talc, Dolomite and Limestone rocks are of this category.

2. **Mechanical Sedimentary Rocks**: These rocks are formed from the disintegration of igneous and metamorphic rocks. The natural agents erode and transport these rocks and deposit them at some places. After a long period of time, they cemented to form rocks. Sandstone, Shale and Clay are the examples of rocks of this type.

3. **Chemical Sedimentary rocks**: These are formed by precipitating of minerals from water. It is formed usually through evaporation of chemical rich solutions. These rocks are also called as evaporates. Rock Salt is an example of this kind.

Metamorphic Rocks

- The word Metamorphic is derived from two Greek words "Meta" and "Morpha", Meta means change and Morpha means shape. When Igneous and sedimentary rocks subject to high temperature and pressure, the original rocks get altered to form a new kind of rock called metamorphic rocks. Metamorphism is of two

types. They are 1.Thermal Metamorphism: If the change in the rocks is mainly caused by high temperature, the process is called as thermal metamorphism. 2. Dynamic Metamorphism: If the change in the rock is mainly caused by high pressure, the process is called as Dynamic Metamorphism.

✓ **Formation of Metamorphic Rocks from Igneous rocks**

- Granite into gneiss caused by dynamic metamorphism.
- Basalt into slate caused by thermal metamorphism.

✓ **Formation of Metamorphic Rocks from Sedimentary rocks**

- Sandstone into quartz caused by thermal metamorphism.
- Shale into slate caused by thermal metamorphism.

✓ **Characteristics of Metamorphic Rocks**

- Metamorphic rocks are mostly crystalline in nature.
- They consist of alternate bands of light and dark minerals.

Rock cycle

- Igneous rocks are the primary rocks formed first on the earth. These rocks are weathered, eroded, transported and deposited at some places to form sedimentary rocks. The Igneous and Sedimentary rocks are changed into metamorphic rocks under the influence of temperature and pressure. The metamorphic rocks are also get disintegrated and deposited to form sedimentary rocks. Formation of igneous rocks takes place when there is an outflow of molten materials. Like this, the rocks of the earth crust keeps on changing from one form to another form under various natural forces and agents. The endless process is referred as Rock Cycle.

Uses of rocks

- Rocks have been used by mankind throughout the history. Rocks are highly valuable and important to almost all aspects of our economy. The minerals and metals in rocks have been found essential to human civilization. Rocks are used for many purposes in our life and some of them are given below. Rocks are useful for making

1. Cement
2. Writing chalk,
3. Fire,
4. Building materials,
5. Bath scrub,
6. Kerb stone,
7. Ornament,
8. Roofing materials,
9. Decorative materials,
10. These are valuable source of minerals such as gold, diamond, sapphire etc.

Soil and its Formation

- Soil is a mixture of organic matter, minerals, gases, liquids and organisms that together support life. Soil minerals form the basis of soil. It forms on the surface of the earth. It is known as the 'skin of the earth'. Soils are produced from rocks (parent material) through the processes of weathering and natural erosion. Water, wind, temperature change, gravity, chemical interaction, living organisms and pressure differences all help break down parent material. It leads to the formation of loose material. In course of time, they further break down into fine particles. This process release the minerals locked in the rock fragments. Later on, the vegetative cover which develop in that region forms humus content in the soil. This way the soil gets matured gradually.

  - **Soil Composition:** The basic components of soil are mineral, organic matter, water and air. It consists of about 45% mineral, 5% organic matter, 25% of water and 25% air. It is only a generalized fact. The composition of soil varies from place to place and time to time.

  - **Soil profile:** The soil profile is defined as the vertical section of the soil from the ground surface and extends downwards.

  - **Classification of soils:** Soils are classified on the basis of their formation, colour, physical and chemical properties. Based on these, soil is classified into six major types. They are: Alluvial soil, Black soil, Red soil, Laterite soil, Mountain soil, Desert soil

  - **Alluvial soil:** These soils are found in the regions of river valleys, flood plains and coastal regions. These are formed by the deposition of silt by the running water. It is the most productive of all soils. It is suitable for the cultivation of sugarcane, jute, rice, wheat and other food crops.

  - **Black soils:** These soils are formed by weathering of igneous rocks. Black soil is clayey in nature. It is retentive of moisture. It is ideal for growing cotton.

  - **Red Soils:** These soils are formed by weathering of metamorphic rocks and crystalline rocks. The presence of iron oxide makes this soil brown to red in colour. It is usually found in semi-arid regions. It is not a fertile soil. It is suitable for millet cultivation.

  - **Laterites soils:** These are the typical soils of trophical regions. These soils are found in the regions which experienced alternate wet and dry condition. As these soils are formed by the process of leaching, it is in fertile. It is suitable for plantation crops of tea and coffee.

- **Mountain soils:** These soils are found over the slopes of mountain. Soils in these regions are thin and acidic. However characteristic of soil differs from region to region based on the altitude.

- **Desert soils:** These are sandy soil found in the hot desert regions. These soils are porous and saline. Since it is infertile agriculture in these soils are not so successful.

- **Soil Erosion**: Soil erosion is the removal or destruction of the top layer of soil by natural forces and human activities. Soil erosion reduces the fertility of soil which in turn reduces the agricultural productivity. Running water and wind are the major agents of soil erosion. Sheet erosion, Rill erosion and Gully erosion are the major types of soil erosion.

Layers of Soil

O-Horizon or Humus	This layer is dominated by organic material (leaves, needles, twigs, moss and lichens).
A- Horizon or Top Soil	It is a part of top soil, composed of organic matter mixed with mineral matter.
E- Horizon or Elevated layer	E-Stands for elevated layer. This layer is significantly leached of clay, iron, and aluminum oxides, which leaves a concentration of ore
B- Horizon or Sub-soil	This layer reflects the chemical or physical alteration of parent material. Thus iron, clay, aluminum and organic compounds are found accumulated in this horizon.
C- Horizon or Parent Rock	Partially weathered parent material accumulates in this layer.
R- Horizon Parent Rock	This layer consists of unweathered part of bed rock.

Soil conservation

- Soil conservation is the process of protecting the soil from erosion to maintain its fertility. The methods that are widely practiced for conserving soil are afforestation, controlled grazing, construction of dams, Crop rotation, Strip farming, contour ploughing, terrace farming, checking shifting cultivation, wind break etc.,

Uses of soils

- Soil is one of the important natural resource. It is a basic requirement for plant growth and supports various life forms on the earth.

  ✓ The minerals present in the soil enhance and nourishes the crops and plants.

- ✓ It is used in making of ceramics or pottery.
- ✓ It is a source of material for construction and handicraft works.
- ✓ It acts as natural filter of water and purifies it.
- ✓ Soil supports ecosystem and play an important role in land management.

- Rocks and soils are the important renewable natural resources. Both of them play an important role in everyday life of human beings as well as economic development. Nowadays rock-based companies are in increase which provide employment to a sizeable population. Soils attract human settlement and other economic activities. As India is an agricultural country, the proper management of soil resource will lead to sustainable food production besides its use for various other purposes. So, the soil resources must be conserved.

NOTE

- ❖ Petrology is a branch of geology which deals with the study of rocks. '**Petrology**' is derived from the Greek word "**Petrus**" refers to rock and "**Logos**" refers to study
- ❖ The word **Igneous** is derived from the Latin word '**Ignis**' means '**fire**'
- ❖ Some major **Active Volcanoes**: Mount Vesuvius, Mt. Stromboli and Mt. Etna in Italy and Mauna Loa and Mauna Kea in Hawaii Islands.
- ❖ Oldest sedimentary rocks of the world has been identified in Greenland and estimated as 3.9 billion years old.
- ❖ Sedimentary rocks are the important source of natural resources like coal, oil and natural gas.
- ❖ One of the world wonders TajMahal in India was built by White Marble in a metamorphic rock.
- ❖ Quartzite and Marble are the rocks commonly used for construction and sculpture works. Marbles are widely used for making beautiful statues and decorative items such as vase, tiny gift articles and grinded marble is used to produce plastics, paper etc.,
- ❖ World Soil Day is observed on 5th December, every year
- ❖ **How long does it take to form soil?**
  The time needed to form a soil depends on the Climate. The environments which is characterized by mild climate, takes 200-400 years to form one cm of soil and in wet tropical area, soil formation is faster and takes upto 200 years. To become a well matured soil, it takes about 3000 years.

10th book

Unit 4. Resources and Industries

Introduction

- Any matter or energy derived from the environment that is used by living things including humans is called a natural resource. Natural resources include air, water, soil, minerals, fossil fuels, plants, wild life etc. Many natural resources are used as raw materials. They play a vital role in the economic development of any region. Natural resources are classified on several basis. Based on continued availability, the resources are categorised into two types. Renewable Resources are those which have natural regeneration after their utilisation. Solar energy, wind energy, biogas, tidal energy, wave energy etc. are the renewable resources. Non- Renewable resources are the sources that cannot be replaced again after utilisation. Coal, petroleum, natural gas etc. fall under this category.

Minerals

- Mineral is a natural substance of organic or inorganic origin with definite chemical and physical properties. The process of extracting mineral from the earth is known as mining. The mines near the earth crust are known as open pit mines while the deep mines are known as shaft mines.

Types of Minerals

- On the basis of chemical and physical properties, minerals are broadly grouped under two categories. They are metallic and non-metallic minerals.

a. Metallic Minerals

- Metallic minerals are the minerals which contain one or more metallic elements in them. Metallic minerals occur in rare, naturally formed concentrations known as mineral deposits. These deposits consist of a variety of valuable metals such as iron, manganese, copper, bauxite, nickel, zinc, lead, gold etc.

i. Iron ore

- Iron ore is the most widely distributed elements of the earth crust, rarely occurs in a free state. It enters into the composition of many rocks and minerals especially from igneous and metamorphic rocks. The total recoverable reserves of iron ore in India are about 9602 million tons of haematite and 3408 million tons of magnetite. About 79% haematite deposits are found in Assam, Bihar, Chhattisgarh, Jharkhand, Odisha and Uttar Pradesh. About 93% magnetite deposits occur in Andhra Pradesh, Goa, Karnataka, Kerala and Tamil Nadu. Karnataka alone contributes about 72% of magnetite deposits of India.

Iron ores are rocks and minerals from which metallic iron can be economically extracted. The ores are usually rich in iron oxides and vary in colour from dark grey, bright yellow, or deep purple to rusty red. The iron is usually found in following form.

Form of Iron ores	Iron Content (%)
Magnetite	72.4%
Hematite	69.9%
Goethite	62.9%
Limonite	55%
Siderite	48.2%

- Jharkhand is the leading producer of iron ore with 25% the country's production. Singhbhum, Hazaribagh, Dhanbad and Ranchi districts are its major producers. Odisha with 21% production ranks second. Sundargarh, Mayurbhanj, Sambalpur and Keonjhar districts are its major producers. The magnetite production of Chhattisgarh is 18% (Rajgarh and Bilaspur are its leadings districts) and the Karnataka is 20% (Chikmangalur, Chitradurga, Shimoga and Dharwad districts are its major producers). Andhrapradesh and Karnataka produce about 5% each. Kurnool, Guntur, Cuddapah and Anantapur districts in Andhra Pradesh and Salem, Namakkal, Tiruvannamalai, Tiruchirappalli, Coimbatore, Madurai and Tirunelveli districts in Tamil Nadu are notable for the production of iron ore. SAIL (Steel Authority of India Limited): The Ministry of Steel is responsible for planning and development of iron and steel industry in India.

ii. Manganese

- Manganese is a silvery grey element. It is very hard and brittle in nature. It is always available in combination with iron, laterite and other minerals. It is an important mineral used for making iron and steel and serves as basic raw material for alloying. It is the most important mineral for making iron and steel. Nearly 10 kg manganese is required for manufacturing one ton of steel. It is also used in the manufacturing of bleaching powder, insecticides, paints and batteries. Manganese deposits occur mainly as metamorphosed bedded sedimentary deposits. The largest deposits of manganese is found in Odisha(44%) followed by Karnataka (22%), Madhya Pradesh (12%), Maharashtra & Goa(7% each), Andhra Pradesh (4%) and Jharkhand (2%). Rajasthan, Gujarat, Telengana and West Bengal together constitute about 2% of the India's manganese resource. Nagpur, Bhandara and Ratnagiri districts in Maharastra and Balaghat and Chhindwara districts in Madhya Pradesh are the leading producers. Odisha is the third largest producer with 24% (Sundargarh,Kalahandi, Koraput and Bolangir districts are the major ones). Other producers are Andhra Pradesh (13%) and Karnataka (6%). Srikakulam, Visakhapatnam, Cuddapah and Guntur districts in Andhra Pradesh and the districts of Shimoga, Bellary, Chitradurga and Tumkur are the important districts of Karnataka. It is the most

important mineral for making iron and steel. India is the fifth largest producer of manganese in the world.

iii. Copper

- Copper is the first metal that prehistoric man has started using for many purposes. Being flexible, it can be made into utensils of any shape. Brass and Bronze are obtained when the copper alloys with zinc and tin respectively. Copper has been commonly used for making cooking utensils and other objects of common utility. In modern days, it is extensively used in vast variety of electrical machinery, wires and cables Largest reserves of copper ore is in the state of Rajasthan (53.81%) followed by Jharkhand (19.54%) and Madhya Pradesh (18.75%). The states of Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Telangana, Uttarkhand and West Bengal account for 7.9% of the total copper reserves of India.

- Jharkhand is the largest producer ofcopper with 62% of India's production.Singhbhum and Hazaribagh districts are its leading producers of copper. Odisha is the other major producer with 50.2% production. Rajasthan ranks third with 28% production. The districts of Khetri, Alwar and Bhilwara are notables in this state. The states of Uttarkhand(Dehradun and Garhwal districts),Andhra Pradesh (Guntur, Kurnool and Nellore districts), Karnataka (Chitradurga and Hassan districts) and Tamil Nadu contributes about 7% of production each.

iv. Bauxite

- Bauxite is an important ore from which aluminium is extracted. It is found in the rock consisting mainly of hydrated aluminium oxides. Bauxite is widely distributed as surface deposits in the areas of laterite soil. Being light in weight and tough, aluminium is used in the manufacture of aircraft s and automobile engines. Bauxite is also used in the manufacture of cement and chemicals. The main bauxite deposits occur in Odisha – 50.2%, Gujarat – 15.8% (Junagadh, Amreli and Bhavnagar districts), Jharkhand – 11.9% (Ranchi and Gumila districts), Maharashtra – 9.9% (Sindhudurg and Ratnagiri), Chhattisgarh – 6.2% (Ballarpurand Durg districts), and Tamil nadu – 2.7%. Being light in weight and tough, aluminium is used in the manufacture of aircraft s and automobile engines. Bauxite is also used in the manufacture of cement and chemicals. Orissa is the largest producer of bauxite in India with approx. 1,370.5 million tonnes. India's State and Central Government is very supportive in production of Bauxite and other Industrial Minerals in Orissa, Jharkand, Tamil Nadu.

b. Non-Metallic Minerals

- These minerals do not contain metal in them. Mica, limestone, gypsum, nitrate, potash, dolomite, coal, petroleum etc are the non- metallic minerals.

i. Mica

- In ancient time, Mica was used in ayurvedic medicine. Mica became very popular with the development of electrical industry. Abhrak is a good quality mica. It is translucent, easily splitable into thin sheets, flat, colourless, elastic and incompressible. Mica is used in making of insulating properties, as it withstands high voltage and has low power loss factor. Since it is a non-conductor of electricity, it is exclusively used in electrical goods. It is also used in making of lubricants, medicines, paints and varnishes.

- The major deposits of mica are found in Andhra Pradesh(41%) with Nellore, Visakhapatnam, West Godavari and Krishna are its major districts. Other important states in mica deposits are Rajasthan(21%) and Odisha(20%). Bhilwara, Jaipur and Ajmer are the notable districts in Rajasthan and, Rayagada, Bolangir and Sundargarh districts are the major producers in Odisha. Dhanbad, Palamu, Ranchi and Singhbum districts are the major mica mines in Jharkhand state.

ii. Lime Stone

- Limestone is associated with rocks composed of either calcium carbonate or the double carbonate of calcium and magnesium or mixture of both. Limestone also contains small quantities of silica, alumina, iron oxides, phosphorous and sulphur. Limestone is used in the industries ofchemicals for soda ash, caustic soda, bleachingpowder, paper, cement, iron and steel, glassand fertilizers. The major producing areas: Andhra Pradesh produces about 20% with major concentration in Cuddapah, Kurnool and Guntur districts. Telengana also accounts for about 20% of the country's production with the districts of Nalgonda, Adilabad, Warangal and Karimnagar as major producers. Rajasthan produces about 18% (Jodhpur, Ajmer, Bikhaner and Kota districts), Madhya Pradesh about 12% (Jabalpur and Satna districts) and Tamil Nadu about 8.4% (Salem, Kancheepuram, Tiruchirappalli, Thoothukkudi, Tirunelveli and Virudhunagar districts) of limestone production of India. In terms of the reserves of limestone, the state of Karnataka leads with 27%, followed by Andhra Pradesh and Rajasthan (12% each), Gujarat (10%), Meghalaya (9%), Telangana (8%), Chhattisgarh and Madhya Pradesh (5% each) and the remaining by other states.

iii. Gypsum

- Gypsum is a hydrated sulphate of calcium which occurs as white,opaque or transparent minerals in beds of sedimentary rocks such as limestone, sandstone and shale. Gypsum is used in the manufacture of cement, fertilizers, wall board, plaster of paris and in soil conditioning. The state of Rajasthan alone accounts for 81% of its reserves. 14% of its reserves is found in Jammu and Kashmir and 2% in

Tamil Nadu. The remaining 3% resources are found in the states of Gujarat, Himachal Pradesh, Karnataka, Uttarakhand, Andhra Pradesh and Madhya Pradesh. Rajasthan produces 82% of the country'sproduction. Jodhpur, Bikaner and Jaisalmerare notable districts. Jammu and Kashmirproduces 14% of country's gypsum. Baramula,Doda and Uri districts are its major producers.The states of Gujarat (Bhavnagar andJamnagar districts), Uttarkhand (Dehradunand Mussourrie districts), Andra Pradesh(Nellore, Guntur and Prakasam districts)and Tamil Nadu are the other producers withabout 4% each.

Energy Resources

- The resources from which the electricity generated are called energy resources. Electricity is an important component of our life. No day to day activity takes without the use of this energy. It is also the key factor for all economic activities and industrial development. Energy resources can be classified into renewable and non-renewable. Coal, petroleum, natural gas and nuclear minerals are the sources of non-renewable energy. Water, sun light, wind, bio gas, tides etc., are the sources of renewable energy.

Non-Renewable Energy

a. Coal

- Coal is an inflammable organic substance composed mainly of hydrocarbons. Coal is available in the form of sedimentary rocks. It is used in the generation of thermal power. It has close association with the industrial development of any country. Since it is a valuable one, it is called as "Black Gold". Based on carbon content, it is classifiedin to the following types.

Anthracite:	contains 80 to 90% carbon
Bituminous:	contains 60 to 80% carbon
Lignite:	contains 40 to 60% carbon
Peat:	contains less than 40% carbon

- Coal is an important source of energy in India with its varied and innumerable uses. It can be converted into gas, oil, electricity and thermal power. Besides, it forms a basic raw material for the production of chemicals, dyes, fertilizers, paints, synthetic and explosives. Indian coal is mostly associated with Gondwana series of rocks and is primarily found in Peninsular India. The states of Jharkhand, odisha, West Bengal and Madhya Pradesh alone account for nearly 90% of coal reserves of the country. About 2% of India's coal is of tertiary type and is found mostly in Assam and Jammu & Kashmir.

- Jharkhand is the largest coal producing state in the country followed by odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra. The major coal fields of Jharkhand are Bokaro, North Karanpura, South

Karanpura, Giridih, Ramgarh, Daltongunj and Rajmahal. Talcher and Ranapur in Odisha, Korba and Chirmiri in Chhattisgarh, Umariaand Singrauli in Madhya Pradesh, Tandur, Singareni, Kothagudem and Ramagundam in Andhra Pradesh, Wardha, Ballarpur, Chanda and Kampati in Maharastraand, Raniganj, Asansol and Mejia in West Bengal are the other major coal fields of India.

- Indian lignite (brown coal) deposits occur in the southern and western parts of Peninsular India particularly in Tamil Nadu, Pudhucherry and Kerala. The Ministry of coal has over-all responsibility of determining policies and strategies in respect of exploration and development of coal resource in India. Coal India Limited (CIL), NLC India Limited (NLCIL) and Singareni Collieries Company limited (SCCL) are its public sector under takings.

b. Petroleum (or) Crude oil

- The word petroleum has been derived from two Latin words petro (meaning – Rock) and oleum (meaning oil). Thus petroleum is oil obtained from rocks of the earth. Therefore, it is also called mineral oil. Petroleum is an inflammable liquid that is composed of hydrocarbons which constitute 90-95% of petroleum and the remaining is chiefly organic compounds containing oxygen, nitrogen, sulphur and traces of organ metallic compounds. Petroleum is used as a source of power and fuel for automobiles, aeroplanes, ships and locomotives. Lubricants, kerosene, vaseline, tar, soap, terylene and wax are its by-products. Oil in India is obtained from both from on-shore and off-shore areas. As of 2017, the total estimated crude oil reserves of the country is 604.10 million tons. From this, 324.24 million tons (54%) are found in onshore and 279.86 million tonnes (46%) are in offshore areas. The production of crude oil fluctuates from year to year from 2011-12 to 2017-18 but only with marginal variations. The change is invariably in negative. In natural gas production also the trend is negative except the last year. The change is high in the first three years and it is low to moderate in the remaining years.

Western coast offshore oil fields	Eastern coast offshore fields
Mumbai high oil fields (largest 65%)	Bharmaputra valley (Dibrugarh and Sibsagar districts of upper Assam.)
Gujarat coast (2nd largest)	Digboiiol fields (oldest fields in country)
Basseium oil field, south of Mumbai high	Nahoratiya oil fields (south west of digboi)
Aliabet oil field, south of Bhavanagar	Moran – Hugrijian oil fields (sibsagar districts of assam)
Ankleshwar	Rudrasagar – Lawa oil fields (sibsagar districts of assam)
Cambay – Luni Region	Surrma valley (Badarpur, Masimpur, Patharia)
Ahmedabad Kalol Region	Offshore of Andaman and Nicobar, Gulf of mannar, Baleshwar coast, Punjab,

	Haryana and Uttar Pradesh.

c. Natural Gas

- Natural gas usually accompanies the petroleum accumulations. It is naturally occurring hydro carbon gas mixture consisting primarily of methane, but commonly includes varying amounts of other higher alkanes and sometimes a small percentage of carbon dioxide, nitrogen and hydrogen sulphides. It is formed when layers of decomposed plants and animals are exposed to intense heat and pressure over thousands of years. It is used as a source of energy for heating, cooking and electricity generation. It is also used as fuel for vehicles and as a chemical feedstockin the manufacture of plastics and other commercially important organic chemicals.

- India has a very large proportion of tertiary rock and alluvial deposits particularly in the extra peninsular India. These sedimentary rocks, which were once under the shallow seas, hold the possibility of harbouring oil and gas deposits. The highest concentration of natural gas is found in the Bombay high and basseim oil fields. Jagatia and Gogha in Gujarat, Nahorkatiya and Moran in Assam, Neypaltur, Mangmadam in Thanjavur district in Tamil Nadu, Baranura and Atharnure ranges in Tripura, Barmer and Charaswala in Rajasthan, Miao Pung and Laptang areas in Arunachal Pradesh, Firozpur district in Punjab, Mausar and Maradpur areas in Jammu and Kashmir and Medinipur in West Bengal are the other areas where natural gas reserves have been discovered. The Gas Authority of India Ltd [GAIL] is doing pioneer work in the field of natural gas exploration. Discovery of gas made rapid strides in the 1985. Oil strikes at Cauvery offshore, at Nanda in Cambay basin and Tarot in Jaisalmer basin in Rajasthan were major discoveries during 1988-89. Recently, it has been found that Krishna- Godavari delta has reserves of Natural gas.

Conventional Energy Sources

a. Thermal power

- Thermal power is generated using fossil fuels like coal, diesel, petroleum and Natural gas. National Thermal Power Corporation [NTPC] was established in 1975. At present NTPC has 13 coal based super thermal power projects and 7 gas / liquid fuel based combined cycle projects in the states of Assam, Bihar, Jharkhand, Chhattisgarh, Mizoram and West Bengal. It accounts for over 90% of the installed capacity. Tamil Nadu produces about 5% of the total thermal electricity produced in India. Neyveli, Mettur, Thoothukudi and Ennore (Chennai) are the important thermal power stations in Tamil nadu.

b. Nuclear power

- The energy released during nuclear fission or fusion is used to generate electricity. Nuclear energy is generated mainly from the minerals of Uranium and Thorium. Nuclear power programme in India was initiated in 1940's when 'Tata Atomic research commission was incorporated in August 1948. The first nuclear power station was setup at Tarapur near Mumbai in 1969 with the capacity of 320 mw. Later atomic reactors were installed at Rawatbhata (335 MW), near Kota in Rajasthan (100 MW), Kalpakkam (440 MW) and Kudankulam (2,000 MW) in Tamil Nadu and Narora (235 MW) in Uttar Pradesh, Kaiga in (235 MW) in Karnataka and Kakarapara (235 MW) in Gujarat.

Renewable or Non-Conventional EnergyResources

a. Hydro power

- Power generated from water is termed as hydroelectricity. Hydro power is the energy harnessed from running water. Hydro power is considered as one of the most economic and non-polluting sources of energy. It contributes nearly 7% of global electricity production. The cost of production of hydroelectricity is relatively low, making it a competitive source of renewable energy. It is also a flexible mode of power generation as the quantity of production can either be increased or decreased very quickly adapting to changing demands. India is fortunate to have a large potential of hydro- power potential. It is quite unevenly distributed in India. Of the total hydro-electric potential of the country, rivers of Assam, Arunachal Pradesh, Manipur, Nagaland and Tripura account for 30.4%, eastward flowing rivers of the peninsular India 20.9%, westward flowing rivers of the western Ghats (South of the Tapti) 10.5%, the Ganga Basin (excluding the potential of Nepal) 11.7%, the Indus Basin 16.0% and the rivers of central India 10.5%.

b. Solar Energy

- Solar Power is the conversion of sunlight into electricity, either directly using photovoltaic (PV) or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking system to focus a large area of sunlight into a small beam. Photovoltaic convert light into an electric current using the photovoltaic effect. The mass objectives of the solar thermal energy programme, being implemented by the Ministry of Non-Conventional Energy Source (MNES) are market development, commercialisation and utilisation of heat energy requirement of different applications in domestic, institutional and industrial sectors. Solar power is used in water heaters, refrigerators, drying, street lighting, cooking, pumping, power generator, photovoltaic cells, salon parts etc. Andhra Pradesh, Gujarat, Rajasthan, Maharashtra and Madhya Pradesh are the major solar power producers.

c. Wind Energy

- Wind energy is extracted from air flow using wind turbines. It is a cheap and pollution free source of energy. Power from wind mills are used for pumping water and to sail propel ships. Wind power is plentiful, renewable, widely distributed, clean and produces no greenhouse gas emissions during operation. These plants occupy only a less space. The development of wind power in India began in 1986 with first wind farms were set up in coastal areas of Gujarat (Okha), Maharashtra (Ratnagiri) and Tamil Nadu (Thoothukudi) with 55 KW Vestas wind turbines. The capacity has significantly increased in the last few years. India has the fourth largest installed wind power capacity in the world.

d. Biomass Energy

- Bio energy may be obtained through bio-degradable materials like animal dung, kitchen wastes, water hyacinth, agricultural residues and city wastes etc. It is clean and cheap source of energy. India has a potential of about 18 GW of energy from Biomass. Currently, about 32% of total primary energy used in India is derived from Biomass. Energy derived from biomass is mostly used for domestic purposes.

e. Tidal and wave Energy

- There are two main sources of ocean energy. They are Ocean tides and Ocean waves. It is estimated that India possesses 8,000-9,000 MW of tidal energy potential. The Gulf of Cambay is the best suited area with about 7,000 mw potential of tidal energy. This is followed by Gulf of Kachch (1,000MW) and sunder bans (100MW). At present a 900mw tidal power plant is proposed to be set up in the Gulf of Kachch region. Wave energy potential in India is estimated to be 40,000 MW. An wave energy power plant of 150 KW(maximum) has been installed at vizhinjam near Thiruvananthapuram. An another plant of this kind has been set up near Andaman& Nicobar Islands.

Industries

- It refers to the activities which converts the raw materials into finished products. This sector is called as the value addition sector. On the basis of the source of raw materials, Industries are classified into the Agro based industries, Forest based industries and Mineral based industries.

Agro based industries

- These industries draw their raw materials from agricultural sector. The following part discusses the agro based industries in India.

a. Cotton Textile Industry

- Textile is a broad term which includes cotton, jute, wool, silk and synthetic fibre textiles. This sector in India with 3400 textiles mills with installed capacity of more than 50 million spindles and 842000 rotors is the second largest in the world. Traditional sectors like hand loom, handicrafts and small power-loom units are the biggest source of employment for millions of people in rural and semi urban areas. The cotton textile industries contribute about 7% of industrial output, 2% of India's GDP and 15% of the country's export earnings. It is one of the largest sources of employment generation in the country. With over 45 million employees, the total employment in this industry is well over 25million worker. At present there are 1,719 textiles mills in the country. Out of which 188 mills are in public sector, 147 in cooperative sector and 1,284 in private sector. Currently, India is the third largest producer of cotton and has the largest loomarc and ring spindles in the world. At present, cotton textile industry is the largest organized modern industry of India. About 16% of the industrial capital, 14% of industrial production and over 20% of the industrial labour of the country are engaged in this industry. The higher concentration of textile mills in and around Mumbai, makes it as "Manchester of India". Presence of black cotton soil in Maharastra, humid climate, presence of Mumbai port, availability of hydro power, good market and well developed transport facility favour the cotton textile industries in Mumbai. The major cotton textile industries are concentrated in the states of Maharashtra, Gujarat, West Bengal, Uttar Pradesh and Tamil Nadu. Coimbatore is the most important centre in Tamil Nadu with 200 mills out of its 435 and called as "Manchester of SouthIndia". Erode,Tirupur, Karur, Chennai, Thirunelveli, Madurai, Thoothukudi, Salem and Virudhunagar are the other major cotton textiles centres in the state.

b. Jute Textiles

- Jute is a low priced fibre used mainly for making package materials like gunny bags. Today jute is blended with cotton and wool to produce textiles. India is the largest producer of jute goods contributing 35% of the world's total output. This is the second important textile industry in India after cotton textiles. Jute is the golden fibre which meets all the standards of goods packing with its natural, renewable, bio degradable and eco-friendly products. The first jute mill in India was established at Rishra near, Kolkata in 1854 by the English man George Auckland.

- India tops in the production of raw jute and jute goods and second in the export of jute goods next to Bangladesh. Jute production includes gunny bags, canvas, pack sheets, jute web, carpets, cordage, hessians and twines. Now jute is also being used in plastic furniture and insulation bleached fibres to blend with wool. It is also mixed with cotton to make carpet and blankets. The major jute producing areas are in West Bengal and concentrated along the Hooghly river within the radius of six kilometre of Kolkata. Titagarh, Jagatdat, Budge-Budge, Haora and Bhadreshwar are the chief centres of jute industry. Andhra Pradesh,

Bihar, Uttar Pradesh, Assam, Chhattisgarh and Odisha are the other jute goods producing areas.

c. Silk Industry

- India has been well known for the production of silk. Since the ancient times, India is the second largest producer of raw silk next only to China. Sericulture is a labour intensive industry and provides employment to 7.56 million people make to weaker and marginalised sections of society. Karnataka is the largest producer of silk with an average of 8200 metric tons every year which is about one third of the total silk production of India. Other major producers of silk are West Bengal, Jammu Kashmir, Bihar, Jharkhand, Chhattisgarh, Uttar Pradesh, Punjab, Assam and Tamil Nadu states. India exports exclusively silk fabrics, silk scarves, dress material and sarees. It exports to the principal countries like Europe, U.S.A, U.K, Russia, Saudi Arabia, Kuwait and Singapore.

d. Sugar Industry

- Sugar can be produced from sugar cane, sugar-beets or any other crop which have sugar content. In India, sugar cane is the main source of sugar. At present this is the second largest agro based industry of India after cotton textiles. India is the world's second largest producer of sugar cane after Brazil. This industry provides employment to 2.86 lakh workers. Sugar industry is decentralized and located near the sugarcane growing areas as they are weight loosing and bulky to transport. Uttar Pradesh is the largest producer of sugar, producing about 50% of the country's total. Other major producers are Maharashtra, Uttar Pradesh, Karnataka, Andhra Pradesh, Tamil Nadu, Bihar, Punjab, Gujarat, Haryana and Madhya Pradesh states. These states account for more than 90% of the sugar mills and sugar production.

Forest based industries

- Forestprovide us with different types of material which are used as raw material for certain industries like paper, lac, sports goods, plywood etc.

a. Paper industry

- Paper Industry has emerged as a diversified and specialized industry in India that produces numerous types of papers that comes in various use such as sheet paper, paper boxes, tissues, paper bags, stationery, envelopes and printed-paper products such as books, periodicals, and newspapers. In India the Soft wood is the principal raw material used for making paper especially newsprint and high class printing papers. Paper is the pre-requisite for education and literacy and its use is an index of advancement in these two fields as well as the overall well-being of the society.

- The first successful effort was made in 1867 with the setting up of the RoyalBengal paper mills at Ballyganj near Kolkata. Subsequent successful efforts were made at Lucknow in 1879, Titagarh in 1882, Pune in 1887, Raniganj in 1892, Kankinra in 1892 and Naihati in 1918.The raw materials for paper industry includes wood pulp, bamboo, salai and sabai grasses, waste paper and bagasse. West Bengal is the largest producer of paper in the country followed by Madhya Pradesh, Odisha and Tamil nadu states.

Mineral based industries

- Mineral based industries use both metallic & non-metallic minerals as raw materials. The major mineral based industry of country is the iron steel industry

a. Iron and steel industries

- Iron and steel industry is called a basic metallurgical industry as its finished product is used as raw material by host of other industries. Several industries like engineering, heavy machines and machine tools, automobile, locomotives and railway equipment industries use iron and steel as their primary raw material. Due to this, the steel producing capacity of a country is generally taken as an indicator of its level of industrial development. The modernization of the industry was started in 1907 with the establishment of Tata Iron and Steel Company at Sakchi, now called Jamshedpur. Iron and steel industry of India is mainly concentrated in the states of Jharkhand, West Bengal and Odisha. Proximity to the coal fields of Jharia, Raniganj, Bokaro and Karanpura and the iron ore mines of Mayurbhanj, Keonjar and Brona are responsible for this. This area also has sufficient deposits of limestone, dolomite, manganese, silicon and dolomite which are required for the industry.

S.NO	Name of Industry	Place	Establishment year	Product
1.	Tata Iron and Steel Company (TISCO)	Jamshedpur, Jharkhand	1911	Pig Iron
2.	Indian Iron and steel Company (IISCO)	Burnpur, Hirapur, Kulti, West Bengal	1972	Pig Iron & Crude steel
3.	Visweshwaraya Iron Steel Ltd (VISL)	Bhadravati, Karnataka	1923	Alloy and Sponge steel
4.	Hisdustan Steel Ltd (HSL) Collaborated with Russia	Bhilai, Chattisgarh	1957	Railway Equipment's and Ship Building
5.	Hindustan Steel Ltd (HSL) Collaborated with Germany	Rourkela, Odisha	1965	Hot and Cold rolled sheets, Galvanized sheets and electrical plates
6.	Hindustal Steel Ltd (HSL) Collaborated with United	Durgapur, west Bengal	1959	Alloy steel, Construction materials

	Kingdom			and railway equipment's
7.	Hisdustan Steel Ltd (HSL) Collaborated with Russia	Bokaro, Jharkhand	1972	Sludge and Slog
8.	Salem Steel Ltd	Salem, Tamil Nadu	1982	Stainless Steel
9.	Vijayanagar Steel Plant	Tornagal, Karnataka	1994	Flat steel and Long Steel
10.	Visakhapatnam Steel Plant (VSO)	Visakhpatnam, Andhra Pradesh	1981	Hot Metal

Automobile Industry

- India is set to emerge not only as a large domestic market for automobile manufacturers, but also as a crucial link in the global automotive chain. It is one of the most dynamic industrial groups in India. The first automobile industry of India was started in 1947. The industry is the Premier Automobiles Ltd located at Kurla (Mumbai). It was followed by the Hindustan Motors Ltd at Uttarpara (Kolkata) in 1948. At present, India is the 7th largest producer of automobile manufacturers which include two wheelers, commercial vehicles, passenger car, jeep, scooty, scooters, motor cycles, mopeds and three wheelers. Major centres are at Mumbai, Chennai, Jamshedpur, Jabalpur, Kolkata, Pune, New Delhi, Kanpur, Bengaluru, Sadara, Lucknow and Mysuru. Tata Motors, Maruti Suzuki, Mahindra & Mahindra and Hindustan Motors are the largest passenger car manufacturers of Indian companies in the country. Presence of foreign car companies such as Mercedes Benz, Fiat, General Motors, Toyota and the recent entryof passenger car manufacturers BMW, Audi, Volkswagen and Volvo makes the Indian automobile sector a special one. Tata Motors, Ashok Leyland, Eicher Motors, Mahindra & Mahindra and Ford Motors are the major Indian companies which manfacture commercial vehicles. MAN, ITEC, Mercedes-Benz, Scania and Hyundai are the foreign companies engage in the manfacture of commercial vehicles. Twowheeler manufacturing is dominated by Indian companies like Hero, Bajaj Auto and TVS.

- The automobile industries are found in four clusters viz; Delhi, Gurgaon and Manesar in North India, Pune, Nasik, Halol and Aurangabad in West India, Chennai, Bengaluru and Hosur in South India and Jamshedpur and Kolkata in East India. Electrical and Electronic

Industries

- Heavy electrical industries manufacture equipment used for power generation, transmission and utilization. Turbines for steam and hydro power plants, boilers for thermal power plants, generators, transformers, switch gears etc. are the chief products of this industry. The most important company in the field of heavy

electrical is Bharat Heavy Electricals Ltd (BHEL). It has its plants at Hardwar, Bhopal, Hyderabad, Jammu, Bengaluru, Jhansi and Tiruchirappalli. This Industry covers a wide range of products including television sets, transistor sets, telephone exchanges, cellular telegram, computers and varied equipment's for post and railway, defence and meteorological department. Bengaluru is the largest producer of electronic goods in India, hence it is called as the "Electronic Capital of India". The other major producers of electronic goods centers are Hyderabad, Delhi, Mumbai, Chennai, Kolkata, Kanpur, Pune, Lucknow, Jaipur and Coimbatore.

Software Industry

- India is home to some of the finest software companies in the world. The software companies in India are reputed across the globe for their efficient IT and business related solutions. The Indian Software Industry has brought about a tremendous success for the emerging economy. In India, software industry began in 1970 with the entry of Tata Consultancy Services (TCS). Along with this, L & T, InfoTech, i-Flex, Accenture, Cognizant, GalexE Solutions India Pvt Ltd and ITC InfoTech are the major software industries in the country. At present, there are more than 500 software companies all over India. It exports software service to nearly 95 countries in the world. The main centres of IT parks are located in Chennai, Coimbatore, Thiruvananthapuram, Bengaluru, Mysuru, Hyderabad, Visakhapatnam, Mumbai, Pune, Indore, Gandhi Nagar, Jaipur, Noida, Mohali and Srinagar.

Major challenges of Indian Industries

Industries in India face many problems. Some major problems are listed below.

- Shortage and fluctuation in Power Supply.
- Non- availability of large blocks of land.
- Poor access to credit.
- High rate of interest for borrowed loan.
- Non- availability of cheap labourers.
- Lack of technical and vocational training for employees.
- Inappropriate living conditions nearby industrial estates.

NOTE

- The organisations associated with minerals in India are the Geological Survey of India (Headquarter is at Kolkata), Indian Bureau of Mines (Headquarter at Nagpur) and Non-Ferrous Material Technology Development Centre (NFTDC), located at Hyderabad. The Ministry of Mines is responsible for the administration of all mines and minerals (Development and Regulation Act, 1957).
- MOIL- Manganese Ore India Limited state-ownedmanganese-ore miningcompany headquarteredin Nagpur. With a marketshare of 50%, it was

the largest producer ofmanganese ore in India.

- Hindustan Copper Ltd is a Government-owned corporationin the centralpublic Enterprise under theMinistry of minies, India.HCL is the only vertically integratedcopper producer in India engaged in awide spectrum of activities ranging fromMining, Beneficiation, Smelting, Refiningand Continuous Cast Rod manufacturer.Bauxite is an oxide ofaluminium; the name has beenderived after the French wordLe Baux.
- National Aluminium Company Limited, abbreviated as NALCO, (incorporated1981) has units in Odisha at places like Angul and Damanjodi. It was incorporatedas a public sector enterprise of the Ministry of Mines, Government of India in 1981.
- Coal India Limited (CIL) is an Indian state-controlled coal mining company headquartered in Kolkata, West Bengal, its field offices are located at Dhanbad, Ranchi, Bilaspur, Nagpur, Sambalpur, Kothagudam and Asansol. It is the largest coal-producing company in the world.
- The Ministry of Petroleum and Natural Gas (MOP&NG) is a ministry of the Government of India. It is responsible for the exploration, production, refining, distribution, marketing, import, export, and conservation of petroleum, natural gas, petroleum products, and liquefied natural gas in India.
- Gail (India) Limited (GAIL) (formerly known as Gas Authority of India Limited) is the largest state-owned natural gas processing and distribution company in India. It is headquartered in New Delhi. It has the following business **segments**: natural gas, liquid hydrocarbon, liquefied petroleum gas transmission, petrochemical, city gas distribution, exploration and production, GAILTEL and electricity generation.
- Compressed natural gas (CNG) (methane stored at high pressure) is a fuel which can be used in place of gasoline, diesel fuel and propane/LPG. In comparison to other fuels, natural gas poses less of a threat in the event of a spill, because it is lighter than air and disperses quickly when released. Biomethane – cleaned-up biogas from anaerobic digestion or landfills – can be used. Natural gas vehicles are increasingly used in Delhi, Ahmedabad, Mumbai, Pune, Kolkata Lucknow, Kanpur, Varanasi, etc.
- The Nuclear Power Corporation of India Limited (NPCIL) is an Indian public sector undertaking based in Mumbai, Maharashtra. It is wholly owned by the Government of India and is responsible for the generation of nuclear power for electricity. NPCIL is administered by the Department of Atomic Energy (DAE) is responsible for designing, and operating the nuclear power stations in India.
- NHPC Limited (National Hydroelectric Power Corporation) is located in Faridabad, India
- The first hydro-electric power station in India was established at "Darjeeling" in 1897.
- Solar Energy Corporation of India Limited (A Government of India Enterprise)head quarter is located at New Delhi.
- Tamil Nadu has the largest installation of wind turbines in the country in the
- Muppandal-Perungudi area near Kanniyakumari is the largest concentrations of wind farm capacity at a single location in the world.

- The National Institute of Wind Energy (NIWE), Chennai was established in Tamil Nadu in 1998 as an autonomous institution under the administrative control of the Ministry of New and Renewable Energy. CIWE main activities include resource assessment and testing & certification.
- The first cotton textile mill was established at Fort Gloster near Kolkata in 1818.
- Byssinosis, also called "brown lung disease" or "Monday fever", is an occupational lung disease caused by exposure to cotton dust in inadequately ventilated working environments.
- National jute board is headquarter at Kolkata.
- Ginning is the process of cotton fibre is separated from the cotton seed.
- The first attempt to produce iron and steel unit was set up at Porto Novo in Tamil Nadu in 1830.
- CSTRI is the only research institute in the country dedicated to the Research & Developmental activities related to silk technology. CSTRI was established in the year 1983 by the Central Silk Board, Ministry of Textiles, Govt. of India having head quarter at Bangalore
- Development Commissioner for Handlooms was set up as an attached non-participating office on 20th November, 1975 under the Ministry of Commerce. At present it is functioning under the Ministry of Textiles having headquarters at UdyogBhawan, New Delhi.
- The first paper mill of India was started in 1812 at Serampore in West Bengal.
- National Newsprint and Paper Mills (NEPA) is at Nepanagar in Burhanpur District of Madhya Pradesh.
- Chennai is nicknamed as the "Detroit of Asia" due to the presence of major automobile manufacturing units and allied industries around the city. Make in India program was launched in 2014 to put India on the world map as a major hub for global design and manufacturing.

12th book
Unit 3. RESOURCE

Introduction

Have you heard about **Voyager 1** launched in 1977 still is travelling at the speed of **62140 km/ hour or 17 km/sec.?** Do you know what fuel is used in it? It is **hydrazine**. What, do you think, would be the future fuel? It is certainly going to be **hydrogen**. Think about how hydrogen stands as an important future fuel.

- A resource is a naturally occurring exploitable material that a society perceives to be useful to its economic and material wellbeing. Willing, healthy and skilled workers also constitute a valuable resource, but without access to materials such as fertile soil or petroleum, human resources are limited in their effectiveness.

- Resources are the basis of the economic development of any nation. Different countries are at different levels of economic development primarily because of the variation in the availability of natural resources. The US and west European countries are economically prosperous because they possess vast natural and human resources and technology. On the other hand, in most parts of Africa and Asia, though they are naturally rich in resources, due to their lack of knowledge, the resources are unutilized and they are not used in the service of man.

Classification of Resources

- Resources are classified on various bases. Based on the continual availability, resources are classified in to **renewable** and **non- renewable resources.**

- The resources which can always be used again and again are known as **renewable resources**. It means these resources have natural regeneration and are inexhaustible. Air, water, solar energy etc. are examples of renewable resources. **Non-renewable resources** are available in finite quantities and cannot be obtained once if they are utilized. If these resources are used in large scale, they will get exhausted soon and as such these resources are called as **exhaustible resources.** Coal, oil and minerals are examples of this type.

- On the basis of origin, the resources are classified in to **biotic** and **abiotic resources**. When a resource is originated from living organism, the resource is known as **biotic resource**. Coal, mineral oil and forests are examples of biotic resources. **Abiotic resources** are composed of non-living inorganic matter. Air, land, water and minerals are examples of this type.

- On the basis of status of development, the resources are classified in to **potential resources** and **developed resources**. Potential resources are those which are known to exist and may be used in the future. Until the resource is extracted and put in to use, it remains a potential resource. **Developed resources** are those which have been surveyed and their quality and quantity have been determined

for utilisation. The development of resources depends on technology and level of their feasibility. Petroleum resource from Mumbai High is an example of Developed resources.

- Apart from the above classifications, the resources which are available in nature are known as **natural resources** and the one created by man is known as **man-made resource**. Similarly the air like resources which exist everywhere is called as **ubiquitous resources** and the resources which are concentrated only at specific places are known as **localised resources.** This kind of resource may exercise great influence on the economic development of the respective regions.

Mineral Resources

- A homogeneous, naturally occurring substance which has a definite chemical composition is called a mineral. They can be identified by their physical properties and chemical components. Minerals exist in different types based on their formation. Minerals play an indispensable part of our daily activities. Almost everything we use, from a tiny particle to a huge building or a big ship all, is made up of minerals. Minerals are one of the most valuable resources of the earth. All the stages of human development or progress have been named after them. For example, stone age, copper age, bronze age and Iron Age.

- They are exhaustible or non-renewable. Besides, they are distributed very unevenly. They are generally found in the form of ores. The ore contains several impurities. Minerals are separated from the ores involving a number of distinct processes.

- A country's economic development is depending on the minerals. There are several types of minerals, but according to their characteristics and commercial use.

Uses of Minerals

- Minerals are basic and essential raw materials in our daily lives and are vital for economic, social and technological development. They are used,

    - ❖ In the construction of buildings, bridges and settlement.
    - ❖ As raw materials in industries
    - ❖ As fuels
    - ❖ In the manufacture of defiance equipment's.
    - ❖ In the field of communication like manufacturing telephone, wires, cables, electronic devices etc.
    - ❖ In making of alloys for various purposes.
    - ❖ In making of ornaments.
    - ❖ In the manufacture of fertilizers, pesticide, fungicides etc.

Mode of Occurrence of Minerals

- Minerals are generally found in 'Ores'. It is actually an accumulation of any mineral mixed with other elements. Minerals generally occur in many forms. They are

1. Veins and lodes

- Minerals generally occur in the cracks, crevices, faults and joints of the igneous and metamorphic rocks. Minerals in smaller occurrence are called a 'Vein' and a larger occurrence is called a 'lode, for example, Copper and Gold are found in lodes and veins.

2. Beds or Layers

- Minerals that are formed as a result of deposition, accumulation and concentration generally occur in horizontal layers. E.g. Coal, Potash, etc.

Residual mass of weathered particles

- When the decomposed rocks are washed away by water, the soluble particles are removed, leaving a mass containing ores. Such occurrences are called residual mass. E.g. Bauxite

3. Alluvial deposits or placer deposits

- These are the deposits found in the sands of valley floor and at the foot hills. These deposits consist of the minerals such as Gold, Silver and Platinum.

The world distribution of minerals

- Metallic Minerals The minerals which contain metal in them are called as metallic minerals.

Iron - Ore

- It is the basic mineral and the backbone of industrial development of the world. Iron Ore is the most widely distributed element of the earth's crust and it rarely occurs in a free state. It is found as the composition of many rocks and minerals. Iron-ore makes up 4.6% of the earth crusts. Iron is found in the form of Iron - ore. They are classified into 4 categories.

  (i) Magnetite: It is red in colour and has 72% of pure Iron
  (ii) Hematite: It is black in colour and has 70% of pure Iron

(iii) Limonite: Its colour varies from dark brown to yellow and has 50% of pure iron.

(iv) Siderite: It is brown in colour and contains only 30% of pure iron is present.

- The iron content of these ores is highly variable. If the iron content is less than 30% in an ore, it is considered to be uneconomical. Iron is mixed with fixed proportions of Manganese, Nickel, Chromium or Vanadium to make different varieties of steel.

Distribution of Iron ore

- Iron - ore is unevenly distributed in the world. Good quality Iron ore is found in Australia, Brazil, Russia, China, USA, Ukraine, Canada, etc. Russia has the largest proven reserves of iron ore in the world.

- Australia is the largest producer of Iron ore in the world. Other leading producers are China, Brazil, India and Russia. The Majority of Iron ore is (84%) produced by 5 countries alone.

Iron ore

Rank	Country	Production (metric ton)	Share (%)
1	Australia	531,075,350	33.72
2	China	345,841,000	21.99
3	Brazil	271,275,900	17.22
4	India	124,852,650	7.93
5	Russia	55,550,000	3.53
	Others		15.64

Major Iron Ore Fields in the World

Country	Iron ore fields
Australia	Mt. Bruce, Mt. Goldsworthy, Mt. whaleback, etc.
China	Manchuria Region, Shandong, Sinkiang region, etc.
Brazil	Itabria in south east region.
India	Chhattisgarh and Baster region, Odisha, Chitradurg, Kdermukh, Mayurbbanj, region etc.
Russia	Ural region, Kuzbas, Angara, etc.
U.S.A	Messabi range, Marquette range, cornwall, Albama, Appalachin region, etc.
Germany	Rhur basin.
Ukraine	Krivoi rog.

Manganese ore

- It is a kind of Ferro-alloy used to manufacture the special quality steel. A little manganese added to iron, removes gases and acts as a 'Cleanser' in the manufacturing process. Nearly 6 Kg of manganese is used for making one ton of steel.

- Manganese is used for special quality steel making; it makes steel anti - corrosive, hard and clean. It helps to increase toughness, strength and durability to resist oxidation in blast furnaces. It is used to produce alloys with Copper, Bronze, and Nickel. It is used for producing heavy machinery, tools, bleaching powder, insecticides and paints.

Distribution and production of Manganese ore

- South Africa, Australia, China, Gabon, Kazakhstan, Brazil, India, Ghana, Ukraine and Mexico are the major countries possessing manganese ore. South Africa is the largest producer of manganese ore in the world, followed by Australia. The other leading manganese producers are China, Gabon and Brazil. India is the 8th largest producer of manganese in the world though it possesses the largest reserves of manganese in the world.

Manganese-Ore Production

Rank	**Country**	**Production (metric ton)**	**Share (%)**
1	South Africa	4,754,560	30.84
2	Australia	2,388,500	15.50
3	China	2,150,000	13.95
4	Gabon	1,658,500	10.76
5	Brazil	1,141,684	7041
	others		21.54

Copper

Rank	Country	Production (metric ton)	Share (%)
1	Chile	5,552,600	27.20
2	Peru	2,353,859	11.53
3	China	1,851,000	9.10
4	United states	1,430,000	7.00
5	Congo	1,035,631	5.07
	Others		40.13

Copper

- It is a non - ferrous, soft brown metal. It is a good conductor, with high luster, density and melting point. Copper occurs in three forms as native metal in its pure state, as oxides and as sulphide.

- The chief ore of copper is copper pyrite. It yields nearly 76% of the world production of copper. Copper is extracted by the process of crushing, concentration, roasting, smelting and refining. It was discovered in the earliest stage of civilization. Copper is one of the first metals known and used by man. It is found in the igneous and metamorphic rocks. Copper is unfortunately very soft, but by mixing with tin, bronze can be obtained and mixing with zinc, brass can be obtained which is harder and tougher than pure copper. Copper is used in

  (i) Electrical Engineering

  (ii) Metallurgical Industries

  (iii) Making of alloys and making tubes, pipes, pumps, radiators and boilers. They are also used in the production of a wide range of ornamental materials.

Production and distribution of Copper

- Copper deposits are found in almost every country. The main producers are Chile, Peru, China, USA and Congo. Chile is the largest producer of Copper in the world. It produces 27.20% of the world Copper, followed by Peru, which produces 11.53%. India holds 35th rank and it produces only 0.15% of the world's production.

Bauxite

- Bauxite is an important ore which is the main source of Aluminum. It is an impure raw material. It generally occurs as an ingredient of chemical compounds in highly complex minerals such as Cryolite, Corundum and Kaolin. Bauxite occurs quite near the surface and is generally mined by open cast method. It has a wide range of applications which include construction of buildings, utensils and airplane parts.

Production and world distribution of Bauxite

- The main Bauxite producers are Australia, China, Brazil, Guinea and India. The World's greatest Bauxite producers and exporters are the countries located in the tropical and sub-tropical region. Australia is the largest producer of bauxite in the world. India is the 5th largest producer of bauxite in the world.

BAUXITE (ORE)

Rank	Country	Production MT	Share in %
1	Australia	83,516,578	29.31
2	China	65,000,000	22.81
3	Brazil	39,244,200	13.77
4	Guinea	31,117,131	10.92
5	India	24,644,632	8.66
	others		14.53

Gold

- Gold is a precious metal which occurs in alluvial or placer deposits or as reefs or lodes in the underground. Gold is used extensively for jewellery and also in dentistry, glass and porcelain dyes, in medicines and other industries. The purity of gold is expressed in terms of carat. China, Australia, Russia, USA and Canada are the leading producers of gold in the world. India ranked 33rd position in the gold production in 2016.

GOLD

Rank	country	Production	Share in %
1	China	453,500	14.11
2	Australia	282,421	8.79
3	Russia	262,380	8.16
4	United states	222,211	6.91
5	Canada	165,034	5.13
	Others		56.90

Do you know?
Fool's Gold refers to pyrite of Iron Sulphide because of its similarity in shape and colour to actual gold.

Platinum

- Platinum is a rare metal. It is costlier than gold. It has a very high melting point. It is a heavy, malleable, ductile, highly inactive, silverish, white transaction metal. It is one of the densest metal almost twice as dense as lead. Platinum is found with other rare metals such as osmium, Palladium, Iridium and rhodium. Platinum is also used in industrial applications. South Africa is the largest producer of platinum in the world. The other leading producers are Russia, Zimbabwe, Canada and USA.

Platinum

Rank	Country	Production Kg	Share in%
1	South Africa	133,241	71.75
2	Russia	21,860	11.77
3	Zimbabwe	15,110	8.14
4	Canada	9,300	5.01
5	USA	3,891	2.10
	Others		1.33

Non- metallic minerals

- The minerals which do not contain metal in them are called as non-metallic minerals.

Mica

- Mica is a Latin word micare means to shine, to flash or to glitter. Mica has a crystalline and layered structure and can be split into very thin sheets. It does not react to water, acids, oil or solvents. It is lightweight, flexible and strong. It can resist extremely high temperatures or sudden changes in temperature and is able to withstand high voltages and insulate with low power loss. It can absorb or reflect light, which enables a decorative effect and protects against ultra-violet (UV) light.

Major Uses of Mica

- Mica has several applications. There are several main sectors where the use of mica is identified. They are the paint and coatings sector, Cosmetics and personal care companies, Plastics and printing ink manufactures the electronics sector, the automotive sector, the construction industry and the oil industry.

Phosphate

- Phosphate occurs in the sedimentary rocks or as phosphate nodules. Another source is bird dropping of Guano. It is the most important source of phosphorus. It is mainly used in fertilizer. China is the largest producer of Phosphate in the world. The other leading producers are Morocco, USA, Russia and Peru. The Guano deposits are found in Peruvian and Chilean deserts in South America. India is the 20thlargest producer of Phosphate in the world.

Phosphate (2016)

Rank	Country	Production	Share in %

		MT	
1	China	43,319,400	51.58
2	Morocco	8,601,000	10.24
3	USA	7,615,000	9.07
4	Russia	48,36,00	5.76
5	Peru	4,103,220	4.78
	Others		18.57

Do you know?
Agencies involved in the exploration of minerals in India. GSI, ONGC, MECL, NMDC, IMB, BGML, HCL, NALCO are the departments involved in mining in different states of India.

Energy Resources

- Resources may be classified into renewable and non-renewable resources. Mineral resources like coal, Petroleum and natural gas are the exhaustible or non-renewable resources. They cannot be replaced once they are consumed. Coal and petroleum are the fossil fuels, on which the modern culture relies so much.

- Energy gives motion to our industrial machines and vehicles. It is the primary input in the production of goods and services. The wheel of progress moves with the flow of energy. The energy resources may be classified into two types.

(i) Nonrenewable sources of Energy

- Once these resources are used, they cannot be regained again. In other words, they are exhaustible. They are coal, Petroleum natural gas and atomic fuels.

Coal

- Coal is a fossil fuel. It is a flammable, black or brown sedimentary rock and is mainly composed of carbon. It is the altered remains of prehistoric vegetation that originally accumulated in swamps and peat bogs. The dense forest plants were converted into coal due to intense pressure and heat inside the earth by the process of carbonization. Most of the coal resources of the world were formed during the carboniferous period (280 to 350 million years ago). The quality of the coal is determined by its carbon content. The following types of coal have been identified on the basis of their physical properties. They are,

(i) **Peat** is the first stage of transformation of wood into coal and it has only 30 to 35% of carbon.

(ii) **Lignite or Brown** coal is the inferior quality and contains 35-45% carbon

(iii) **Bituminous or coking coal** is the second best variety of coal and contains 70-90% of carbon. It is the most widely spread and most widely used variety of coal. It is the most popular coal in commercial use.

(iv)**Anthracite** is the best quality coal, which contains more than 95% of carbon. It is very hard but emits very less smoke and leaves very less ash. However its deposits are limited.

Production and world distribution of Coal

- Coal reserves are found in more than 70 countries of the world but the major coal reserves occur in the USA, Russia, China and South Africa. China is the largest producer of steam coal in the world followed by India. The other leading producers of steam coal are USA, Indonesia, and South Africa etc.

Steam coal – It is used for producing steam and it has high sulphur content.

Steam Coal

Rank	Country	Production (metric ton)	Share in %
1	China	2,49,793,000	47.42
2	India	601,131,000	11.44
3	United states	553,936,000	10.54
4	Indonesia	459,469,000	8.74
5	South Africa	253,452,000	4.82
	others		17.04

HOTS

Why is hydrogen used as fuel in rockets?

China was the largest producer of coking coal in the world in 2016 followed by Australia. The other leading producers of coking coal are Russia, India and USA.

Cooking Coal

Rank	Country	Production MT	Share in %
1	China	591,998,000	54.67
2	Australia	189,302,000	17.48
3	Russia	83,800,000	7.74
4	India	61,661,000	5.69
5	United states	50,645,000	4.68
	Others		9.74

Major Coal Mining Centres

Country	Mining centers
China	Shansi, shantung, Fushun, Shenyang, etc.
India	Bokaro, jaria, korba, ranikanch, singerni, etc.
U.S.A	Arkansas, colorodo, illionions, Indiana, Michigan etc.
Australia	Bowen basin, Brisbane, Canberra, Sydney, New-castle, Tasmania, etc.
Russia	Moscow-Tula region, Chokot, basin, Ob basin, etc.

Trade

- The main exporters of coal in the world are Australia, Indonesia, Russia, Colombia and South Africa and the main importers are China, India, Japan, Korea and Germany.

Uses of Coal

- Man has used coal for hundreds of years. But it has gained importance only after industrial revolution. It contributes about 25% of global energy demand. Coal is used for various purposes. It is used as a source of steam energy, electrical energy, domestic fuel, metallurgical coke, chemical industries and byproducts such as Ammonium sulphate, Naphthalene, Phenol, Benzene, etc.

Petroleum (or) Mineral oil

- Petroleum is a mineral that exists under the surface of the earth in liquid, solid and gaseous forms. Liquid petroleum may be in the form of crude oil. The solid form may be mineral waxes or asphalts. The gaseous form is natural gas. It is a main source of energy in the World due to its multiple uses. The human activities are directly or indirectly depend on the use of petroleum or its sub products.

Formation and occurrence of mineral oil

- It is formed by slow chemical and bio chemical decomposition of the remains of organic matter in sedimentary rocks. It is found in the pores of the sedimentary rocks. Oil is lighter than water hence, floats over water. Drilling of oil wells is the hole drilled in the earth's crust and when it reaches the rock cap, the natural gas comes out first with a great pressure. When the pressure of gas subsides, petroleum starts flowing out when the pressure of natural gas is released.

Petroleum reserves of the world

- The west Asia or Middle East is has the largest petroleum reserves, which is about 60% of the world's oil reserve. The total estimated world's oil reserves in

2008 were 1,243 (109 bbl). Saudi Arabia, Canada, Iran, Iraq and Kuwait have large reserves of petroleum.

Production and world distribution of petroleum

- The petroleum producing countries of the world can be grouped in to five geographical regions:

    1. West Asia (or) Middle East region
    2. American region
    3. Russian region
    4. East & south Asian region and
    5. African region

- Saudi Arabia is the largest oil producer of the world with 13.62% of the world output of oil. Russia is the second largest producer in the world. India is placed at 24th position in petroleum production in the world. The distribution of oil is naturally uneven; Middle East contains 60% of global reserves and rest of the world only 40%.

Petroleum

Rank	Country	Share in %
1	Saudi Arabia	13.62
2	Russia	12.72
3	USA	12.62
4	Iraq	5.09
5	Iran	5.03
6	china	4.64
	Others	46.28

Trade

- The world leading exporters of petroleum are Saudi Arabia, Russia, Iraq, UAE and Canada and the main importers are USA, China, India, Japan and Korea.

Do you know?
OPEC is the short form of the "Organisation of Petroleum Exporting Countries. It was formed in 1960 at Bagdad convention. Initially it comprised of Saudi Arabia, Iran, Iraq, Kuwait and Venezuela. Later on added in eight countries Libya, Algeria, Qatar, UAE, Nigeria, Ecuador and Angola, Indonesia left from OPEC in recently.

Major Petroleum Production Centres

Country	Production centres

Saudi Arabia	Ghawar, Abquiaq, Abuhadriya, etc.
Russia	Volga-Caspin region, Kamchatka- Sakhalin region, Ob Lena basin.
U.S.A	Tennessee- new york, ohino, Indiana, Pennsylvania, Texa, Mississippi, gulf of California, etc.
Iraq	Kirkuk, Mosul, Daura, etc.
China	Taching, Chinchou, Yemen, south china sea, etc.

Natural Gas

- It is the cheapest source of energy. It is found along with or without petroleum. It is considered as an environment friendly fuel because of its low carbon dioxide emissions. Therefore, this is the only fuel for the present century and it is also called green energy. A powerful odorant, ethanethiol is added, so that leaks can be detected easily. It is prepared by refining petroleum or wet natural gas.

Natural gas reserves and Production

- The known natural gas reserve in the world is about 6254 trillion cubic feet. Most of these reserves are found in Russia, Iran, Qatar, UAE, Saudi Arabia, USA etc. USA has the largest reserve and is the leading producer of natural gas in the world followed by Russia. India is the 28th producer of natural gas in the world. It is widely used as a fuel in industries and domestic cooking purposes. Petrochemical industries use it as fuel and raw material. It is also used in chemical industries, artificial rubber, plastic, fertilizers, ink, and carbon and as artificial lighting.

Natural Gas

Rank	Country	Production (metric ton)	Share (%)
1	United states	755,010	20.56
2	Russia	641,000	17.45
3	Iran	202,440	5.51
4	Qatar	181,250	4.94
5	Canada	157,179	4.28
	Others		47.28

Trade

- Russia, Qatar, Norway, Canada and Algeria are the leading exporters of Natural gas in the world. Japan, Germany, China, Italy and Turkey are the leading importers of natural gas.

Nuclear Energy

- It is commonly said, this energy holds the key of future. Energy contained within the nucleus of an atom is called nuclear energy. Heavy metals like Uranium, Thorium, Radium, Plutonium and Lithium are the main sources of nuclear energy. However Uranium is the most important source of nuclear energy. The nuclear energy production was started first in USA in 1950. Nuclear energy now provides about 11% of the World's electricity. At present there are more than 450 operable fission reactors in the world. The world's first commercial nuclear power station Calder Hall at Wind scale, England was opened in 1956.

Uranium (U3O8)

Rank	Country	Production (metric ton)	Share (%)
1	Kazakhstan	29,113	38.89
2	Canada	16,666	22.26
3	Australia	7,352	9.82
4	Namibia	4,302	5.75
5	Niger	4,101	5.48
	Others		17.80

Do you know?
Most devastating nuclear accidents
1. Three mile Island- March 28, 1979 USA
2. Chernobyl - April 29, 1986, Russia
3. Fukushima Daiich- March 11, 2011, Japan

Renewable sources of Energy:

- All regions of the world are facing the twin problems of fast increasing demand for energy and limited supplies and rapidly depleting conventional sources of energy. Under these circumstances, non-conventional sources of energy are getting more importance. These sources are renewable, clean and non-polluting. They are solar, wind, geothermal, wave, tidal energy, bio-gas etc.

Hydel Power

- Hydro electricity is produced by using the potential energy of water falling from a certain height. The falling water spins the turbine blades and energy is produced. It is a clean eco-friendly and renewable source of energy. It contributes nearly 7% of the world electricity production. China has the largest potential followed by Brazil, Indonesia, Canada and Zaire. China is the largest producer of Hydroelectricity in the world, followed by Canada.

Solar energy

- It is based on mechanical conversion of solar energy into electricity. It is available in abundance but only in the recent period it gets more importance due to technological development. Solar energy is used for various purposes.

Do you know?

Noor Complex is the world's largest concentrated solar power (CSP) plant, located in the Sahara Desert.

Kamuthi, the world`s largest single solar power plant

Kamuthi Solar Power Project is a photovoltaic power station spread over an area of 2,500 acres (10 km2) in Kamuthi, Ramanathapuram district. The project was commissioned by Adani Power. With a generating capacity of 648 MW at a single location, The Kamuthi Solar Power Project was completed on 21 September 2016. Around 8,500 workers installed an average of 11 MW of capacity per day to complete the project within 8 months. The entire solar park is connected to a 400 kV substation of the Tamil Nadu Transmission Corp. The solar panels are cleaned daily by a self-charged robotic system.

- USA is the major producer of solar cells at present. It is simply the energy provided by the sun, which makes production of solar electricity possible. **Solar power in India** is a fast developing industry. The country's solar installed capacity reached 26 GW as of 30 September 2018. India expanded its solar-generation capacity 8 times from 2,650 MW on 26 May 2014 to over 20 GW as on 31 January 2018. The country added 3 GW of solar capacity in 2015-2016, 5 GW in 2016-2017 and over 10 GW in 2017-2018, with the average current price of solar electricity dropping to 18% below the average price of its coal-fired counterpart.

Wind Energy

- The wind is a clean, free and readily available renewable energy source. Wind turbines are capturing the wind's power and converting it to electricity. Wind power has become a pillar in their strategies to phase out fossil and nuclear energy. Wind energy is now the second fastest growing source of electricity in the world. It fulfills about 5% of world's electricity demand. The world's largest wind farm is in Altamont pass in California. India is emerging as a major wind power producer of world. The important wind farms in India - (i).The largest wind farms in India are Muppandal in Kanyakumari District of Tamil Nadu and Jaisalmer wind park in Rajasthan. They are the first and second largest wind farms of India. Based on the location of its generation it is classified into:

  1. Onshore wind energy and
  2. Offshore wind energy

1. Onshore wind energy –Energy generated from the plants located on the land is known as onshore wind energy. Onshore wind has the advantage of being one of the most affordable renewable energy sources. It is cheaper than any other renewable source of energy but it requires more area to install than any other energy.

2. Offshore wind energy –It refers to the use of wind farms developed in seas and oceans. The largest offshore wind farms are currently in the U.K and Germany. These two countries installed 2/3 capacity. London Array is the largest offshore wind farm in the world. The first offshore wind farm is planned near Dhanuskodi in Tamil Nadu.

Tidal **energy** - It is a renewable energy powered by the natural raise and fall of ocean water. Its production is very small. The first tidal power station was located in La Rance in France. The largest tidal power station is at Sihwa Lake in South Korea and it is the largest tidal power producer in the world. There are three different category of sources from which the tidal energy is generated. The sources are tidal streams, barragesandtidallagoons.

- India's first attempt to harness tidal power for generating electricity would be in the form of a 3MW plant at the Durgaduani creek in sunderbans delta of West Bengal. The Gulf of Kutch and Cambay in Gujarat and the Ganges delta in sunderbans, the world's largest mangrove, are the 3 sites identified as potential areas for tidal power generation in India.

Geo Thermal Energy

- Geo thermal energy is derived from the natural heat of the earth. The United States is the world's largest producer, and the largest geothermal development in the world is The Geysers north of San Francisco in California, the U.S.

- In India, exploration and study of geothermal fields started in 1970. The GSI (Geological Survey of India) has identified 350 geothermal energy locations in the country. The most promising of these is in Puga valley of Ladakh. The estimated potential for geothermal energy in India is about 10000 MW. There are seven geothermal provinces in India: the Himalayas, Sohana, West coast, Cambay, Son-Narmada-Tapti (SONATA), Godavari, and Mahanadi.

Conservation of Resources

- It takes millions of years for the formation of minerals. Compared to the present rate of consumption, the replenishment rate of minerals is very slow. Hence, mineral resources are finite and non- renewable. Due to this, it is important to conserve the mineral resources.

Ways of Conserving Resources

- Controlling population growth will reduce the demand for resources.
- Creating social awareness regarding the importance of conservation of resources
- Reusing and recycling of resources.
- Using the renewable source of energy as an alternative to non- renewable resources.
- Developing the usage methods which minimize the wastages.
- Propagating the environmental ill effects caused by various products.
- Choosing the products with less packaging.

12TH GEOGRAPHY
4. Economic activities

INTRODUCTION

Waymo car

Have you heard about Waymo car? A car without brakes, accelerators or steering wheel – a driverless car is indeed a dream come true.

Google started testing self-driving technology with the Toyota Prius on freeways in California in 2009.

A new development was the unveiling of a new prototype vehicle in 2014, capable of being a fully self-driving car. These intelligent cars use sensors and software to detect objects like pedestrians, cyclists and can safely drive around them. According to Google, the car can process both map and sensor information to find out its exact location - precisely which street or lane it is driving in. The sensors are so powerful that it can detect all kinds of objects. What's more interesting, the software can predict what these objects around the car will do next and take action accordingly.

In an instance, where the traffic signal turned green and the car was about to move forward, the car sensed an ambulance coming from the right side and it stopped, making way for the ambulance. Google calls its cars, 'experienced drivers'. Each car's speed is capped safely at 25 mph (40 km/hr). The cars halt for 1.5 seconds after the signal turns green at a junction as many accidents happen during this time.

But the cars can travel as fast as 161 km/hr. To ensure safety, the front side has about 2 feet of foam and the windshield is made of plastic instead of glass. This is the amazing product of secondary industries which we learn about as part of economic activities in this lesson

Economic activity refers to the activity of making, providing, purchasing and selling goods or services. Economic activities exist at all levels within a society. Human beings are engaged in various kinds of economic activities. In general all the economic activities are broadly categorised into Primary, Secondary and Tertiary activities. The Tertiary activities are further sub divided into Quaternary and Quinary activities.

Let us first understand the meaning and concept of the different categories of economic activities.

Types of Economic system:

1. **Subsistence economy:** Goods and services which are created for the use of the producers and their kinship groups.

2. **Commercial economy:** Goods and services which are produced mainly for sale. Market competition is the primary force determining the production and distributions.

3. **Planned economy:** Goods and services created are controlled by government

agencies. Supply and price are controlled by the state. It was practiced earlier by the Communist controlled societies.

Primary activities

Primary activities help man to fulfill his needs and desires, by using resources which are gifted to man by nature. These activities are directly connected with nature. Hunting, Gathering, Pastoralism, Fishing, Forestry, Mining and Agriculture are the primary activities.

Hunting and Gathering

Until 12,000 years ago, all humans lived as hunters and gatherers. At present only 0.0001% human live as hunters and gatherers. Gathering and hunting are the oldest known economic activity in the world. It often involves primitive societies which collect both plants and animals to satisfy their needs for food, shelter and clothing. These primitive activities are being carried out still in a very few parts of the world. Gathering is practiced in the areas of High altitude zones of Northern Canada, Northern Eurasia and Southern Chile and in the low altitude zones of the Amazon Basin, Tropical Africa, Northern fringe of Australia and interior parts of South East Asia. Present day gatherers and hunters are confined to a few pockets. Inuit in the Arctic region, Pygmies of Kalahari, Pintupi, Aborgines of Australians, and Paliyan of South India are the examples of foragers.

Pastoralism

Pastoralism is the process of grazing and rearing of different types of animals like cattle, sheep, goats, etc. in an organised manner to get animals products. The animals rearing can be primitive which is carried on by nomads or highly scientific means on a commercial scale. So, animal grazing and rearing can be divided into two broad categories as Nomadic Herding and Commercial Livestock Rearing.

Nomadic Herding (or) Pastoral Nomadism

It is a primitive subsistence activity in which the herders rely on animals for food, clothing, shelter, tools and transport. They move from place to place along with their livestock, depending on the availability of pastures and water. These people do not lead a settled life but keep on moving from place to place. Pastoral nomadism is commonly practiced in regions with little arable land, typically in the developing world. They are mostly found in central and western Asia, Northern and Western regions of Africa and some parts of southern Africa and Tundra regions.

Transhumance

Transhumance is the seasonal movement of people with their livestock between fixed summer and winter pastures. In mountain region it implies movement between higher altitude pastures during summer and valleys in winter.

Gujiars, Bakarwals, Gaddis and Bhotiyas in the Himalayan region migrate from plains to the mountain in summer and to the plains from the high altitude

pastures in winter. In the tundra regions, herders move from south to north in summer and from north to south in winter. The number of pastoral nomads has been decreasing and the areas operated by them shrinks due to developments and spreading of other economic activities.

Commercial Livestock Rearing

Commercial livestock rearing is more organised and capital intensive activity in comparison with the Nomadic pastoralism. It is generally practiced in permanent ranches. Ranches refer to the large stock farms, usually fenced in, where animals are breed and reared on a commercial scale. Animals are grazed over large areas which are known as ranches in Prairies and estancia in Pampas. Most modern technology is used for commercial grazing, great emphasis is laid on breeding, genetic improvement, disease control and health of the animals. Products such as meat, wool, hides and skin are processed and packed scientifically and exported to different world markets. New Zealand, Australia, Argentina, Uruguay and USA are the major countries where commercial livestock rearing is practiced.

Do you know?

Employees of the economic activity	
Economic activity	**Name**
Primary	Red collar
Secondary	Blue collar
Tertiary	Pink collar
Quaternary	White collar
Quinary	Gold collar

Agriculture

Agriculture is the most fundamental form of human activity and includes not only cultivation of crops but also the domestication of animals. The following are the major agricultural types and their characteristic features.

Shifting Cultivation

Shifting Cultivation is a kind of traditional farming practiced by tribes in the hilly and forest regions. It is practiced especially in tropical Africa. In this farming an area of ground is cleared of vegetation and cultivated for a few years and then abandoned for a new area until its fertility has been naturally restored. They are called with different names in different regions as follows Shifting Cultivation in Northeast India.

S.No	Name	Region
1	Jhuming/Bewar	North eastern states of India
2	Ladang	Malaysia
3	Chengin/Kaingin	Philippines
4	Milpa	Central America and Mexico
5	Konuko	Venezuela

6	Roca	Brazil
7	Masole	Congo
8	Ray	Vietnam
9	Humah	Indonesia
10	Taungya	Myanmar
11	Chen	Sri Lanka

Subsistence agriculture

Subsistence Agriculture is a type of farming in which output is consumed almost entirely by the farmers and their families leaving only a small proportion for sale. Farmers follow traditional method of cultivation in this kind of farming.

Intensive agriculture

Intensive Agriculture is the one in which the agricultural land is utilised intensively. Farmers prefer the cultivation of short duration crops which enables the cultivation of two or three crops in the same piece of land in a year. Generally it is practiced wherein the size of the agricultural land holding is small.

Plantation Agriculture

Plantation agriculture is a form of commercial farming where crops are grown for profit. Large land areas are needed for this type of agriculture. Countries that have plantation Agriculture usually experience high annual temperatures and receive high annual rainfall. Plantation is mainly found in countries that have a tropical climate. The important plantation crops are tea, coffee, cocoa, rubber, oil palm, sugarcane, bananas and pineapples.

Extensive Farming

It is a kind of farming practiced in the regions where the size of the land holding is very large. It is practiced in the Interior parts of semi-arid lands of the mid-latitudes. Wheat is the major crop of this region and the farming is highly mechanized.

Mixed Farming

It is an agricultural system in which a farmer conducts different agricultural practice together, such as crops, fishing and livestock. The aim is to increase income through different sources and to complement land and labour demands across the year.

Do you know?

Pomology – the study of growing fruits.
Olericulture – science of vegetable growing.
Floriculture – refers to cultivation of flowers.
Sericulture – refers to Rearing of Silkworms

Mediterranean Agriculture

Mediterranean agriculture is highly specialised commercial agriculture. It is practised in the countries on either side of the Mediterranean Sea in Europe and in

North Africa from Tunisia to Atlantic coast, southern California, central Chile, south western parts of South Africa and south and south western parts of Australia. This region is an important supplier of citrus fruits. Viticulture or grape cultivation is a speciality ofthe Mediterranean region. Best quality wines in the world with distinctive flavours are produced from high quality grapes in various countries of this region. The inferior grapes are dried into raisins and currants. This region also produces olives and figs. The advantage of Mediterranean agriculture is that more valuable crops such as fruits and vegetables are grown in winters when there is great demand in European and North American markets.

Horticulture

Specialised cultivation of flowers, vegetables and fruits is called horticulture. It is also termed as "truck farming". These crops are grown on small farms which are well connected to the markets by cheap and efficient means of transportation. It is labour and capital intensive crops. The main areas are northwest Europe, northern eastern USA and Mediterranean region. The study of grape cultivation is known as viticulture.

Von Thunen model of agriculture

The Von Thunen model of agricultural land use was created by the farmer, landowner, and economist Von Thunen in 1826 in a book called The Isolated State. Von Thunen model was created before industrialization and is based on the following limiting assumptions:

The city is located centrally within an "Isolated State" that is self-sufficient and has no external influences.

- The Isolated State is surrounded by an unoccupied wilderness.
- The land of the State is completely flat and has no rivers or mountains to interrupt the terrain.
- The soil quality and climate are consistent throughout the State.
- Farmers in the Isolated State transport their own goods to market via ox cart, across the land, directly to the central city. Therefore, there are no roads.
- Farmers act to maximize profits.

In an Isolated State with the foregoing statements being true, Von Thunen hypothesized that a pattern of rings around the city would develop based on land cost and transportation cost.

The Four Rings

Ring 1: Dairying and intensive farming occur in the ring closest to the city. Because vegetables, fruit, milk, and other dairy products must get to market quickly, they would be produced close to the city. The first ring of land is also more expensive, so the agricultural products would have to be highly valuable ones and the rate of return is maximized.

Ring 2: Timber and firewood would be produced for fuel and building materials in the second zone. Before industrialization and coal power, wood was a very important fuel for heating and cooking. Wood is very heavy and difficult to transport, so it is located as close to the city as possible.

Ring 3: The third zone consists of extensive field crops such as grains for bread. As grains last longer than dairy products and they are much lighter than fuel, to reduce transport costs, they can be located farther from the city.

Ring 4: Ranching is located in the final ring surrounding the central city. Animals can be raised far from the city because they are self-transporting.

What the Model Tells Us?

Even though the Von Thunen model was created in a time before factories, highways, and even railroads, it is still an important model in geography. The Von Thunen model is an excellent illustration of the balance between land cost and transportation costs. When one gets closer to a city, the price of land increases. The farmers of the Isolated State balance the cost of transportation, land, and profit and produce the most cost-effective product for market. Of course, in the real world, things do not happen as they would in a model.

Mining

The process of extracting minerals from the earth crust is known as mining. The discovery of minerals in the history of human development is reflected in many stages in terms of copper, Bronze and Iron Age. The use of minerals in ancient times was largely confined to making of tools, utensils and weapons. The actual development of mining began with the industrial revolution and its importance is continuously increasing.

Types of Mining

Open-pit or opencast mining

Open pit mining involves mining minerals ore that can be found near the surface layer of the site. Some quarries can be over 1000 meters deep. This form of mining doesn't require tunneling into the earth and is a simple method of mining that yields high production.

Surface Mining

Surface mining is the process of mining the ores found on the surface of the earth. In this process, any unwanted soil is stripped off from the land and the ore beneath is extracted. Surface mining often leaves behind large areas of infertile land and waste rock as 70% of the mined earth is waste materials.

Underground or sub surface mining/Shaft mining

Sub-surface mining involves the digging of a network of shafts and tunnels into the earth to reach and extract the deposit of mineral ore beneath the earth. In comparison to other methods, underground mines impacts are less on the

environment and are more harmful to those working within them. In modern practice, underground mines are pre-assessed for oxygen toxicity levels and a system of ventilation machines and protocols are in place to ensure workplace safety.

In-Situ Mining

It is a rarely used method of mining material. It is also called as solution mining. It is the process of pumping a solution into the ore body, which dissolves the ore and is then extracted by a second pump. This method is used most in mining uranium deposits.

Secondary Activities

Secondary sector transforms the raw materials obtained from the primary sector into consumer goods. So it consists of manufacturing and industrial activities. Since it adds value for the raw materials, it is also called as value addition sector. Industries consume large quantities of energy and require factories and machinery to convert the raw materials into goods and products. The secondary sector supports both the primary and tertiary sectors.

Factors affecting location of Industries

1. Availability of raw-materials or nearness to raw-materials: Availability of raw materials or nearness to raw materials is a primary factor which governs location of industries. An industry is located in a place where raw materials are available in abundance and at cheaper rates. It is more so for the weight loosing and bulky raw materials. For example, oil refinery factories are established at Visakhapatnam because oil is imported through Vizag port.

2. Availability of power: Availability of power is another important factor of concentration or location of industries. In olden days steam was used for running industries. As a result industry is established near the coal mines. But with the invention of electricity, today industries are located in any place where electricity is available. Industries like aluminum units are located near the hydroelectric projects.

3. Transport costs: Transport costs also influence the location of industries. Industries incur transport costs for bringing raw-materials and for sending the finished goods into the markets. It is economical to start an industry near the area where transport costs are minimum and low. Raw-materials which are heavy and occupy large place, require huge cost for transporting them. So an industry must be located near the area where the transport costs are minimal.

4. Nearness to the market: This is a chief factor governing the location of an industry in modern period. Several advantages are secured when an industry is established near the market. Production can be carried on in accordance with the changes in the consumers' tastes. Economies of transport can be secured in importing raw-materials.

5. Availability of labour: Labour is required for organizing the productive affairs of an industry. The entrepreneurs like to start industries in those areas where labour is abundantly available. The growth of cotton textile industry near Bombay is due to the availability of cheap labour.

6. Government policy: The policy of government also influences the location of industries. The Government may establish an industry on political considerations by giving several incentives. It provides finance, land, water, and transport and communication facilities in backward regions with a view to developing them. It also provides tax concession, marketing consultancy, export and import facilities.

7. Availability of capital: Capital is the most essential factor for the establishment of an industry in a locality.

Weber's Theory of Location

Weber has developed an industrial location emphasising the least cost principle. This is based on assumptions relating to transport costs and other conditions. From his theory, industrial locations for three different situations are made clear.

Assumptions:

1. Some resources are available only in certain regions. Yet, resources such as water are ubiquitous (present everywhere).

2. Markets are found only in specific places.

3. Transport costs are determined based on the weight of the raw materials and distance of transfer.

4. There is competition in the markets for the commodities produced at the industry.
5. Humans use their discretion in their consumer behavior in relation to the industrial commodities.

Based on these assumptions, together with the notion of high profits with least costs and imagination, Weber describes his theory of industrial location.

Weber uses a triangular structure to elaborate on his theory of industrial location using least transport cost principle. The two corners of the triangle defined by the base line represent the places where raw materials are found (R1 and R2). The market (M) is at the apex of the triangle. In the figure below, R1 and R2 are resource locations, consisting of two types of resources. M is the market and P is the industrial location.

As the logic behind Weber's location indicates, some industries produce finished products which lose weight (weight losing raw materials). In this case, the transport cost for raw materials transfer to the industrial location is higher than the

transport cost of moving finished products from industrial location to market. It is because the waste from raw materials at the industrial site will be high. Hence, it is profitable to have industry at the raw materials' locations.

If industry is located at the raw material source R1, then raw material R2 must be transported to industrial location R1 and the finished products must be transported to the market M. This results in transport costs. Likewise the industry could be located at R2, too. But if it is located at M, R1 and R2 resources must be transported to market M. This would also involve transport costs. If on the other hand, the industry is located half way between R1 and R2, and then the transport cost to bring the raw materials from R1 and R2 is equal. Transport cost involved in transporting the finished products to the Market decreases because of small distance to market M (if transport cost is assumed to increase with distance).

In the final analysis, the transport cost for raw materials to the industrial location P and the finished products to market M from P together is the least when industry is located at P. There is thus a chance for increased profit for the industry.

The triangle at top left represents a location where distance to be covered by transport is at minimum, the triangle at the top right illustrates the location of a 'weight – losing industry' and the triangle at the bottom left represents the location of a 'weight – gaining industry'. Hence, the location of industry at P is an 'optimal industrial location'.

As the industry is located at a point between the raw materials locations, transport cost to transfer bulky raw materials is reduced considerably. The transport cost for transferring the finished products from the industry to the market is also small. In such a context, Weber believes that it is profitable to set up the industry at a location in between the industry.

There are some industries which manufacture finished products gaining weight in the process. The transport cost between raw materials location and industry is lower than the transport cost of finished products from industrial location to the market. It is logical therefore to locate the industry at the market. According to Weber, this location is more profitable to the industry than any other. The Weber's location theory is that it is based on the transport cost. Nevertheless, this theory of industrial location is considered superior to other industrial location theories for its logical conclusion.

On the Basis of Labour

Large Scale Industries

Industries which employ a large number of labourers with huge capital are called large-scale industries. Cotton and jute textile industries are large scale industries.

Small Scale Industries

Industries which employ a small number of labourers with small investments are called small scale industries. They include nut & bolt making, coir making, plastic bags industries, dying industry, match box making, weaving industry are some examples for small scale industries

Cottage Industries

Those industries whose labour force consists of family units or individuals working at home with their own equipments are called cottage industries. It is a small and often informally organized industry. The industries like weaving and pottery are the examples this category. On the Basis of size of raw-Material and Finished Goods

Heavy Industries

Industries which use heavy and bulky raw-materials and produce products of the same category are called heavy industries. Iron and steel industry presents a good example of heavy industries.

Light Industries

The light industries use light raw-materials and produce light finished products. Electric fans, sewing machines are light industries.

On the basis of Ownership

Private Sector Industries

Industries owned by individuals or firms such as Bajaj Auto or TISCO situated at Jamshedpur are called private sector industries.

Public Sector Industries

Industries owned by the state and its agencies like Bharat Heavy Electricals Ltd., or Bhilai Steel Plant or Durgapur Steel Plant are public sector industries.

Joint Sector Industries

Industries owned jointly by the private firms and the state or its agencies such as Gujarat Alkalies Ltd., or Oil India Ltd. fall in the group of joint sector industries.

Co-operative Sector Industries

Industries owned and run co-operatively by a group of people who are generally producers of raw materials of the given industry such as a sugar mill owned and run by farmers are called co-operative sector industries.

On the Basis of Source of Raw Materials

Agro Based Industries

Agro based industries are those industries which obtain raw-material from agriculture. Cotton textile, jute textile, sugar and vegetable oil are representative industries of agro-based group of industries.

Mineral Based Industries

The industries that receive raw materials primarily from minerals such as iron and steel, aluminum and cement industries fall in this category.

Pastoral-Based Industries

These industries depend upon animals for their raw material. Hides, skins, bones, horns, shoes, dairy, etc. are some of the pastoral-based industries.

Forest Based Industries

Paper card-board, lac, rayon, resin, tanning of leather, leave- utensils, basket industries are included in this type of industries.

Classification based on Nature of products

Based on the nature of products it is classified into basic industries and consumer goods. Basic industries are manufacturing goods by using them as raw materials are basic industries. For example Iron and steel machines for textile industry. Consumer industries are producing goods for consumers. For example, Television, soap, biscuits, etc.

Tertiary activities

The tertiary industry provides services to its consumers. It is also known as service industry/sector.

All types of services and special skills provided in exchange of payments are called tertiary activities. Health, education, law, governance and recreation etc.; require professional skills. These services require other theoretical knowledge and practical training. Most of the tertiary activities are performed by skilled workers and professionally trained experts and consultants.

Tertiary activities involve commercial output of services rather than the production of tangible goods. Expertise provided by service relies more heavily on special skills, experience and knowledge of the workers rather than on the production techniques, machinery and factory processes. Trade and commerce, transport, communication and services are the categories of tertiary sector. Tertiary sector is further divided into quaternary and quinary sector.

Quaternary Activities

The quaternary sector of the economy consists of intellectual activities, example, libraries, scientific research, education, and information technology. The workforce who is readily involved in this sector is typically well-educated, and people are often seen earning well through their participation in this industry.

Quinary Activities

The professions of the people working in this industry are generally referred to as "gold collar" professions since the services included in the sector focus on interpretation of existing or the new ideas, evaluation of new technologies, and the creation of services. It involves highly paid professionals, research scientists, and government officials. The people are designated with high positions and powers,

and those who make important decisions that are especially far-reaching in the world around them often belong to this category.

Division of the world

For analytical purposes, World Economic Situation and Prospects classifies (WESP) all countries of the world into one of three broad categories: developed countries, countries in transition (South-Eastern Europe Commonwealth of Independent States and Georgia) less developed countries and developing countries.

The classification of countries is based on the economic status such as Gross Domestic Product (GDP), Gross National Product (GNP), per capita income, industrialization, the standard of living, etc. Developed Countries refer to the sovereign state, whose economy has highly progressed and possess great technological infrastructure, as compared to other nations.

Developed countries

A developed country, industrialized country, more developed country, or more economically developed country (MEDC), is a country that has a developed economy and advanced technological infrastructure relative to other less industrialized nations. Most commonly, the criteria for evaluating the degree of economic development are gross domestic product (GDP), gross national product (GNP), the per capita income, level of industrialization, amount of widespread infrastructure and general standard of living.

Developed countries have generally post-industrial economies, meaning the service sector provides more wealth than the industrial sector. As of 2015, advanced economies comprise 60.8% of global GDP based on nominal values and 42.9% of global GDP based on purchasing-power parity (PPP) according to the International Monetary Fund. In 2017, the ten largest advanced economies by GDP in both nominal and PPP terms were Australia, Canada, France, Germany, Italy, Japan, South Korea, Spain, the United Kingdom, and the United States.

Countries in transition

A country in transition economy or transitional economy is an economy which is changing from a centrally planned economy to a market economy. Transition economies undergo a set of structural transformations intended to develop market-based institutions. These include economic liberalization, where prices are set by market forces rather than by a central planning organization. The process has been applied in the former Soviet Union and Eastern bloc countries of Europe and some Third world countries, and detailed work has been undertaken on its economic and social effects.

The Least Developed Countries

The Least Developed Countries is a list of countries that, according to the United Nations, exhibit the lowest indicators of socioeconomic development, with the lowest Human Development Index ratings of all countries in the world. A country is classified among the Least Developed Countries if it meets three criteria.

- Poverty – adjustable criterion based on GNI per capita averaged over three years. As of 2018 a country must have GNI per capita less than US$1,025 to be included on the list, and over $1,230 to graduate from it.
- Human resource weakness (based on indicators of nutrition, health, education and adult literacy).
- Economic vulnerability (based on instability of agricultural production, instability of exports of goods and services, economic importance of non-traditional activities, merchandise export concentration, handicap of economic smallness, and the percentage of population displaced by natural disasters).

The world's 10 biggest economies in 2017

The economy of the United States is the largest in the world. At $18 trillion, it represents a quarter share of the global economy (24.3%), according to the latest World Bank figures.

China follows, with $11 trillion, or 14.8% of the world economy. Japan is in third place with an economy of $4.4 trillion, which represents almost 6% of the world economy. European countries take the next three places on the list: Germany in fourth position, with a $3.3 trillion economy; the United Kingdom in fifth with $2.9 trillion; and France in sixth with $2.4 trillion. India is in seventh place with $2 trillion, and Italy in eighth with an economy of over $1.8 trillion. Ninth place goes to Brazil, with an almost $1.8 trillion economy. And in 10th is Canada, with an economy of over $1.5 trillion. The economy of the United States is larger than the combined economies of numbers three to 10 on the list.

Fastest-growing economy

Although China trails the US by $7 trillion, it's catching up. China's economy grew by 6.7% in 2016, compared with America's 1.6%, according to the IMF. It has also overtaken India as the fastest-growing large economy. The IMF's World Economic Outlook estimated China's economy grew at 6.7% in 2016, compared with India's 6.6%. The chart above shows the world's 40 biggest economies individually, but grouped by colour into continents. The Asian bloc clearly has a larger share than anywhere else, representing just over a third (33.84%) of global GDP. That's compared to North America, which represents just over a quarter, at 27.95%. Europe comes third with just over one-fifth of global GDP (21.37%). Together, these three blocs generatemore than four-fifths(83.16%) of the world's total output.

Transport & Communication		
Std.	**Unit**	**Topic**
7th Term II	2	Tourism
9th	7	Maping skills (7.2 – 7.3)
10th	5	India Population, Transport, Communication, Trade
12th	6	Geo infomatics

eelam
7th Term 2
Unit 2
Tourism

Introduction

The word tourist was derived from an old English word "tourian" which refers to a person who travels out of his usual environment for not more than one year and less than 24 hours. The purpose of travel may be religious, recreation, business, historical and cultural.

The Basic components of Tourism

Tourism has become an important source of income for many regions and even for the entire countries of the world. Tourism is an essential part of the life of the society because of its direct impact on social, cultural, educational and economic sector of the nation and on their international relations too.

The three main components of tourism are

- Attraction
- Accessibility
- Amenities.

These three components are together known as A3 concept.

Attractions

Attractions mainly comprise of two types such as:

- Natural attraction
- Cultural attraction

Natural attraction includes landscape, seascape, beaches, climatic condition and forests.Cultural attractions are historic monuments and other intellectual creations. Apart from this, cultural attractions also includes fairs and festivals.

Accessibility

Accessibility means reachability to a particular place of attraction through various means of transportation such as road, rail, water and air. Transport decides the cost of travel and the time consumed in reaching or accessing a specific attraction.

Amenities

Amenities are the facilities that cater to the needs of a tourist.

1. Accommodations in terms of hotels, restaurants, cafes and other staying units.
2. Travel organizers, Tour operators and Travel Agents
3. Foreign exchange centres, passport and visa agencies
4. Sectors related to Travel Insurance, Safety and Security

Types of Tourism

From the ancient times, travel is a fascination for mankind. Tourism can be divided on the basis of nature, utility, time and distance as indicated below.

- Religious tourism
- Cultural tourism
- Historical tourism
- Eco-Tourism
- Adventure tourism
- Recreational tourism

Religious Tourism

Religious tourism is one of the oldest types of tourism, wherein people travel individually or in groups for pilgrimage to a religious location such as temples, churches, mosques and other religious places. Religious tour to Kasi (Varanasi) by Hindus, to Jerusalem by Christians and to Mecca by Muslims are few of the examples for religious tourism.

Historical Tourism

It focuses on visiting historically important places like museums, monuments, archaeological areas, forts, temples and so on. Angkorwat of Cambodia, Tajmahal of India and Pyramids of Egypt are some of the examples to quote for Historical Tourism.

Eco-Tourism

Eco tourism typically involves travel to destinations where plants and animals thrive in a naturally preserved environment. Amazon rain forest, African forest safari, trekking in the slopes of Himalayas are the famous incredible Eco friendly attractions

Gastronomy refers to an aspectof **cultural tourism.**

Adventure Tourism

Adventure tourism is a type of tourism involving travel to remote or exotic places in order to take part in physically challenging outdoor activities. For e.g. sky dive in Australia, Bungee jumping in New Zealand, mountaineering in the peaks of Himalayas, rafting in the Brahmaputra River at Arunachala Pradesh

Recreational Tourism

This type of tourism aims at enjoyment, amusement or pleasure are mainly for 'fun activity'. Waterfalls, hill stations, beaches, and amusement parks are the attractive spots for recreational tourism.

Apart from this, there are certain modern types of tourism, which got developed in recent years.

They are

- Annual Holiday tourism
- Industrial Tourism
- Seasonal Tourism
- International Tourism
- Group Tourism
- Sports Tourism
- Health Tourism
- Farm and Rural Tourism.

International Tourism

International tourism is undertaken to visit the places of international importance and to gather knowledge about international culture and customs. For this, there are certain travel forms and formalities to be fulfilled by the tourists, such as passport, Visa, Foreign Currency, Air ticket, Travel insurance, and other immigration details.

- VISA – A document issued to a person (or) a stamp marked on the passport of a personwho wants to visit other country.
- Tourist VISA - Recreation sight seeing
- Student VISA – Higher education

- Employment VISA – Work in a country
- Medical VISA – Medical treatment in a reputed hospital of a country

Basic Elements of Tourism attractions

Certain elements are fundamental to attract tourists as travel destinations. They are

- Pleasant weather
- Scenic beauty
- Historical and cultural monuments

Geographical Components of Tourism

1. **Landforms:** Mountains, Plateaus, Canyons, Valleys, Caves, Cirques, Sand dunes, Coral reefs, Cliffs, etc.,
2. **Water:** Rivers, Lakes, Waterfalls, Hot springs and Geysers, Snow and Glacier, Water Currents, Tides and Waves.
3. **Vegetation:** Forest, Grasslands, Moors, Deserts etc.,
4. **Climate:** Sunshine, Clouds, Admirable Temperature, Rain and Snow.
5. **Animal life:-**
   (a) Wildlife : Birds, Game Reserves, Zoos.
   (b) Hunting and Fishing
6. **Settlement features:-**
   (a) Towns, Cities, Villages
   (b) Historical remains and Monuments
7. **Culture:-**
   Ways of life, traditions, folklore, arts and crafts.

Game Reserves: An area of land set aside for the protection of wild animals.

Tourism Attractions in India

India is a country known for its gentle hospitality with spicy food and culture. Visitor friendly traditions with varied life style, culture, heritage, colourful fairs and festivals are abiding attractions for the tourists. All types of land form, varied climate, rich resources for eco and adventure tourism are the versatile specialty of India. Technological parks and science museums, pilgrimage centers with wonderful art and architecture are an added advantage for tourists. Yoga, Ayurveda and Natural remedial Health resorts attract tourists from all over the world.

Religious Tourism

India being a multi-religious country, religious tourism is the most popular type of tourism. Various package tours are organized for the people to attend the religious rituals and to visit places of religious importance. Most famous religious spots of India are as follows:

Rameswaram - Tamil Nadu
Kanchipuram - Tamil Nadu
Varanasi(Kasi) - Uttarpradesh
Saranath - Uttarpradesh
Vaishnavadevi temple - Jammu & Kashmir
St. Francis Xavier Cathedral - Goa
Amritsar - Punjab
Monasteries of Ladakh - Jammu & Kashmir

Scenic attraction is a very important factor in tourism. Scenery consisting of Mountains, Lakes, Waterfall, Glacier, Forests, and Deserts are the major features attracting people to visit them. India is blessed with nature and gifted with immense beauty from rolling hills to deep valley and snow covered mountains to lush green carpet.

Hill Stations in India

The Indian sub continent has seven principal mountains ranges and the largest of all is the Himalayas that lie in the northern part of India. Most of the Himalayan hill stations in India are located in states of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Arunachal Pradesh, Nagaland and Meghalaya. Maharashtra, Karnataka, Tamil Nadu and Kerala have hill stations in the Western Ghats. Andhra Pradesh, Odisha have hill stations in the Eastern Ghats.

The beautiful hill stations in India

Kodaikanal, Ooty - Tamil Nadu
Nainital, Mussoorie - Uttarakhand
Darjeeling - West Bengal
Gulmarg - Jammu & Kashmir
Shillong - Meghalaya
Shimla, Manali - Himachal pradesh
Munnar - Kerala
Gangtok – Sikkim

ITC – Inclusive Tour Charter IATA – International Air Transport Association IATO – Indian Association of Tour Operators TAAI - Travel Agents Association of India TTTHA - Tamil Nadu Tour Travel and Hospitality Association TTDC – Tamil Nadu Tourism Development Corporation

Water falls in India

In India there are many spectacular and wonderful waterfalls covered by dense forest, huge walls of rock and lush green trees. Among these waterfalls, some are seasonal, while some are perennial. Few of the amazing waterfalls are in swing during the monsoon season. This season brings lot of tourists to these bubbling waterfall sites. Notable waterfalls of India are given below:

S.No	Water falls	Geographical location
1.	Thalaiyar waterfalls	Horse tail type located in Dindugul district of Tamil Nadu
2.	Jog water falls	Segmented waterfall (Raja, Rani and thunder) located in Shimogo district of Karnataka
3.	Nohkalikai waterfalls	Tallest plunge type of waterfall situated in the East khasi hill district of Meghalaya.
4.	Talakona waterfalls	It is the highest waterfall in Andhra Pradesh. A lot of medicinal herbs are seen around the region.
5.	Aathirappally waterfalls	The Niagara of India, is located in Thrissur district of Kerala

Wild life and Bird Sanctuaries

India possesses a wide range of forests and grasslands. Diversity of these lands makes it one of the hotspot for flora and fauna. The dense and dark forest of Indian States provides suitable habitat for a wide and an unique variety of animals and birds. Royal Bengal Tigers, Indian Lions, Elephants, Rhinoceros, Indian leopard and Reptiles are the major tourist attractions. Bird sanctuaries attract attention for their exclusive variety of birds. Diverse range of climate of India invite birds from remote places to feed, breed and to nurture their young ones in the Indian bird sanctuaries.

Wildlife Sanctuaries in India

S.No.	Wildlife sanctuary	State	Animals
1.	Mudumalai wildlife sanctuary	Tamil Nadu	Tiger, Elephant , Bison, Deer
2.	Kaziranga National Park	Assam	Tiger,Deer, Buffalo
3.	Ranthambor National Park	Rajasthan	Tiger
4.	Kanha National Park	Madhya Pradesh	Swamp Deer
5.	Sundarbans National Park	West Bengal	Bengal Tiger
6.	Gir National Park	Gujarat	Lions
7.	Bhadra Wildlife Sanctuary	Karnataka	Bison, Leopard, Gaur
8.	Periyar National Park	Kerala	Elephant, Deer
9.	Corbett National Park	Uttarakhand	Tiger

Bird Sanctuaries in India

S.No	Bird Sanctuary	State
1.	Koonthankulam bird sanctuary	Tamil Nadu
2.	Kumarakom bird sanctuary	Kerala
3.	Bharatpur bird sanctuary	Rajasthan
4.	Mayani bird sanctuary	Maharashtra
5.	Uppalapadu bird sanctuary	Andhra pradesh
6.	NalSarovar bird sanctuary	Gujarat
7.	Nawabganj bird sanctuary	Uttar Pradesh

Beaches

India is a country with 7517 km long coastline comprising the most beautiful beaches bounded by Arabian sea and Bay of Bengal. Indian beaches are enriched with diverse coastal land forms filled with aquatic flora and fauna. Lush backwater in the lagoons of Kerala and picturesque beaches of Goa such as calangute, Aguda are the notable tourist destinations for water sports activities. The most charming and enchanting beaches of India are listed below.

S.No.	Beaches	States	Geographical features
1.	Dhanushkodi	Tamil Nadu	Turquoise blue sea water
2.	Varkala Beach	Kerala	Sea Cliffs for wonderful sunset views
3.	Tarkarli Beach	Maharashtra	Coral reefs and marine adventure
4.	OM Beach	Karnataka	Two semi circular caves that join together forming the inverted symbol of OM
5.	Aguda Beach	Goa	A huge hill dominates the southern side of the beach.
6.	Marari Beach	Kerala	Saddle like rock(Hammock) Beach

Tourist Attraction in Tamil Nadu

Tamil Nadu has various tourist attractions like religious centres, spiritual retreat centres, beaches, hill stations, waterfalls, wildlife, art, culture, architecture, crafts, heritage monuments etc. The Government of Tamil Nadu has recognized the importance of tourism long ago and facilitated its development in desired directions. Exploring new avenues like medical tourism and adventure tourism in the past decades have helped Tamil Nadu tourism to achieve more than twenty percent annual growth. Tamil Nadu earns the largest share of income from tourism in India.

Religious Tourism

Tamil Nadu is a state popularly known as land of Temples and has been the greatest source for spiritual rejunuvation for travellers all over the world. The state is home to around 33,000 ancient temples that mainly belongs to Dravidian style of architecture. Some of the world renowned religious destinations are as follows:

- Thanjavur Big temple
- Madurai Meenakshi temple
- RameswaramRamanathaswami temple
- Temples of Kancheepuram
- VelankanniMadha church
- NagoreDargah

Hill Stations in Tamil Nadu

Tamil Nadu being situated in the Southern end of the Western and Eastern Ghats, is the home for several hill stations. Popular among them are Udagamandalam (Ooty), Kodaikanal, Yercaud, Coonoor, Valparai, Yelagiri, Sirumalai, Kalrayan Hills and Palani Hills, Shevroy hills and Cardamom Hills. They are also abodes of thick forest and wild life.

Ooty - Queen of Hills
Yercaud - Lake forest (Poor Man's Ooty)
Yelagiri - 14 hairpin bends
Kodaikanal - Princess of Hill Stations
Kotagiri - Green Hills
Velliangiri Hills - Kailash of the South
Kolli Hills - motor able terrain with 70 hairpin bends
Anaimalai Hills - Top slip
Meghamalai - High wavy mountains
Javadi - Nature's Heaven

Waterfalls in Tamil Nadu

Mountains and rivers of Tamil Nadu combined together created many endearing waterfalls. Waterfalls in Tamil Nadu with its inspiring natural wonders attracts many tourists. A trek amidst thick green trees, steep hills and a bath in the gushing water is most rejuvenating. Here is the list of famous water falls of Tamil Nadu.

S.No.	Waterfalls	Geographical location
1.	Hogenakal falls	It is a beautiful waterfall located in Dharmapuri district.
2.	Kumbakkarai falls	River Pambar cascades to form this fall at the foot hills of Kodaikanal in Theni district.
3.	Monkey falls	This waterfall lies on Anaimalai hills range in Coimbatore surrounded by Evergreen forests.
4.	Killiyur falls	Situated in the shervarayon hill ranges of the Eastern Ghats.

		Madurai Meenakshi Temple
5.	Courtallam	Courtallam is located in Tirunelveli district. It is known for medical spa
6.	AgayaGangai	It is a waterfall in Puliacholai on Kolli Hills in Eatern Ghats of Namakkal district.
7.	Suruli Falls	This falls is also called as Cloud Land falls (or) Meghamalai falls. It is located in Theni district.

Wildlife and Bird Sanctuaries in Tamil Nadu

Wildlife sanctuary in Tamil Nadu includes Bird sanctuaries and National Parks. Tamil Nadu is also well known for the diverse natural heritage that it possesses. Hence tourists are highly excited about the wildlife tour across the state. The total area of Tamil Nadu is approximately 130,058 sq.km. 17.6% of the land area comprises of thick forests. Visitors will get to watch a smooth blend of wet evergreen forest, dry and wet deciduous forests, grasslands, sholas, mangroves and thorny scrubs. Besides varied natural vegetation, another prized possession of Tamil Nadu is wildlife Sanctuaries including Tiger, Elephant, Deer, Monkey, Bison etc., for protecting the entire flora and fauna. Wildlife Sanctuaries of the state are enlisted below:

Wildlife Sanctuaries

S.No.	Name of Wildlife Sanctuary	District
1.	Mudumalai Wildlife Sanctuary	Nilgiris
2.	Mundanthurai Wildlife Sanctuary	Tirunelveli
3.	Point Calimere Wildlife Sanctuary	Nagapattinam
4.	Indira Gandhi Wildlife Sanctuary	Coimbatore
5.	Kalakad Wildlife Sanctuary	Tirunelveli

Bird Sanctuaries in Tamil Nadu

S.No.	Name of Birds Sanctuary	District
1.	Vettangudi birds Sanctuary	Sivagangai
2.	Karaivetti birds Sanctuary	Ariyalur
3.	Vellode birds Sanctuary	Erode
4.	Vedanthangal birds Sanctuary	Kancheepuram

National Parks in Tamil Nadu

S.No	Name of	District

	National Parks	
1.	Guindy National Park	Chennai
2.	Gulf of Mannar Marine Park	Ramanathapuram
3.	Indira Gandhi National Park	Coimbatore
4.	Mukurthi National Park	Nilgiris
5.	Mudumalai National Park	Nilgiris

Beaches in Tamil Nadu

Tamil Nadu being a Coastal state in India which consists of several beaches. Some of them are world famous tourist spots. Beach is a lovely place to hang around with friends, families and kids. All these are ideal destinations for sun bath relaxation and water sports activities.

S.No.	Beaches	Geographical features
1.	Kovalam Beach Kanchipuram	Small fishing village
2.	Marina Beach Chennai	Second longest urban beach
3.	Kanyakumari Beach	Multi-coloured sand
4.	Rameshwaram Beach	Waveless beach
5.	ElliotBeach Chennai	Beautiful beach active in day & night
6.	Mahabalipuram Beach Kanchipuram	Architectural and Archeological beach
7.	Silver Beach Cuddalore	Water sports is the entertainment
8.	Muttukadu Beach Kanchipuram	Calm and Shallow

Environmental Impact of Tourism

The quality of the environment is essential for tourism. The tourism industry created several positive and negative impacts on the environment.

Positive Impacts

- Direct financial Contributions
- Contributions to government revenues
- Improved environmental management and planning
- Increasing environmental awareness
- Protection and reservation of environment

Negative Impacts

1. Depletion of Natural Resources
   - Water resources
   - Local resources
   - Land degradation

2. Pollution
   - Air and Noise Pollution
   - Solid Waste and Litering
   - Sewage

3. Destruction and Alteration of Eco system
   - Air
   - Water
   - Soil

9th BOOK Unit 7
Mapping Skills (7.2 – 7.3)

7.2 Remote Sensing as a Source of Map Data

Remote Sensing refers to the observation and measurement of earthly objects without touching them.

'Remote' means far away and 'Sensing' means observing or collecting information. Remote sensing means acquiring information of things/places from a distance, using a variety of tools and methods.

We operate three remote sensing organs in our body.

Remote sensing has a long history, dating back from the use of cameras carried by balloons and pigeons in the 18th and 19th centuries. During the 20th century, airborne photographs and satellite remote sensing developed swiftly.

Aerial photography

Aerial photography refers to the technique of obtaining information about places or objects or phenomena with the help of photographs taken using cameras mounted on low flying birds, balloons, helicopters, aeroplanes and drones. The aerial photographs are captured continuously with a time gap of 10-30 seconds at a fixed height. Each photo will have a slight overlap of the area in the preceding photo. By making a mosaic of all the photos excluding the overlapping areas, a stereoscopic (3D) image of the study area can be produced.

Felix Nadar was a French photographer, journalist, novelist and balloonist. In 1858, he became the first person to take aerial photographs. He took his first photograph in 1853 and pioneered the use of artificial lighting in photography, working in the catacombs of Paris. Around 1863, Nadar built a huge (6000 m^3) balloon named Le Géant ('The Giant').

Satellite Remote Sensing

Satellite remote sensing is the science of collecting data about an object or area from artificial satellites orbiting the Earth. The term 'satellite imagery' refers to digitally transmitted images of the satellites.

The preliminary data is retrieved fromsatellites like LANDSAT, CARTOSAT,OCEANSAT, etc. Fire and flood details can beextracted and delivered to relevant authoritieswithin two hours of satellite image capture.E.g. major earthquakes in China and NewZealand, bushfire in Victoria and floods

inKerala.Dynamic phenomena such as flood,movement of wild animals, shoreline changes,finding lost ships and planes. Researchers usesatellite imageries for these.

Components of remote sensing

- Energy source
- Transmission path
- Target
- Sensor

People cannot be tracked generallyby satellite or aerial photographsbut they can be tracked by theirmobile phone signals.

Global Navigation Satellite System (GNSS)

Have you ever bookeda cab using a smart phoneapp? Did you see the mapshowing the route of yourtravel and movement ofyour vehicle on mobilephones? How is it possibleto calculate the time duration of your travel?

Satellite remote sensing	Aerial Photography
• High cost of satellite systems. Takes at least 10years to plan, construct, test and launch. • Satellites collect large amount of data ofthe entire area in a short span. • It allows global coverage and does notrequire permission. • Satellites circle the Earth; they can repeatand revisit easily. • Weather does not affect the functioningof satellites. • All information is digital; it can beeasily integrated with software for imageimprovement.	• Surveying can be planned and executed ina shorter time economically. • Takes more time to capture an area.Aircraft needs to fly back and forth. • It covers a small area and needs permissionfrom authorities. • Revisits or repeatability involves extracost. • Adversely affected by bad weather • It is an analogue record, so no furtherimprovement is possible after obtainingphotographs.

In the 21st century, GNSS has become a part of our lives to promote the safety and convenience of transport. Global Navigation Satellite System (GNSS) is a satellite system connected with a small electronic receiver or tracker to locate, monitor and track a user's vehicle wherever in the world. It can also set up instant alerts when a driver of a vehicle speeds or deviates from a particular area. GNSS applications are used in tracking or mapping vehicles, ships and aircraft. A group of satellites (Space Segment) working with a network of ground stations (Control Segment) provide location data. The receiver (User Segment) converts satellite signals into location, speed and time data.

Examples of GNSS

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- Europe-Galileo„„
- USA-NAVSTAR Global Positioning System (GPS)„„
- Russia-Global'nayaNavigatsionnayaSputnikovaya Sistema (GLONASS)„„
- China- BeiDou Navigation Satellite System„„
- India's-IRNSS (NAVIC) system

a. Global Positioning System (GPS)

Without the Global Positioning System (GPS) on our vehicles and mobile phones, we would feel lost. GPS is the U.S. implementation of the world's first and currently the most used Global Navigation Satellite System (GNSS) created by the U. S. Department OfDefense (DOD). It became fully operational in 1995. NAVSTAR (Navigation Satellite Timing and Ranging) is a network of 24 U.S. satellites in six different orbits in space flying 20,350 km above the surface of the Earth; each one circles the planet twice a day to provide continuous, worldwide coverage. GPS receivers now come in all shapes and sizes, Most are the size of a cellular phone. Some are handheld, others are installed in ships, planes, trucks and cars.

Advantages of GPS

„„

- GPS technology has tremendous applications in everything from mobile phones, watches, bulldozers, shipping containers and ATMs.„
- The main purpose of GPS is to help in providing accurate transport data (distance, route and direction). It helps in military searches and rescue in wars. It can work as a reliable tourist guide.„„
- GPS helps during accident and rescue efforts, speeding the delivery of emergency services and disaster relief.„„
- Weather forecasting, earthquake monitoring and environmental protection can be done effectively by using GPS.

b. Geographic Information System (GIS)

Geographic Information System is a computer-based tool for managing a large amount of data collected for a given geographic region through remote sensing, GPS and other sources. The Geographic Information System is a combination of computer hardware, software, geographic data and the personnel.

G - Geographic - A particular area
I - Information - facts in order
S - System - arrangement

GIS was first recognised in the late 1950s by Waldo Tobler and Roger Tomlinson (Canada). Prime examples of importing GIS for public welfare are Google Maps, Yahoo Maps and Google Earth.

The key ingredient is location. We must have a coordinate, an address or a distance from a known point that helps us to link the information to a location on a map. Each type of data of an area is stored as a separate 'layer' of the map. In GIS, layers may be used some times and removed according to need. Examples are hospitals, schools, water bodies, parks and ATMs. The computers can create maps showing any combination of data.

Bhuvan

Bhuvan (Sanskrit for Earth) is a free internet based computer application launched by the Indian Space Research Organization (ISRO)on August 12th 2009. It enables visualization ofIndian Remote Sensing (IRS) images taken overa year ago, by ISRO's seven satellites, includingCartoSat-1 and CartoSat-2. Using Bhuvanconnected to Internet, one can explore placesof interest, scenes of events in the news or partsaround the world they may never visit in person,by either entering the names of places or coordinates(latitudes and longitudes). Bhuvan hastremendous uses for scientists, academicians,policy makers and the general public.

APPOLO STUDY CENTRE

10th Unit – 5
India Population, Transport, Communication, Trade

Introduction

The study on human population is one of the most important aspects in geography of any region. The human population has many components but the most fundamental are its number, composition, distribution and density. Therefore, it is essential to study these components. The study on these aspects also would reveal the workforce of the country.

The population of India as per 2011 census is 1,210.19 million (1,21,01,93,422). It shows an increase of 19.31crores from the population of 2001. Population Census of India provides the detailed information about the demography of India. Along with population, we will study about the transport and communication of India in this chapter.

Population

The total number of people residing in a country at a specified period of time is called the 'Population' of that country. India is the second most populous country in the world next only to china. India covers only 2.4 percent of the land area of the world, but is the home of about 17.5 percent of the world's population. It shows that the proportion of population of India is far higher than the proportion of its area. Thus, a little more than one out of every six persons in the world is from India. Our population is almost equal to the combined population of the USA, Indonesia, Brazil, Pakistan, Bangladesh and Japan and total population of these six countries is 1214.3 million.

Census

Population census is the total process of collecting, compiling, analysing or otherwise disseminating demographic, economic and social data pertaining, at a specific time, of all persons in a country or a well-defined part of a country. It happens in an interval of ten years. The data collected through the census are used for administration, planning, policy making as well as management and evaluation of various programmes by the government.

Distribution and Density of Population

The term 'Population Distribution' refers to the way the people are spaced over the earth's surface. The distribution of population in India is quite uneven because of the vast variation in the availability of resources. Population is mostly concentrated in the regions of industrial centres and the good agricultural lands. On the other hand, the areas such as high mountains, arid lands, thickly forested areas and some remote corners are very thinly populated and some areas are even

uninhabited. Terrain, climate, soil, water bodies, mineral resources, industries, transport and urbanization are the major factors which affect the distribution ofpopulation in our country.

In India the first censuswas carried out in the year1872. But the first completeand synchronous census wasconducted in 1881. And the2011 census represents the fifteenth censusof India.

Uttar Pradesh is the most populous state in the country with a population of 199.5 million followed by Maharashtra (112.3 million), Bihar (103.8 million) West Bengal (91.3 million) and the combined Andhra Pradesh (84.6 million). These five states account for about half of the country's population. More than one fourth of the population live only in the two states of U.P and Maharashtra. Sikkim is the least populous state of India(0.61 million). Delhi with 16.75 million population tops among the Union territories.

The uneven distribution of population in the country is the result of several factors such as physical, socio-economic and historical ones. The physical factors include relief, climate, water, natural vegetation, minerals and energy resources. Socio-economic factors consists of the religion, culture, political issues, economy, human settlements, transport network, industrialization, urbanization, employment opportunity etc.

Density of population

Population density is a better measure of understanding the variation in distribution of population. It is expressed as number of persons per unit area usually per sq km. According to 2011, the average density of population of India is 382 persons per sq.km. India is one of the most thickly populated ten countries of the world. The most densely populated state of India is Bihar and the state with least population density is Arunachal Pradesh. Among the union territories, Delhi is the densely populated one with 11,297 per sq.km, while Andaman and Nicobar Islands have the lowest density of population.

Spatial pattern of population density	
Density	**Places**
Very Low density (less than 150 persons per sq.km)	Arunachal Pradesh (17), Andaman and Nicobar Islands (46), Mizoram (52), Sikkim (86) Nagaland (120), Manipur (122), Himachal Pradesh (123), Jammu and Kashmir (124) and Meghalaya (132)
Low Density (150 to 300 persons per sq.km)	Arunachal Pradesh (17), Andaman and Nicobar Island s(46), Mizoram (52), Sikkim (86) Nagaland (120), Manipur (122), Himachal Pradesh (123), Jammu and Kashmir (124) and Meghalaya (132)
Moderate Density (300 to 500 persons per	Gujarat (308), The combined Andhra Pradesh (308) Karnataka (319), Tripura (350), Maharashtra (365), Goa

sq.km.)	(394), Assam (397) and Jharkhand (414) are the states with moderate population density. Assam has tea estates, Andhra Pradesh, Karnataka and Jharkhand
High Density (500 t0 1000 persons per sq.km)	Punjab (550), Tamil Nadu (555), Haryana (573), Uttar Pradesh (827) and Kerala (859) The union territory of Dadra and Nagar Haveli (698)
Very High Density (greater than 1000 persons per sq.km)	West Bengal (1029), Bihar (1102), Lakshadweep (2013), Daman and Diu (2169), Puducherry (2598), Chandigarh (9252) and Delhi (11.297).

Population Growth and Change

The growth rate of population is an important demographic feature. It not only helps in understanding the population change that a society has undergone in the past but also helps in predicting the future demographic characteristics of an area. Population growth refers to the change in the number of inhabitants of a country/territory during a specified period of time. The growth of population is expressed in percentage and is described as the growth rate of population. The following table shows the decadal growth rate of population from 1901 to 2011.

Growth of population in India has gone through the different phases. Population of the country in 1901 was 238 million and it grew to 1,210 million over a period of little more than a century. The following are the different stages of population growth of India.

The Period of Stagnant Population (1901-1921): During the first phase of 20 years (1901-1921), the population of India grew by 15 million. The year 1921 registered a negative growth rate of -0.31% which happened only once throughout the demographic history of India and is called the year of Great Demographic Divide.

The Period of Steady Growth (1921- 1951): During the second phase of 30 years (1921-1951), the population of India grew by 110 million.

The Period of Steady Growth (1951- 1981): During the third phase (1951-1981), the population of India grew from 361 million in 1951 to 683 million in 1981. Growth rate in this period is almost doubled when compared to the previous phase of growth rate. This period is often referred to as the period of population explosion.

The period of High Growth with Definite Signs of Slowing Down (1981-2011): Population of India increased from 685 million to 1210 million during this phase. The growth rate of population decreased from one census to other. This marks the beginning of a new era in the demographic history of India.

Population change refers to an increase or decrease of population of anarea from one period to another period. Population growth is influenced by the birth rate,

death rate and migration. These three make the changes in population. Birth rate refers to the number of live births per thousand people in a year and the
Death rate refers to the number of deaths per thousand people in a year. The rapid decline in death rate is the major cause of the rapid growth of population in India.

Migration

It is the movement of people across regions and territories. It can be internal (within a country) or international (between the countries). Internal migration does not change the size of population of a country but it influences the distribution of population in a nation. It plays an important role in changing the composition and distribution of population. In India, the mass migration is from rural to urban. Unemployment and under employment in the rural areas are the push factors and the employment opportunity and higher wages in the urban areas caused by the industrial development are the pull factors of migration in the country. 45 out of 121 crores of people in India are reported to be migrants as per 2011 census. Migrants constitute about 37% of population. Migrants are 48% from female and 52% from male.

Population composition

Population composition refers to the characteristics such as age, sex, marital status, caste, religion, language, education, occupation etc. The study of composition of population helps us to understand the social, economic and demographic structure of population.

Age composition

The age composition of population refers to the number of people in different age groups in a country. It is one of the most basic characteristics of a population. It helps us to understand the proportion of population in dependent and independent category. Population of a nation is generally grouped in to three broad categories. In India, the children who have less than 15 years of age constitute 29.5% and the people above 60 years constitute 8.0%. So, the dependent population in India is 37.5%and the independent population (16- 59 yrs) is 62.5%. It shows that our country has enormous manpower.

Sex Ratio

Sex ratio is defined as the number of females per 1000 male population. This is an important social indicator to measure the extent of equality between males and females in a society at a given time.

According to 2011 census, the sex ratio of the country is 940 females per 1000 males. This suggests that the size of female population is lower than males. Only in the state of Kerala and the union territory of Pondicherry the sex ratio is greater than

1000. It is 1084 in Kerala and 1038 in Puducherry. The lowest sex ratio is recorded in the union territory of Daman and Diu(618).

The ratio between theeconomically active andeconomically inactive ofpopulation is termed asDependency Ratio.

Literacy Rate

The people who are able to read and write are known as literates. It is an important indicator of quality of people. The percentage of literate people to the total population is termed as literacy rate. There has been a steady improvement in the literacy levels in India. India's literacy rate as per 2011 census is 74.04%. From this, the literacy rate of male is 82.14% and the female is 65.46%. It shows that still there is a vast gap (16.68%) between the male and female literacy rates. Kerala ranks first in the country with a literacy rate of 93.91% followed by union territory Lakshadweep with 92.28%. The lowest literacy rate is found in Bihar (63.82 %).

Occupational structure

The economically active part of a country's population is enumerated during the census operations and stated as workers. Workers are placed under three fold categories in census record. They are main workers, marginal workers and non-workers. According to the Census of India, all those who had worked for the major part of the preceding year (at least 6 months or 183 days) are recorded as main workers. Those who worked for less than six months are recorded as marginal workers and the people who have not worked at all comes under non- workers. Work participation rate denotes the percentage of total workers i.e., total main and marginal workers to the total population in an area. The work participation rate in India is 39.79% in 2011, out of which the work participation rate of male is 53.25% and the female is 25.51%. From the workers, main workers constitute 75.23% and the remaining 24.77% of the people belong to marginal workers.

Population Dynamics

Human population dynamics is a field that tracks factors related to changes in the size of population and its characteristics. Predicting population changes is an important aspect of population studies. The demographic trend affects the economic, social, and environmental systems. An increase in human population can affect the quality of natural resources like biodiversity, air, land, and water. The size of Population and characteristics undergoes changes constantly. These changes are reflected clearly in every other aspect of our country.

Problems of over Population

In India, growing pressure of Population on resource base, created many socioeconomic, cultural, political, ecological and environmental problems. The

Population problems vary in space and time and differ from region to region. Some of the major issues created by the overpopulation in our country are overcrowding, unemployment and under employment, low standard of living, malnutrition, mismanagement of natural and agricultural resources, unhealthy environment etc.

Urbanization

The process of society's transformation from rural to urban is known as urbanization. The level of urbanization of a place is assessed based on the size of population of the towns and cities and the proportion of population engaged in non-agricultural sectors. These two are closely linked to the process of industrialization and expansion of the secondary and tertiary sectors of economy.

Urbanization in India

The level of urbanization is measured in terms of percentage of urban population. The level of urbanization in the country has increased more than three times from 1901 to 2011. The percentage of urban population of India was 27.82% in 2001 and it rose to 31.16% in 2011 shows an increase of 3 % in a decade.

The level of urbanization varies widely among the states. Goa is the most urbanized state with 62.17% of urban population. Himachal Pradesh is the least urbanized state with 10.04% of urban population. Among the Union territories, Delhi is the most (97.50 %) urbanized region followed by Chandigarh (97.25%). Among the major states, Tamil Nadu continues to be the most urbanized state with 48.4% percent of urban population followed by Kerala (47.7%) and Maharashtra (45.2%).

S. No	Type of Towns /UAs / OGs	2001 (in Numbers)	2011 (in Numbers)
1.	Statutory towns	3799	4041
2.	Census Towns	1362	3894
3.	Urban Agglomeration	384	475
4.	Out Growths	962	981

As per 2011 Census, there are 7,935 towns (statutory and census) in the country. The number of towns has increased to 2,774, from 2001 census. In 2011, 475 Urban agglomeration (UAs) with 981 outgrowths (OGs) have been identified as Urban Agglomerations as against 384 UAs with 962 OGs in 2001 Census. Out of 468 UAs belongs to Class I category, 53 UAs have the population of one million and above each and these urban centres are known as "Million Cities". These are the major urban centres in the country. Among the Million Cities, there are three major Urban Agglomerations with more than 10 million population each and are known as "Mega Cities". They are Greater Mumbai UA (18.4 million), Delhi UA (16.3 million) and Kolkata UA (14.1million).

Impact of Urbanization

Urbanization and population concentration go hand – in – hand and are closely related to each other. A rapid rate of urbanization in a society is taken as an indicator of its economic development. Urbanization is increasing rapidly in the developing countries including India. Rural to urban migration leads to population explosion in urban areas. Metropolitan cities like Mumbai, Kolkata and Delhi have more population than that can accommodate. The urban population of India had already crossed the 377million in 2011, which is more than the total population of USA. By 2030, more than 50% of India's population is Expected to live in urban areas. The following are the major problems of urbanization in India

- It creates urban sprawl.
- It makes overcrowding in urban centres.
- It leads to shortage of houses in urban areas.
- It leads to the formation of slums.
- It increases traffic congestion in cities.
- It creates water scarcity in cities.
- It creates drainage problem.
- It poses the problem of solid waste management.
- It increases the rate of crime.

Human Development

Dr.Mahabub-ul-haq defined as "it is a process of enlarging the range of people's choice, increasing their opportunities for education, health care, income and empowerment. It covers the full range of human choices from a sound physical environment to economic, social and political freedom".

Human Development Indicators: (as per UNDP)

Population trends, health outcomes, education achievements, national income and composition of resources, work and employment, human security, human and capital mobility, supplementary indicators: perceptions of well-being and status of fundamental rights treaties are the human development indicators.

Measuring of Human Development

Human Development Index (HDI) is a composite index focusing on three basic dimensions of human development: i) Health - Life expectancy at birth ii) Education - Expected years of schooling for school age children and average years of schooling for the adult population. iii) Income - Measured by-gross national income and percapita income.

Human Development Classification

HDI classifications are based on HDI fixed cut off points, which are derived from the quartiles of distributions of the component indicators. The HDI of less than 0.550 is used for low human development, 0.550 - 0.699 stands for medium human development, 0.700 - 0.799 for high human development and 0.8 or greater for very high human development.

Transportation

Transport is a system in which passengers and goods are carried from one place to another. Transport system is considered as the lifeline of a country. Earlier man travelled on foot or used animals for transport. With the discovery of wheel, transport was made easier and gradually different means of transport were developed. There are three major means of transport in the world.

Means of Transport		
Land	**Water**	**Air**
• Road ways • Railways • Pipelines	• Inland • waterways • Ocean routes	• Domestic airways • International Airways

Transport Network in India

Transport is one of the most important components of infrastructure and it is essential for economic development of a country, especially for a large country like India. India has a good transport network of roads, railways, airways and waterways providing necessary connectivity between different parts of the country.

Roadways

Roads play an important role in carrying goods and passengers for short, medium and long distances. It is highly suitable for short distance services. It is comparatively easy and cheap to construct and maintain roads. Road transport system can establish easy contact between farms, fields, factories and markets and can provide door to door transport services. Roads are the most universal mode of transport. Indian roads are cost efficient. It is used by all sections of people in the society. India has the second longest road network in the world with a total length of 56,03,293 km as of 2016. About 85% of passengers and 70 % of freight traffic are carried by roads every year.

Sher shah suri built the shahi (Royal) road to strengthen and consolidate his empire from the Indus valley to the Sonar valley in Bengal. This road from Kolkata to Peshawar was renamed as GrandTrunk(GT) road during the British period. At present, it extends from Amristar to Kolkata. It is bifurcated into 2 segments: (a) (NH)-1 from Delhi to Amristar, and (b) NH-2 from Delhi to Kolkata.

For the purpose of construction and maintenance, roads are classified into National Highways (NH), State Highways (SH), District Roads, Rural Roads (Village roads), Border Roads and International Highways.

1. Classification of Roads in India

a. National Highways (NH)

National Highways form the most important system of road transportation in India. These highways are running through length and breadth of the country connecting capitals of states, major Ports, rail junctions, industrial and tourist centres. Ministry of Road Transport and Highways of India, is responsible for the development and maintenance of National Highways in India. The total length of the National Highways (NHs) in India is 1,01,011 km which accounts for 1.8 % of the total road network length in 2016. The longest National highway is NH-7 which runs from Varanasi in Uttar Pradesh to Kanniyakumari in Tamil Nadu covering a distance of 2369 km. The shortest national highway is NH-47A, which runs from Ernakulum to Kochi port (Willington Island) covering a distance of 6 km.

b. State Highways

The state highways are usually roads that link important cities, towns and district headquarters within the state and connect them with national highways or highways of neighbouring states. These roads are administered and financed by state governments. State Highway runs to the length of 1, 76,166 km as of 2016.

c. District Roads

District Roads provide connectivity between the district and taluk headquarters with the state highways and national highways. District Roads are constructed and maintained by the Public Works Department of the states. The total length of the road of this category is 5,61,940 km(16.81%) in 2016.

d. Rural Roads (Village Roads)

Rural roads connectivity is a key component of rural development. These roads are vital for providing links in the rural areas. It links the different villages with their neighbouring towns. They are maintained by Village Panchayats. The total length of rural roads in India is 39,35,337 km as of 2016. Rural roads consist of Panchayat roads, (ZillaParishad, Panchayat Samiti, Gram Panchayat); roads of the Pradhan Mantri Gram SadakYojana (PMGSY) and those constructed by the State PWDs.

National Highways Authorityof India (NHAI) wasestablished in 1995. It is anautonomous body under theMinistry of Surface Transport.

e. Border Roads

These are the roads of strategic importance in border areas. They are constructed and maintained by Border Roads Organization. It was established in 1960 for the development of the roads of strategic importance in the northern and north-eastern border areas. Border Roads Organization has constructed world's highest road joining Chandigarh and Leh in Ladakh. This road runs at an average altitude of 4,270 meters.

Golden Quadrilateral: 5,846 km long road of 4/6 lanes connecting, India's four metropolitan cities: Delhi-Kolkata-Chennai-Mumbai-Delhi. This project was launched in 1999.

North–South and East-West Corridors: North- South corridor aims at connecting Srinagar in Jammu and Kashmir with Kaniyakumari in Tamil Nadu (including Kochi-Salem Spur) with 4,076km long road. The East-West corridor has been planned to connect Silchar in Assam with the port town of Porbandar in Gujarat with 3,640km of road length. The two corridors intersect at Jhansi.

f. Expressways

These are multi-lane good quality highways for high speed traffic. Some of the important expressways are; (i)Mumbai-Pune Road, (ii) Kolkata-Dumdum Airport road (iii) Durgapur-Kolkata road and (iv) Yamuna expressway between Delhi and Agra.

g. International Highways

These are the roads that link India with neighbouring countries for promoting harmonious relationship with them. These highways have been constructed with an aid from world bank under an agreement with the Economic and Social Commission for Asia-Pacific (ESCAP). These roads connect important highways of India with those of the neighbouring countries such as Pakistan, Nepal, Bhutan, Bangladesh and Myanmar. In India the densest road network is found in the northern plains where it is relatively easy to construct roads. In mountainous area, it is quite difficult to construct roads. Road density is the highest in Kerala and lowest in Jammu &Kashmir.

Railways

Indian railway system is the main artery of the country's inland transport. Railways cater to the needs of large scale movement of traffic, both for freight and passenger, thereby contributing to economic growth. Railways are considered as the backbone of the surface transport system of India. It promotes national integration by bringing people together. It also promotes trade, tourism, education etc. Railways help in the commercialization of the agriculture sector by facilitating the quick movement of perishable goods. Its role in transporting raw materials to industries and finished goods to markets is invaluable. Indian railway network is the largest in

Asia and second largest in the world. The length of Indian railways network as of 2017 is 67,368 km with 7,349 railway stations.

The first train steamed offfrom Mumbai to Thane in1853, covering a distance of34 km. In 1951, the systemswere nationalized as one unit"The Indian Railways". The headquarterof Indian Railways is New Delhi.

For operations and management, the Indian Railways is organized into 16 zones. 1) Northern Railway - Delhi 2) North- Western Railway - Jaipur 3) North-Central Railway- Allahabad 4) North-Eastern Railway - Gorakhpur 5) North-East Frontier Railway - Guwahati 6) Eastern Railway - Kolkata 7) East coast Railway - Bhubaneswar 8) East-Central Railway - Hazipur 9) West-Central Railway - Jabalpur 10) Central Railway - Mumbai (VT) 11) Western Railway - Mumbai (Churchgate) 12) Southern Railway - Chennai 13) South- Central Railway - Secunderabad 14) South Eastern Railway - Kolkata 15) South-Western Railway - Hubball and 16) South East Central Railway - Bilaspur. The Northern Railway accounts for the longest route length, followed by the Western Railway.

- The first sub-urban railwaywas started in 1925 inMumbai.
- Chennai becomes the sixthIndian city with metrorailway.
- Gatiman Express is the fastestoperational train in India. This trainconnects New Delhi and Agra andtouches 160 km/h. This train takesa travel time of 105minutes to cover200km journey.

a. Konkan railway

One of the important achievements of Indian Railways has been the construction of Konkan Railway in 1998. It connects Roha in Maharashtra to Mangaluru in Karnataka and the track measures 760 km. It is considered as an engineering marvel. On its routes, the railway crosses 146 rivers and streams, nearly 2000 bridges and 73 tunnels. Asia's longest tunnel nearly 6.44 km long is in this route. The states of Maharashtra, Goa and Karnataka are partners in this undertaking. The rail link between Banihal in Jammu region and Qazigund in Kashmir valley was opened in 2013. This rail line passes under the PirPanjal Range through a 11.2 km long tunnel.

b. Metro Railways in India

There are 8 cities with metro rail connectivity in India. They are Kolkata (West Bengal), Chennai (Tamil Nadu), Delhi, Bengaluru (Karnataka), Gurgaon (Haryana), Mumbai (Maharashtra), Jaipur (Rajasthan) and Kochi (Kerala). The metro in Kolkata is the first one in India. It is also called as Mass Rapid Transit System (MRTS). As of September 2018, India has 507 km of operational metro lines and 381 stations.

The state of Meghalaya has norailway network.

Pipeline transport:

Pipelines provided a very convenient mode of transport to connect oil and natural gas fields, refineries and to the markets. In the past, these were used to transport water to cities and industries. Now solids can also be transported through a pipeline when converted into slurry. The initial cost of laying pipeline is high but subsequent running cost is minimum. It can be laid through difficult terrain as well as under water. It ensures steady supply of goods and reduces the transhipment losses and delays are the major advantages of pipeline transport. Oil field in upper Assam to Kanpur, from Salaya in Gujarat to Jalandhar in Punjab and gas pipeline from the Hazira in Gujarat otJagadispur in Uttar Pradesh are the three important network large network of pipeline in the country.

Waterways

A waterway is an important mode of transport for both passenger and cargo traffic in India. It is the oldest and also the cheapest means of transport and most suitable for carrying heavy and bulky materials from one country to another. It is a fuel-efficient and eco-friendly mode of transport. The water transport is of two types- Inland Waterways and Ocean water ways(sea routes).

a. Inland Waterways

India has an extensive network of inland waterways in the form of rivers, canals, lakes and backwaters. It depends upon the depth and width of the waterways and the continuity of the water flow. The total navigable length of our country is 14,500 km, out of which about 5,200 km length of rivers and 4,000 km length of canals can be used by mechanized crafts. The total cargo carried by inland waterways is just about 0.1% of the total inland traffic of India. For the development, maintenance and regulation of national waterways in the country, the Inland water ways Authority was setup in 1986. The major national waterways are: National Waterway 1: It extends between Haldia and Allahabad, measures 1620 km and includes the stretches of the Ganga- Bhagirathi-Hooghly river system. National Waterway 2: This waterway includes the stretch of the Brahmaputra river between Dhubri and Sadiya a distance of 891 km. National Waterway 3: This waterway extends between Kollam and Kottapuram in the state of Kerala. It is the first national waterway in the country with 24 hour navigation facilities along its entire stretch of 205 km.

b. Oceanic Routes

Oceanic routes play an important role in the transport sector of India's economy. About 95% of India's foreign trade by volume and 70 percent by value moves through ocean routes.

Coastal shipping plays an important role in transport of bulk goods in India. Shipping is not only the most economical mode of transport, it is also an environment friendly mode. The sea and oceanic routes are mainly used for international trade and are connected through ports. There are 13 major and 200 minor or intermediate ports in India. The major ports are administered by the Central Government and minor ports are managed and administered by various state governments. The major ports on the east coast are Kolkata (including Haldia Dock), Paradip, Visakhapatnam, Chennai, Ennore and Tuticorin. The major ports on the west coast are Kandla, Mumbai, NhavaSeva (Jawaharlal Nehru Port), New Mangalore, Marmagao and Kochi. India has four major shipyards. Hindustan shipyard in Vishakhapatnam, Garden Reach workshop in Kolkata, Mazagaon Dock in Mumbai, Kochi Shipyard in Kochi. India is the second largest ship owning country in Asia and ranks 16th in the World.

Air Transport

Airways are the quickest, costliest, most modern and comfortable means of transport, Air transport facilitates connectivity on a national, regional and international scale. It has made accessibility easier by connecting difficult terrains like high mountains and sandy deserts. It carries passengers, freight and mail. Air transport plays a key role in times of emergency as well as in the event of natural and man-made calamities like floods, epidemics and wars.

Air transport in India made a beginning on 18th February, 1918 when Henry Piquet carried a mail from Allahabad to Naini. In 1953, eight different airlines which were in operation in the country were nationalised.

Domestic Airways fly within the boundaries of a country and International Airways connect major cities of the world. The Indian Airlines and Air India are the two airline services run by the government of India. Indian Airlines provides the domestic air services and Air India provides international air services. Presently, there are 19 designated international airports available in the country. These airports are managed by Airports Authority of India. Some of them are Netaji Subhash Chandra Bose International Airport, Kolkata, Chennai International Airport, Chennai, Indira Gandhi International Airport, Delhi, ChhatrapatiShivaji International Airport, Mumbai, Thiruvananthapuram International Airport, Thiruvananthapuram, SardarVallabh Bhai Patel International Airport, Ahmedabad, Bangalore International Airport, Bengaluru, Rajiv Gandhi International Airport, Hyderbad etc. Besides this, there are about 80 domestic airports and about 25 civil enclaves at defence air fields.

a. Pavan-Hans Helicopter Ltd

Pavan-Hans Helicopter Ltd has been providing Helicopter support services to the petroleum sector, including ONGC and oil India Ltd. It is a public sector company based in New Delhi. Its operations are based at the Juhu Aerodrome in

Vile Parle (West) Mumbai. Pavan-Hans is a Mini Ratna–I category public sector undertaking. It often provides services to various state governments in India particularly north east India Inter Island, Ferry services in Andaman & Nicobar Islands, services to Lakshadweep Island etc.,

b. Airports Authority of India (AAI)

Airports Authority of India (AAI) was constituted in 1995. It provides security to Indian Airports. AAI under the ministry of Civil Aviation is responsible for creating, upgrading, maintaining and managing civil aviation infrastructure in India.

Communication

Communication is a process that involves exchange of information, thoughts and ideas. Technology does wonders in communication fields. Communication is categorized in to personal and mass communications.

Personal Communication

The exchange of information between the individuals is called personal communication. It includes post and telegraph services, telephone, mobile phone, short message services, fax, internet, e-mail etc. Personal Communication system enables the user to establish direct contact.

The Indian postal network is the largest in the world with 1,55,000 post offices. Of these more than 1,39,000 post offices are located in rural areas. The postal service was opened to the public in the country in 1837. The first Indian postal stamp was issued in 1852 in Karachi. Collecting and delivering mail is the primary function of the department of posts. It introduced the Quick Mail Service in 1975 and today it covers the entire country. Them Quick Mail Service functions on the basis of the system of PIN (Postal Index Number) code which was introduced in 1972. The premium products include the Money order, e-money order, Speed Post, Express Parcel Post, Business Post, Media Post, Satellite Post, Retail Post, Greeting Post, Data Post, Speed Net and Speed Passport Services.

In 2007, the Government ofIndia merged the Air India andIndian Airlines under NationalAviation Corporation of IndiaLimited (NACIL). In whichNACIL (A) provides international services,NACIL (I) provides domestic services andservices to neighboring countries in southeast Asia and middle East.

Cards and envelopes are considered first class mail and are airlifted between stations covering both land and air. The second class mail includes book packets, registered newspapers and periodicals. They are carried by surface mail, covering land and water transport. To facilitate quick delivery of mails in large towns and cities, six mail channels have been introduced recently. They are called Rajdhani

Channel, Metro Channel, Green Channel, Business Channel, Bulk Mail Channel and Periodical Channel.

India has one of the largest telecommunication networks in Asia. Apart from the urban areas more than two-thirds of the villages in India have already been covered with Subscriber Trunk Dialing (STD) telephone facility, while International communication can be made through ISD (International Subscriber Dialing). There is an uniform rate of STD facilities all over India. Telephone is a form of oral communication. It is considered very essential for the growth of commerce. It is the most preferred form as it provides instant communication. Mobile phone, fax and internet are the other personal communication used in the country.

Mass Communication Systems

Mass Communication enables millions of people to get the information at the same time. It is a great way to provide education as well as entertainment. It helps in creating awareness among the people regard in national policies and programmes. The Mass Communication Systems can provide the information to people in two methods. They are Print Media and Electronic Media.

Electronic Media: Radio broadcasting in India was started in 1923 by the Radio club of Bombay. Since then it gained immense popularity and changed the social and cultural life of people. It was named as All India Radio (AIR) in 1936 and again it was renamed as Akashwani in 1957. It broadcasts a variety of programs related to information, education and entertainment. Special news bulletins are also broadcasted on special occasions like session of parliament and state legislatures.

Television broadcasting has emerged as the most effective audio-visual medium for disseminating information and educating the masses. Television network in India is known as Doordarshan (DD) which started Common National Program (CNP) services and it is extended to the backward and remote rural areas.

Internet (contraction of interconnected network) is the global system of interconnected computer networks that use the Internet protocol suite to link devices worldwide. **Social media** are interactive computer-mediated technologies that facilitate the creation and sharing of information, ideas, career interests and other forms of expression via virtual communities and networks. With over 460 million internet users, India is the second largest online market, ranked only behind China. By 2021, there will be about 635.8 million internet users in India. Despite the large base of internet users in India, only 26 percent of the Indian population accessed the internet in 2015. This is a significant increase in comparison to the previous years, considering the internet penetration rate in India stood at about 10 percent in 2011. Furthermore, men dominated internet usage in India with 71 percent to women's 29 percent.

Print Media: Newspapers are the most common but powerful means of communication come under print media. India has many newspapers which carry information on local, national and international events to the people.

Satellite Communication

The use of Satellite in getting a continuous and synoptic view of larger area has made this communication system very vital for the country. Satellite images are used for weather forecasting, monitoring of natural calamities, surveillance of border areas etc. The communication through satellites emerged as a new era in communication in our country after the establishment of Indian Space Research Organization (ISRO) in 1969.

Satellite system in India can be grouped into two-the Indian National Satellite System (INSAT) and the Indian Remote Sensing Satellite System (IRS).The INSAT, established in 1983, is a multipurpose system for telecommunication, meteorological observation and for various other programs. The INSAT series are used for relaying signals to television, telephone, radio, mobile phone. It is also useful in weather detection, internet and military applications.

The INSAT series, GSAT series, KALPANA-1, HAMSAT, EDUSAT are the major communication satellite used for communication purpose. GSAT–7A is the recent launch (December 19, 2018) for communication programs. INSAT-1B launched on 30th August 1983 is the first communication satellite in INSAT series.

Trade

Trade is an important phenomenon that decides the economic growth of a country. Trade is an act (or) process of buying, selling or exchanging of goods and services. The primitive method of trade was known as the Barter system where goods were exchanged for goods. Later on, money was introduced as a medium of exchange in buying and selling of goods. The difference in value between the imports and exports is called balance of trade. The situation in which the value of exports exceeds the value of imports is termed as favourable balance of trade and the reverse position is termed as unfavourable balance of trade.

Types of Trade

Trade in general, is of two types. They are Internal and International. The trade carried on within the domestic territory of a country is termed as Internal trade. It is also called as Domestic trade or Local trade. Land transport (roadways and railways) plays a major role in this trade. Local currency is used in internal trade. It helps to promote a balanced regional growth in the country i.e, tea from Assam, coffee from Karnataka, Rubber and spices from Kerala, minerals from Jharkhand etc., are supplied to different parts of our country.

Trade carried on between two or more countries is called International trade. It is also called as external trade or foreign trade. Export and Import are two components of International trade. Export means goods and services sold for foreign currency. Import means goods and services bought from overseas producers. Waterways and Airways play a vital role in this type of trade. Foreign currency is involved in international trade. The trade between any two countries is called Bilateral trade. The trade between more than two countries is called Mutilateral Trade.

Exports

The major exports of India are tea, marine products, ores and minerals, leather products, gems and jewels, sports goods, chemicals and related products, plastics and rubber articles, articles of stones, plaster, cement, asbestos, mica, glass ware, paper and related products, base metals, optical, medical and surgical instruments, electronic items, machinery, office equipment's, textiles and allied products.

Imports

The major imports are petroleum products, pearls, precious stones and semi-precious stones, gold and telecom instruments.

India's Trade Performance

The volume of India's foreign trade has increased many fold since independence. During 2008 -2009, the volume of trade was 840755 crores and it rose to 1039797 crores in 2016-2017. The import during 2008-2009 was 1374436 crores and was with a deficit of 40679 crores. The import during 2016–2017 rose to 1396352 crores and was with the deficit of 356555 crores. It reveals that not only the balance of trade is unfavourable but also the increase in the level of deficit.

12th

Unit – 5 - Cultural and Political Geography

Introduction

Geoinformatics is the integration of remote sensing, Global Navigation Satellite System and Geographic Information System dealing with spatial information. The advent of remote sensing, Global Navigation Satellite System and Geographic Information System has made significant changes in surveying and map making. A basic understanding of these components is crucial for carrying out various types of surveys, navigation, hydrology, disaster management, etc.

Remote sensing

Remote sensing is an integrated discipline encompassing some branches of arts, science and technology of collecting information about the terrestrial objects using camera and sensor system. The field of Remote Sensing and GIS has become exciting with rapidly expanding opportunities. Geoinformatics has three major components namely remote sensing, GIS and GNSS.

Elements of Remote Sensing

1. Energy Source

The primary requirement for remote sensing is to have an energy service, which provides electromagnetic energy to the target of interest. The sun being a major source of energy, radiation and illumination having a sharp power allows capturing reflected light with conventional cameras and films.

2. Radiation and the Atmosphere

The energy is required to illuminate the target. This energy is in the form of Electromagnetic radiation. Electromagnetic radiation is a dynamic form of energy that propagates as wave motion at a velocity in space.

3. Interaction with the target

The interaction of Electromagnetic radiation with the target is important to remote sensing for two main reasons. First, information carried Electromagnetic radiation reflected by the earth's surface is modified while traversing through the atmosphere. Second, the interaction of Electromagnetic radiation with the atmosphere can be used to obtain useful information about the atmosphere itself. The total energy is subjected to modification by the several physical process, scattering, absorption and refraction. Scattering is the re-direction of Electromagnetic radiation by particles suspended in the atmosphere or by large molecules of atmospheric gases. The amount of scattering depends upon the size of the particles

and their abundance. The wave length of radiation, depth of the atmosphere through which the energy is travelling. Absorption is the process by which the gas molecules present in the atmosphere strongly absorb the Electromagnetic radiation through the atmosphere in certain spectral bands.

4. Recording of energy by the sensor

After the energy has been scattered by or emitted from the target, we require a sensor (remote not in contact with the target) to collect and record the electromagnetic radiation. A sensor is highly sensitive to all the wave lengths yielding spatially detailed data on absolute brightness. On the basis of the source of electromagnetic energy, the sensor can be classified into two ways. They are active sensor or passive sensor. Active sensor generates and uses its own energy to illuminate the target and records the reflected energy. It operates in the microwave regions of the electromagnetic spectrum. Their wave lengths are longer than 1 mm.

5. Transmission, Reception and Processing

The energy recorded by the sensor has to be transmitted in electronic form, to a receiving and processing station where the data processed into an image. The Image processing methods may be grouped into three functional categories such as Image Restoration, Image Enhancement and Information Extraction.

Image Restoration: Restoration processes are designed to recognize and compensate for errors, noise and geometric distortion introduced into the data during the scanning transmission and recording processes. The objective is to make the image resemble the original scene. Image restoration is relatively simple because the pixels from each band are processed separately.

Image Enhancement: Enhancement is the modification of an image, to alter its impact on viewer. General enhancement distorts the original digital values; therefore enhancement is not done until the restoration processes are completed.

Information extraction: Image restoration and enhancement process utilize computers to provide corrected and improved images for study by human interpreters. The computer makes no decision in these procedures. The human operator must instruct the computer and must evaluate the significance of the extracted information.

6. Interpretation and Analysis

Image interpretation is defined as the act of examining images to identify objects and judge their significance. An interpreter studies remotely sensed data and attempts through logical process to detect, identify, measure and evaluate the significance of environment and cultural object pattern and spatial relationship.

The quality of an image is based on the inherent characteristics of the objects. Further it depends on the following aspects.

- Sensor characteristics
- Season of the year, time of the day when the photo is taken
- Atmospheric effects
- Resolution of the image on scale.
- Image motion etc.

Image interpretation is essential for the efficient and effective use of the data. The elements of image interpretation such as image tone, shape, size, pattern, image texture, shadow and association are helpful to identify the exact target and to analyze.

Classification of remote sensing

On the basis of the sources of electromagnetic energy, the remote sensing can be classified as passive and active remote sensing. In a simple way, we can understand that the passive remote sensing is similar to taking a picture with an ordinary camera where as active remote sensing is analogous to taking picture with camera having built-in flash.

On the basis of the energy source, the active remote sensing generates and uses its own energy to illuminate the target and records the reflected energy whereas the passive remote sensing depend on solar radiation to illuminate the target. On the basis of region of spectrum in which they operate, the active remote sensing operates in the microwave region of the electromagnetic spectrum whereas the passive remote sensing operates in the visible and infrared region of the electromagnetic spectrum. The wave lengths of the active remote sensing are longer than 1 mm whereas the passive remote sensing, the wave length range from 0.4 to 1.0 mm.

Some examples of active sensors are fluorosensor and Synthetic Aperture Radar (SAR). Passive sensors record radiation reflected from the earth's surface. The source of this radiation must come from outside the sensor; in most cases, this is solar energy. Because of this energy requirement, passive solar sensors can only capture data during daylight hours. Active sensors are different from passive sensors. Unlike passive sensors, active sensors require the energy source to come from within the sensor. A laser-beam remote sensing system is an active sensor that sends out a beam of light with a known wavelength and frequency. This beam of light hits the earth and is reflected back to the sensor, which records the time it took for the beam of light to return.

Remote sensing platform

The platform is a stage to mount the camera or sensor to acquire the information about a target under investigation. Based on the altitude above the earth surface, the platform can be classified as Ground borne platform, Air borne platform and Space borne platform.

Ground borne platform

Ground based platforms are used to record detailed information about the surface which is compared with information collected from aircraft or satellite sensors. They are close to the ground. These sensors may be placed on a ladder, scaffolding tall-building, crane etc.

A wide variety of ground based platforms are used in remote sensing. Some of the more common ones are hand held devices, tripods, towers and cranes. Instruments that are ground-based are often used to measure the quantity and quality of light coming from the sun or for close range characterization of objects Permanent ground platforms are typically used for monitoring atmospheric phenomenon although they are also used for long-term monitoring of terrestrial features.

Air borne platform

Aircrafts are generally used to acquire aerial photographs for photo interpretation and photogrammetric purposes. They are classified into two types. They are

- Low altitude aerial remote sensing
- High altitude aerial remote sensing

Balloon

Balloons are used for remote sensing observation (aerial photography) and nature conservation studies. The first aerial images were acquired with a camera carried aloft by a balloon in 1859. Balloon floats at a constant height of about 30 km.

Drone

Drone is a miniature remotely piloted aircraft. It is designed to fulfill requirements for a low cost platform, with long endurance, moderate payload capacity and capability to operate without a runway or small runway. Drone includes equipment of photography, infrared detection, radar observation and TV surveillance. It uses satellite communication link. An onboard computer controls the payload and stores data from different sensors and instruments. The unique advantage is that it could be accurately located above the area for which data was required and capable to provide both night and day data.

Aircraft

The first known aerial photograph was taken in 1858 by French photographer and balloonist, Gaspar Felix Tournachon, known as "Nadar". In 1855 Special aircraft with cameras and sensors on vibration less platforms are traditionally used to acquire aerial photographs and images of land surface features. While low altitude

aerial photography results in large scale images providing detailed information on the terrain, the high altitude smaller scale images offer advantage to cover a larger study area with low spatial resolution.

Space borne platform

The satellites are normally used for the space borne remote sensing. The satellite moves in their orbit. The closed path of a satellite around the earth is called its orbit. These platforms are freely moving in their orbit around the earth and the entire earth or any part of the earth can be covered at specified intervals. The coverage mainly depends on the orbit of the satellite. It is through these space borne platforms, we get the enormous amount of remote sensing data. In space borne remote sensing, sensors are mounted on-board a spacecraft (space shuttle or satellite) orbiting the earth. Space borne remote sensing provides the following advantages:

1. Large area coverage.
2. Frequent and repetitive coverage of an area of interest.
3. Quantitative measurement of ground features using radio metrically calibrated sensors.
4. Semi-automated computerised processing and analysis.
5. Relatively lower cost per unit area of coverage.

Types of satellite orbits

Satellite orbits are designed according to the capacity and objective of the sensors they carry. Depending on their altitude, orientation and rotation relative to the earth satellites can be categorized as

1. Geostationary satellite
2. Polar Orbiting and Sun-Synchronous satellite
3. Spy satellite

Geostationary Satellites

Geostationary Satellite is an equatorial west to east satellite orbiting the earth at an altitude of 35000 km, the altitude at which it makes on revolution in 24 hours. These platforms are covering the same place and give continuous near hemispheric coverage over the same area day and night. These satellites are put in equatorial plane orbiting from west to east. Its coverage is limited to 70°N to 70°S latitudes and one satellite can view one-third globe. These are mainly used for communication and meteorological applications viz. GOES, METEOSAT, INTELSAT, and INSAT satellites. On June 19, 1981 India launched its first geostationary satellite called APPLE. It was an experimental communication satellite launched by the Indian Space Research Organisation (ISRO) with a C-band transponder.

The Ariane Passenger Payload Experiment (APPLE) was ISRO's first indigenous, experimental communication satellite.

India is the only one countrywhich has reached to the marsin its first attempt.

Sun-synchronous satellites

As the satellite orbits the Earth from pole to pole, its east-west position would not change if the Earth did not rotate. However, as seen from the Earth, it seems that the satellite is shifting westward because the Earth is rotating (from west to east) beneath it.
This apparent movement allows the satellite swath to cover a new area with each pass. All the remote sensing resource satellites may be grouped in this category. Few of these satellites are LANDSAT series, SPOT series, IRS series, NOAA SEASAT, TIROS, HCMM, SKYLAB, and SPACE SHUTTLE etc.

Spy satellites

Spy satellites are robotic observational platforms that orbit the Earth in order to image its surface and to record radio signals for military and political purposes. They transmit their data to Earth, where it is interpreted by specialists in centralised, secretive facilities such as the U.S. National Photographic Interpretation Centre in Washington, D.C. Spy satellites have been essential not only to military operations and the formation of national policy but to the verification of arms control treaties such as SALT I, SALT II, etc.

The four basic types of spy satellite are: (1) photo reconnaissance systems that take pictures in visible and infrared light, (2) infrared telescopes designed to detect missile launches, (3) radars that image sea or land even through cloud cover and in darkness, and (4) signals intelligence (SIGINT) satellites (also termed "ferrets"), which are optimised either for characterising ground-based radar systems or for eavesdropping on communications. Sometimes photo reconnaissance and SIGINT functions are combined in single, massive platforms such as the U.S. Keyhole-series satellites.

Although a number of nations have launched spy satellites, the U.S. and the Soviet Union are responsible for by far the greatest number. The Russian Federation, which inherited most of the Soviet Union's space system after 1991, has been unable to afford the cost of adequately updating its spy satellite network. In contrast, the U.S. has continued to deploy ever-more-sophisticated systems in a steady stream. Thus, the majority of spy satellites in orbit today, including all the most capable units, are U.S.-owned. Early U.S. Spy Satellites: Corona, MIDAS, SAMOS.

The Gaofen 4 is the world'smost powerful GEO spysatellite (launched in 2015)which can provide instantcoverage of earthquake ortyphoon hit areas to support humanitarianrelief. It will also allow China to monitorstrategic foreign sites such as WMD facilitiesand naval bases inside its observation box.

Applications of remote sensing

1. **Agriculture**

The satellites have ability to image individual fields, regions and countries on a frequent revisit cycle. Customers can receive field-based information including crop identification, crop area determination and crop condition monitoring (health and viability). Satellite data are employed in precision agriculture to manage and monitor farming practices at different levels.

2. **Forest Management**

The forest - fire, sudden deforestation, encroachment of forest- land are recent challenges to the ecologist. It can be easily identified and curbed with the help of remote sensing satellite pictures.

3. **Geology**

Various fields Remote sensing techniques used in geology are

- Lithological mapping
- Structural mapping
- Geomorphological mapping
- Mineral exploration
- Hydrocarbon exploration
- Sedimentation mapping and monitoring
- Geo-hazard mapping

India once again broke a global spacerecord by launching the world's lightestsatellite weighing a mere 64 grams, calledKalamsat. It was designed and developednot by professional space scientists andengineers, but by 18-year-old Tamil Nadustudent RifathSharook and his team. Thetiny satellite, named after Abdul Kalam,was flown by a NASA sounding rocket on22 June, 2017 and Kalamsat was the onlyIndian payload in the mission. Missiondirector SrimathyKesan that the totalflight time of the rocket was 240 minutes.The satellite, assembled at her T.Nagarresidence in Chennai. The satellite wasseparated from the rocket after spending125 minutes in the space's micro-gravityenvironment. Sharook's project, the firstto be manufactured via 3D printing, gotselected through a competition, 'Cubesin Space', sponsored jointly by NASA and'I Doodle Learning'. The project aims totake the performance of new technology tospace.

4. **Oceanography**

Satellite remote sensing plays an important role in coastal zone management. There it allows us to locate and regularly monitor various aspects such as bathymetry (the measurement of the depth of water in water bodies), chlorophyll content, suspended sediment concentration, etc.

5. **Cartography**

Remote sensing aids in extensive surveys that are made from high altitudes to show the urban development, rural development, mountain areas, desserts, etc. which help the cartographers. High-resolution satellite cameras located at altitudes of several hundred kilometers can record details as small as a few meters on the surface of the Earth.

6. **Meteorology**

The radar system is basically used to collect the weather data. It collects meteorological data from unmanned land/ ocean based Data collection platforms and serves as a communication satellite for rapid exchange of meteorological data among centres and for rapid dissemination of weather forecasts warnings etc, to user agencies.

7. **Topography**

Topography specifically involves the recording of relief or terrain, the three-dimensional quality of the surface, and the identification of specific landforms. Topographic maps usually portray both natural and manmade features. They show and name works of nature including mountains, valleys, plains, lakes, rivers, and vegetation. They also identify the principal works of man, such as roads, boundaries, transmission lines, and major buildings.

8. **Urban Planning**

These information systems also offer interpretation of physical (spatial) data with other socio-economic data, and thereby providing an important linkage in the total planning process and making it more effective and meaningful. Digitization of planning base maps has facilitated updating of base maps wherever changes have taken place in terms of land development etc. Superimposition of any two digital maps which are on two different scales is feasible.

Geographic Information System (GIS)

The Geographic information systems have emerged in the past two decades as an essential tool for urban and resource planning and management. It includes the functions of data entry, data display, data management, information retrieval and analysis. While GIS deals with entire geography of the earth including land, ocean and atmosphere, the art, science and technology dealing with the acquisition, storage, processing, production, presentation and dissemination of the earth's information is called the Geoinformatics. It is the popular means of studies in recent decades which cater the real and useful information to the field of Geography,

Environmental Studies, Town planning, rural development studies, and Defense and Agricultural promotion.

Generation of the computers

1940 – 1956: First Generation – Vacuum Tubes
1956 – 1963: Second Generation – Transistors
1964 – 1971: Third Generation – Integrated Circuits
1972 – 2010: Fourth Generation – Microprocessors
2010 – Fifth Generation – Artificial Intelligence

Components of GIS

The components of GIS can be broadly classified into five types. They are mentioned below.

a. Hardware

Hardware is Computer on which GIS software runs. Nowadays there are a different ranges of computer, it might be Desktop or server based. ArcGIS Server is server based computer where GIS software runs on network computer or cloud based. For computer to perform well all hardware components must have high capacity. Some of the hardware components are: Motherboard, Hard driver, processor, graphics card, printer and so on. These all component function together to run GIS software smoothly.

b. Software

Next component is GIS software which provides tools to run and edit spatial information. It helps to query, edit, run and display GIS data. It uses RDBMS (Relational Database Management System) to store the data. Few GIS software list: ArcGis, ArcView 3.2, QGIS, SAGA GIS. Software Components: GIS Tools, RDBMS, Query Tools, GUI and Layout.

c. Data

Geographic data and related tabular data can be collected in-house compiled to custom specifications and requirements (or) purchased from a commercial data provider.
A GIS can integrate spatial data with other existing data resources often stored in a corporate data base management System. The data can be broadly classified as

a. Attribute data
b. Spatial data
c. Remote sensing data
d. Global data base.

You will learn in detail about each of the above classification of data in higher studies.

d. People

The GIS technology is used by a huge number of industrialists and agencies to help plan, design, engineer, build and maintain information infrastructures that affects our everyday lives.

e. Methods or Procedures

Methods here refer to well-defined, consistent procedures that are required to produce accurate, reproducible result. A neatly conceived implementation plan and business rules are the models and operating practices are unique to each organization. There is need to properly integrate the sophisticated tool through bringing out well-defined procedures in well documented form into the entire business strategy and operation to make the technology effective. Meta data i.e., (data about the data) is the key for documenting these processes.

Functions of GIS

The functions of GIS describe the steps that have to be taken to implement a GIS. These steps have to be followed in order to obtain a systematic and efficient system. The steps involved are data capture, data storage (GIS Data Models), manipulation and analysis.

Data Capture

The input of data into a GIS can be achieved through many different methods of gathering. For example, aerial photography, scanning, digitizing, GNSS is just a few of the ways a GIS user could obtain data. Digitization: A conversion process which converts paper maps into numerical digits that can be stored in the computer. Digitizing simplifies map data into sets of points, lines or cells that can be stored in the GIS computer. In this stage, digitization is carried out. There are two basic methods of digitization: Manual digitizing & scanning.

Data Storage

Some data is stored such as a map in a drawer, while others, such as digital data, can be as a hardcopy, stored on CD or on your hard drive. Once the data have been digitally compiled, digital map files in the GIS are stored on magnetic or other digital media. Data storage is based on a Generic Data Model that is used to convert map data into a digital form. The two most common types of data models are Raster and Vector. Both types are used to simplify the data shown on a map into a more basic form that can be easily and efficiently stored in the computer.

Data Manipulation

The digital geographical data can be edited, this allows for many attribute to be added, edited, or deleted to the specification of the project. Once data are stored in a GIS, many manipulation options are available to users. These functions are often available in the form of "Toolkits." A toolkit is a set of generic functions that a GIS user can employ to manipulate and analyse geographical data. Toolkits provide processing functions such as data retrieval measuring area and perimeter, overlaying maps, performing map algebra, and reclassifying map data. Data manipulation tools include coordinate change, projections, and edge matching, which allow a GIS to reconcile irregularities between map layers or adjacent map sheets called Tiles.

Query and Analysis

GIS was used widely in decision making process for the new commission districts. We use population data to help establish an equal representation of population to area for each district. The heart of GIS is the analytical capabilities of the system.

Global Navigation Satellite System (GNSS)

GNSS refers to the collection of the world's global satellite based positioning systems. It includes GPS (United States) GLONASS (Russia) GALILEO (European Union) BEODOU (China) IRNSS (India) QZSS (Japan). GNSS can provide centimeter level accuracy with a low-cost receiver, if an error correction technique is used. GNSS are recognized to be the systems of choice in outdoor environments and, to a great extent, one of the most accurate source of position (and precise timing) information when it is available.

The first satellite navigation system was Transit, a system deployed by the US military in 1960's. Transit's operations were based on the Doppler Effect: the satellites travelled on well-known paths and broadcast their signals on well-known radio frequency. The received frequency will differ slightly from the broadcast frequency because of the movement of the satellite with respect to the receiver. The satellite broad cast signals that contains orbital data (from which the position of the satellite can be calculated) and the precise time, the signals is transmitted. There are multiple constellations of GNSS satellites orbiting the earth. GNSS satellites' orbit situated about 20,000 km above the earth's surface. They are moving very fast, several kilometers per second. The latest generation of GNSS satellites (Block IIF) weight over 1,400 kg.

GNSS system operated in different countries

The following are the Global Navigation satellite Systems:

GPS (United States)

GPS was the first GNSS system. GPS was launched in the late 1970s by the United States Department of Defence. It uses a constellation of 24 satellites, and provides global coverage.

GLONASS (Russia)

The premier Soviet military navigation network was to be comprised of Uragan satellites. At the end of the Cold War, the constellation was unclassified under the name GLONASS -- a Russian abbreviation of Global Navigation Satellite System. Global Navigation Satellite System by Russian Aerospace Defense Forces is a space-based satellite navigation system.

The life style of GNSS satellites 5-7 years and new satellites are to be launched after a specific time interval in order to fill the gap due to ageing satellites. GLONASS proves very beneficial for Russian territory by 2010. In 2011, restoration of system is improved to enable full global coverage.

GALILEO (European Union)

Galileo is Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. Currently providing Initial Services, Galileo is interoperable with GPS and Glonass, the US and Russian global satellite navigation systems. By offering dual frequency as standard, Galileo is set to deliver real-time positioning accuracy down to the meter range. The Galileo constellation in space will comprise 30 satellites in total. There will be 24 operational satellites, plus 6 spare satellites, circulating in medium Earth orbit on three orbital planes.

BEIDOU (China)

BeiDou Navigation Satellite System (BDS) is a Chinese satellite Navigation system. It consists of two separate satellite constellations. The first BeiDou system is officially called the BeiDou Satellite Navigation Experimental System and also known as BeiDou-1.
On December 27, 2018, Beidou-3 officially began to provide global services. The Beidou-3M/G/I satellites represent the orbital segment of the third phase of the Chinese Beidou navigation system which uses satellites in Medium Earth Orbit and Geosynchronous Orbit and is also known as the Compass Navigation Satellite System.

Japan Aerospace Exploration Agency (QZSS Japan)

QZSS is a regional navigation satellite system that provides service to Japan and the Asia-Oceania region. QZSS (nickname of Michibiki - meaning to 'guide' or 'show the way') QZSS is a Japanese satellite positioning system composed mainly of

satellites in quasi-zenith orbits (QZO). However, the term "Quasi-Zenith Satellite (QZS)" can refer to both satellites in QZO and geostationary orbits (GEO). For that reason, the name "QZO satellite" is used when it is necessary to specifically refer to satellites in QZO. Satellite positioning systems use satellite signals to calculate position information. The QZSS is sometimes called the "Japanese GPS."

IRNSS (Indian Regional Navigational Satellite System)

IRNSS is an autonomous regional satellite navigation system being developed by ISRO (Indian Space Research Organization). It is designed to provide geospatial positioning information within the Indian sub-continent. It enables users to map out their location (altitude, longitude and latitude). The objective of developing IRNSS was to cut down India's dependency on foreign navigation satellite systems.

It provides location information service to users in India and the region extending for up to 1,500 km from the Indian boundary. This is the primary service area of IRNSS information service to users in India and the region extending up to 1500 km from Indian boundary.

IRNSS aims to provide the following services:

1. Standard Positioning Service (SPS) for civilian, research & commercial use,
2. Restricted Service (RS) for authorized users. For example in defense, IRNSS is used for ground, aerial and marine navigation, disaster management, mobile phone integration, mapping and visual & voice navigation for drivers, among others.

The battle for the world's fastest supercomputer has a new victor: Summit
According to IBM, Summit is able to achieve 200 peta flops of performance, or 200 quadrillion calculations per second. This power marks a significant gain on Sunway TaihuLight, which performs a still-staggering 87 petaflops. Summit holds more than 10 peta bytes of RAM, and its funding came as part of a $325 million program funded by the United States Department of Energy. Each of Summit's 4,608 nodes holds two IBM Power9 chips that run at 3.1 GHz.

Applications of GNSS

GNSS applications are widely used to get the quick information about a particular field. Some of the commercial applications are Consumers, Transportation, GIS, Machine Control Port Automation, Precision Agriculture, Construction, Marine Mining, Unmanned Vehicles Surveying, Defence, and Aerial Photogrammetry, etc.

Consumer

GNSS technology has been adopted by the consumer market, in an ever-increasing range of products. GNSS receivers are now routinely integrated into smart phones, to support applications that display maps showing the location of and best route to stores and restaurants.

Transportation

In rail transportation, GNSS is used to track the location of locomotives and rail cars, maintenance vehicles and wayside equipment, for display at central monitoring consoles. Knowing the precise location of rail equipment reduces accidents, delays, and operating costs, enhancing safety, track capacity, and customer service. In aviation, GNSS is being used for aircraft navigation from departure, en route, to landing.

Port Automation

Using GNSS, shipping hubs can improve their operating efficiency by tracking the movement and placement of containers about their yards. Many cranes are equipped with GNSS based steering devices that determine the crane's position and keep it travelling in the desired path, improving accuracy and productivity as well as the safety of operators and workers on the ground.

Machine Control

GNSS technology is being integrated into equipment such as bulldozers, excavators, graders, pavers and farm machinery to enhance productivity in the real-time operation of this equipment, and to provide situational awareness information to the equipment operator.

Precision Agriculture

In precision agriculture, GNSS-based applications are used to support farm planning, field mapping, soil sampling, tractor guidance, and crop assessment. More precise application of fertilizers, pesticides and herbicides reduces cost and environmental impact.

Surface Mining

GNSS information is being used to efficiently manage the mining of an ore body and the movement of waste material. GNSS equipment installed on shovels and haul trucks provides position information to a computer-controlled dispatch system to optimally route haul trucks to and from each shovel.

Survey

Using GNSS, it is possible for a single surveyor to accomplish in one day what might have taken a survey crew of three people a week to complete. Determining a

new survey position once required measuring distances and bearings from an existing (known) survey point to the new point.

Social Geography (population Density & Distribution, Racial, Linguistic Groups & Major Tribes)	**7 th term 1**	**Unit 3. Population and Settlement**
	8 th term 2	**Unit 1 Migration and Urbanisation**
	9 th book	**Unit 6 – Man & Environment**
	12th geography	**Unit 1 – population Geography**
		Unit 5 Culture and Political Geography

7th term 1
3. Population and Settlement

Introduction

Population Geography is a study of demographic phenomena which includes natality, morality, growth rates etc., through both space and time. Increase (or) decrease in population indicates population distribution and growth. The study of movements and mobility of population is called migration. Among the human people from place to place the ancient origin is grouped under major races such us language and religion.

The Races

Race has been defined as a biological grouping within the human species. The race is a group of people with more (or) less permanent distinguishing characteristics that are inherited. The most widely found human racial types are based on visual traits such as head shape, facial features nose shape, eye shape and colour, skin colour, stature, blood groups etc.,The major world Human races are

- ✓ Caucasoid (European)
- ✓ Negroid (African)
- ✓ Mongoloid (Asiatic)
- ✓ Australoid (Australian)

1. **Causasoid:** The Caucasoid is known as European race. This group is the one with fair skin and dark brown eyes, wavy hair and narrow nose. The Caucasoid are also found in Eurasia.
2. **Negroid**: Negroid have the dark eyes, Black skin, black wooly hair, wide nose, long head, and thick lips. They are living in different parts of Africa.

3. **Mongoloids:** The mongoloid race is commonly known as the Asian-American race. The mongoloid have the light yellow to brown skin, straight hair, flat face, broad head and medium nose. Such people are found in Asia and Arctic region
4. **Australoids:** Australoids have wide nose, curly hair dark skin, and short in height. They are living in Australia and Asia.

Races of India

India is said to be one of the cradle lands of human civilization. The ancient Indus valley civilization in India was believed to have been of Dravidian origin in northern India. The Dravidian people were pushed south when the Indo-Aryan came in later. South India was dominated by the three Dravidian kingdoms of the chera, the cholas, and the pandyas. The Dravidian languages are Tamil, Telugu, kannada, Malayalam and Tulu almost all the Dravidians live in the southern part of India.

Religion: Religion means a particular system of faith and worship, which brings human being with human society. Religion, is a symbol of group identity and a cultural rallying point.

Classification of Religion

a. **Universalizing Religions:** Christianity, Islam and Buddhism.
b. **Ethnic Religions:** Judaism, Hiduism and Japanese Shintoism.
c. **Tribal or Traditional Religions:** Animism, Shamanism and Shaman.

Religion	Place of worship
Buddhism	Vihara
Christianity	Church
Hinduism	Temple
Islam	Mosque
Jainism	Basadi
Juadism	Synagogue
Zoroqstrianism	Agiyari

Language: Language is a great force of socialization. Language, either in the written or oral form, is the most common type of communication. Language promotes the transmission of ideas and the functioning of political, economic, social and religious systems.

Languages of India: India has many languages and culture. Each state has its own language though the national language is Hindi, 22 major language were spoken by about 97 percent population of the country. India follows,kashmiri Urdu Punjabi, Hindi Rajasthani, Gujarati, Bengali and Assamese etc., these language are followed in North India. The main language of the Dravidian family are Tamil,

Telugu, Kannada, Malayalam etc., These languages are mainly spoken in southern India.

Today usage of language has changed. It is often used as communicational skill. With the different means of communication and fast moving world advancement in technology helps in understanding of different languages very easily with easy access to electronic media along with its pronunciations. These technologies have really brought the world closer.

Date	Event
11th July	World population day
21st February	International mother language day
Third Sunday in January every year	World Religious day
21st May	The World cultural diversity day

Settlement

Settlement is a place where people live and interact through activities such as agriculture, trading and entertainment. A rural settlement is a community, involved predominantly in primary activities such as agriculture, lumbering, fishing and mining. An urban settlement engages in predominantly in secondary and tertiary activities, such as industries, trade and banking. There is often a correlation between the functions, size of population and population density.

A rural settlement tends to have a small population and low population density. Urban settlement often has a large population size and high population density. Site and situation refers to the location of the actual settlement. The initial choice of a site for a settlement depends on how it is useful for meeting our daily needs, like water supply, availability of farmland, building material and fuel etc.,

Old House Types

In the early periods of human settlement, houses were built using local materials. The form of the house was closely related to the environment. In the agricultural regions, houses were built with mud walls and the roof was made of stalks of paddy (or) other crops of grass (or) thatch. Local wood was used to provide frame for the roof. Such old houses had wide verandahs and an open air circulation. The size of the house depended on the economic status of its inhabitants.

Patterns of Settlements: Settlements also be classified into Compact settlements and Dispersed settlement

Compact settlements

Compact settlement is also known as nucleated settlement. In this type large a number of houses are built very close to each other such settlement develop along

the river valleys and fertile plains, In India compact settlements are found in the northern plains and the coastal plains of peninsular India.

Dispersed Settlements

Dispersed settlements are generally found in the areas of extreme climate, hilly tracts, thick forests, grasslands, areas of extensive cultivation. In these settlements, houses are spaced far apart and after interspersed with fields. In India this type of human settlement is found in the northern kosi tract, the Ganga delta ,theThar Desert of Rajasthan and the foot hills of Himalayas and the Niligris.

A hierarchy of settlements

Rural settlement: Rural settlements are predominantly located near water bodies such as rivers, lakes, and springs where water can be easily available. People choose to settle near fertile lands suitable for agriculture, along with the provision of other basic needs. Hence, they prefer to live near low lying river valleys and coastal plains suited for cultivation. The availability of building materials like wood, stone and clay near settlements is another advantage, for settlements to be built.

Factors Influencing Rural Settlement

- ✓ Nature of topography
- ✓ Local weather Condition
- ✓ Soil and water resources
- ✓ Social organisation
- ✓ Economic condition

Pattern of Rural Settlement

The pattern of settlement has been defined as the relationship between a house or building to another. A rural settlement pattern is a function of relief, climate, water supply and socio-economic factor. It is broadly classified under the following patterns, such as Linear, Rectangular, Circular, Star like pattern etc.,In a Linear settlement, houses are arranged along the either side of a road,railway line, river (or) canal,the edge of a valley,etc., e.g. the Himalayas the Alps, the Rockies.

Linear settlement: The rectangular settlements are almost straight, meeting each other at right angles. Such a settlement is found in plain areas (or) intermontane plain. E.g.,Sutlej. Houses built around a central area are known as Circular pattern of settlements. Such settlement develop around lakes and tanks. The Star like pattern of settlement develops on the sites and places where several roads converge and houses spread out along the sides of roads in all directions.e.g. The Indo – Ganga plains of Punjab and Haryana

Wet Point Settlement: A wet point is a site with reliable supply of water from wells, tank, river, spring (or) pond in an area.

Dry Point Settlement: A dry Point settlement is located in low-lying areas in the regions of excessive dampness. Dry point settlements are not affected by flooding, due to the landscape and the source of water. Such settlements are found in the coastal plains of Kerala and deltas along the east coast of India.

Urban Settlements: The settlements in which most of the people are engaged in secondary and tertiary activities are known as urban settlements. In other words, urban is related to cities and towns. The word urban is often used in terms of town, city, mega city, conurbation, megalopolis.

Classification of Urban Settlements: The definition of urban area varies from ourcountry to another. Some of the common bases of classification are

- ✓ Size of population
- ✓ Occupational structure
- ✓ Administration

- **Town:** Town is a general name for an urban place, usually a settlement meeting a prescribed minimum population threshold. Population more than 5000 people. Based on the function that cities perform they can be classified into the following types of towns, such as administrative, cantonment, academic etc.,

- **City:** The term City is generally applied to large urban places with no strict definitions to separate if from smaller town. City is a nucleated settlement which multifunctional in character, including an established central business district. In India an urban place with more than one lakh population is considered as a city (Population more than 1,00,000).

- **Mega city:** A mega city is a very large city typically with a population of more than 10 million people. A mega city can be a single metropolitan area. E.g. Canton, Tokyo, Delhi, Mumbai are some of the examples of megacities.
- **Megalopolis:** The word megalopolis is given for a large conurbation, when two or more large cities whose total population exceeds ten million. The region made up of cities between Boston and Washington D.C is a well-known megalopolis. In India, Kolkata is the largest urban area which is a megalopolis. Gandhinagar, Surat, Vadodara, Rajput in Gujarat are the important megalopolis cities in India.
- **Conurbation:** A Conurbation is a region comprising of a number of cities, large town, and other urban areas that through population growth and physical expansion have merged to form one continuous urban (or) industrially developed area. West Midland in England, the Ruhr in Germany, Randstad in the Netherlands are example of conurbations. Mumbai in Maharashtra, Gurgaon, Faridabad in Haryana, Noida in Uttar Pradesh are the conurbation cities of India.

- **Satellite Town:** A satellite town is a town designed to house the over population of a major city, but is located well beyond the limits of that city. Satellite towns are generally located outside the rural urban fringe. In India most satellite towns are purely residential in character. Satellite towns occasionally present a look of twin towns such as Dehri and Dalmianager in Rohtas district of Bihar. They may be connected with roads. For e.g. Patna, Barauni, Varanasi and Hajipur.

- **Smart City:** In an urban region, a city which is very much advanced in terms of infrastructure, real estate, communication and market availability is called a Smart City. The first ten smart cities of India are Bhubaneshwar, Pune, Jaipur, Surat, Ludhiana, Kochi, Ahmedabad, Solapur, New Delhi and Udaipur. Tamil Nadu has 12 major cities to be transformed as smart cities. They are Chennai, Madurai, Tirunelveli, Tiruchirappalli ,Thanjavur, Tiruppur, Salem, Vellore, Coimbatore, Thoothukudi, Dindugul and Erode.

Rural	Urban
Rural areas have predominantly primary activities (agriculture)	Urban areas have domination of secondary and tertiary activities (Industries)
Sparsely populated	Densely populated
Villages and hamlet	Cities and towns
Agriculture works	Non Agricultural works
Simple and relaxed life	Fast and complicated life

8th term 2

Unit 1 - Migration and Urbanisation

Introduction

Rajesh and Suresh were new students joined in a school. They were allotted to Section - 'A' in VIII standard. The class teacher and other students of the class welcomed them. Teacher said, "You are going to have two new friends today. So, you all introduce yourselves to others; say your name and place from where you are coming, okay". They started from the first bench. Rajesh and Suresh were sitting in the second bench. Rajesh had a turn to introduce himself. He said, "I am Rajesh, as my mother has been transferred to this school, we migrated from Chennai to Krishnagiri". Now Suresh had a turn to introduce himself. He said, "I am Suresh, coming from the Village called Pudupatti, it is five kilometres away from the school; Madam, Please tell me the meaning of 'migration the word used by Rajesh". The teacher said, "yes, from this lesson you are going to learn in detail about it".

Migration

Migration has been defined differently by different experts. In general, migration is defined as the permanent or semi permanent change of residence of an individual or group of people over a significant distance. So, the term migration refers to the movement of people from one place to another.

United Nations Organization Definition: Migration is a form of geographical mobility of population between a geographical unit to another, generally involving a permanent change of residence.

One of the most important aspects of social science is "Human Migration".It has maintained a close relation with mankind from its earliest stage. Migration is one of the most important dynamic human activities from the very beginning of human life. During the early days, people moved from one place to another in search of food. When most of the people ceased to live in forest and adopted civilized life, they developed relationship with domesticated animals and fertile land. As a result, mobility of mankind changed considerably. They almost left the nomadic life and started to live in permanent settlements. At this stage, people continued to move from one region to another in search of fertile land for cultivation. Afterwards, the nature of mobility frequently changed over a period of time.

Factors of Migration

There are a number of factors which are responsible for the migration of humanpopulation. These factors can be grouped under the heads of favourable and unfavourable factors. The favourable factors which attract people towards a location are called pull factors. The unfavourable factors which make the people to move out from a location are called push factors.
The various causes which are responsible for human migration is categorized under five groups as follows.

a) Ecological or Natural Causes of Migration

The causes operate under this category are natural ones. They include volcanic eruption, earthquake, flood, drought etc. These events force the people to leave their native places and settle in the new areas. The conditions like theavailability of water resources, areas free from hazards, pollution etc., attract the migrants.

b) Economic causes of Migration

Economy is one of the most important causes of human migration from one area to another. Various economic causes determine the level and direction of migration. The availability of fertile agricultural land, employment opportunities, development of technology etc., are some of the economic causes that attract the migration. The mass poverty and unemployment force the people to move outfrom

their native places to the places where the better employment opportunities are available.

Pull Factors	Push Factors
Natural Causes	
Least hazard prone zones	Hazard prone zones
Favourable climate	Climate change (including extreme weather events)
Abundance of natural resources and minerals (e.g.water,oil,uranium)	Crop failure and scarcity of food
Economic Cause	
Potential for employment	Unemployment
Socio-cultural Cause	
Unification	Family conflicts
Demographic Cause	
Under population	Over population
Political Causes	
Political security	War, civil, unrest
Independence and freedom	Safety and security concerns (ethnic, religious, racial or cultural persecution
Affordable and accessible urban services (including healthcare, education, utilities and transport)	Inadequate or limited urban services and infrastructure (including healthcare, education, utilities, transport and water)

Share of Regions in World Population and International Migrants by Origin – 2017

S.No	Name of the Region	Total Population	Percentage of Global Population	International Migrants by origin	Percentage of International Migrants
1	Africa	1,256,268	16.6	36,266	14.1
2	Asia	4,504,428	59.7	105,684	41.0
3	Europe	742,074	9.8	61,191	23.7
4	Latin America and the Caribbean	645,593	8.6	37,720	14.6
5	Northern America	361,208	4.8	4,413	1.7
6	Oceania	40,691	0.5	1,880	0.7
7	Unknown	n/a	n/a	10,560	4.1

8	**World**	**7,550,262**	**100.0**	**257,715**	**100.0**

c) Socio-cultural causes of Migration

Socio-cultural causes also play some roles in the process of migration. Migration of women after marriage and migration associated with pilgrimage are based on the socio-cultural customs

d) Demographic causes of Migration

In demographic sense, the population composition like age and sex, over population and under population are the major causes of migration. It is well known fact that adults are more migratory than any other age-groups.Women mostly migrate after their marriage. Generally over population is considered as a push factor and under population to be pull factor in the context of migration

Female migrants outnumber male migrants in Europe, Northern America, Oceania and Latin America and the Caribbean, while in Africa and Asia, particularly Western Asia, migrants are predominantly men. (International Migration Report, 2017).

e) Political causes of Migration

Various political causes like colonization, wars, government policies etc. have always been playing important role in human migration from time to time. Wars have been one of the significant causes of migration since ancient time.

Types of Migration

Migration can be classified in several ways.It is usually categorized as follows

In 2017, India was the largest country of origin of international migrants (17 million), followed by Mexico (13 million) (International Migration Report, 2017).

a) Based on the movement associated with administrative limits

(i) Internal migration: The movement of people within a country is known as internal migration. Further, the internal migration is classified into four categories on the basis of the place of origin and destination of migrants. Ruralto Urban Migration is the movement of population from rural areas to growing towns and cities mainly in search of employment,education and recreation facilities. Urban toUrban Migration is the migration between one urban centre to the other like in search of higher salaries. Rural to Rural Migration is driven by fertile land for cultivation and other sociological factors like Marriage etc. Urban toRural Migration is the movement from urban
centres to rural areas to get rid-off the urban problems and returning to native places after retirement from jobs. Rural to urban migration is the most common one.

(ii) International migration– Migration that occurs across the national boundaries are known as international migration.

b) Based on the willingness of the migrants for migration

(i) Voluntary migration: If the migration takes place on person's free will, initiative and desire to live in a better place and to improve their financial status, the migration is said to be voluntary.

(ii) Involuntary or forced migration: If the migration takes place against the will of migrants, the migration is termed as involuntary migration. The push factors like war may force the people to emigrate from a place is of this type.

c) Based on the duration of stay of migrants in the place of destination

(i) Short term migration: In this kind of migration, the migrants stay outside only for a short duration before returning to the place of origin. The duration may be from a few days to few months.

(**ii) Long term migration**: It is a kind of migration in which the migrants stay outside at least for a few years.

(iii) Seasonal migration: In this type of migration usually a group of people migrates from their native places during a particular season and returns after end of that season. People migrating to hill stations during summer and the migration of agricultural workers during sowing seasons belong to this category. Transhumance is an another example of seasonal migration.

The number of international migrants worldwide has continued to grow rapidly in recent years, reaching 258 million in 2017, up from 220 million in 2010 and 173 million in 2000 (International Migration Report, 2017).

Consequences of Migration

Migration affects both the areas of origin of migration and the areas of destination. The following are the major consequences of migration.

a) Demographic consequences: It changes age and sex composition of population. Migration of females after their marriage leads to decline in sex ratio in the source regions and increase the sex ratio in the regions of destinations. The migration of male workers in search of jobs decreases the independent population of the source regions which increases the dependency ratio.

b) Social consequences: The migration of people from different regions towards an urban area leads to the formation of plural society

It helps the people to come out of narrow mindedness and people become generous.

c) Economic consequences: The migration of more people from over populated to under populated regions results the imbalance of the resource-population ratio. In some cases, the regions of over and under population may become the regions of optimum population. Migration may influence the occupational structure of the population of an area. Through this it will certainly affect the economy of the regions also. **Brain drain** is a consequence of migration. Brain drain refers to the migration in which skilled people from economically backward countries move to developed countries in search of better opportunities. Eventually, this leads to backwardness in source regions. This is called as **"backwash effect".**

d) Environmental consequences: Large scale movement of people from rural to urban areas causes overcrowding in cities and puts heavy pressure on resources. It leads to rapid growth of cities. The over population in urban areas leads to the pollution of air, water and soil. Scarcity of drinking water, lack of space for housing, traffic congestions and poor drainage are the common environmental problems prevail in urban areas. The lack of space for housing and the rising of land cost lead to the formation of slums.

Urbanisation

Urbanisation refers to the process in which there is an increase in the proportion of population living in towns and cities.

Causes of Urbanisation

Urbanisation is driven by three factors: natural population growth, rural to urban migration and the reclassification of rural areas into urban areas. Present day urbanisation includes changes in demographics, land cover, economic processes and characteristics of geographic area.

In 2007, for the first time in history, the global urban population exceeded the global rural population and the world population has remained predominantly urban thereafter. (World Urbanisation Prospects, 2014 Revision, Highlights).

Origin and Growth of World Urbanisation

The process of urbanisation in the world has a long history.

Ancient Period: The urban centres started developing during the pre-historic period (before 10000 years). During this period primitive man started domestication of plants and animals. It was the period of development of permanent settlements. The river valley regions of the Egypt, Greece and India gave rise to agrarian communities which eventually formed the urban communities and urban centres. The excess production of food grains was the major reason for urbanisation. Ur and Babylon in

Mesopotamia, Thebes and Alexandria in Egypt, Athens in Greece, Harappa and Mohenjodaro in India were noted prehistoric cities of the world.

In ancient period the increase in the number and size of urban centres occurred during the two great colonizing periods of the Greeks and Romans. During the beginning of the 7th century itself many cities were found near the Aegean Sea. During the Greek colonizing period, the expansion of trade promoted the growth of towns and cities

India, China and Nigeria – together are expected to account for 35 % of the growth in the world's urban population between 2018 and 2050. India is projected to add 416 million urban dwellers, China 255 million and Nigeria 189 million(World Urbanisation Prospects, 2018, Key facts)

Medieval Period: It refers to the period after the 11th century. During this period, the European countries, increased their overseas trade which played an important role in the revival of European towns and cities after a period of low development. **At the end of the thirteenth century, Paris, London, Geneva, Milan and Venice were the important cities found in Europe.**

Modern Period: This period starts from 17th century. It marks the third phase of development in urbanisation. The industrial revolution in the19th century accelerated the growth of towns and cities. The Europeans with urban civilization gave birth to a large number of new towns in North America and Soviet Union. The modern means of transport and communication, the development of new trade routes during 19th century had strengthened the trade centres and urban areas. The latest development in urbanisation was noticed in the continent of Africa. Before 1930, Africa had towns only on its coasts but now it has 50 towns with population exceeding 1,00,000. Major cities in Africa are Cairo, Nairobi, Mombasa, Bulawayo, Duala, Abidian, Logos, Accra, Addis Abba, Leopoldville, Luanda, Cape Town, Natal, Pretoria etc. Thus, in modern age, the accelerating urbanisation is resulting in a redistribution of population throughout the world.

In 1950, 30% of the world's population was urban, and by 2050, 68 % of the world's population is projected to be urban (World Urbanisation Prospects, 2018, Key facts).

World Urbanisation

S.No	**Name of the Region**	**Urban Population in %**
1	North America	82
2	Latin America and Caribbean	81
3	Europe	74
4	Oceania	68
5	Oceania	50

6	Africa	43
World Average		55

World Top Five Cities

S.No	Name of the city	Population in Million
1	Tokyo (Japan)	37
2	Delhi (India)	29
3	Shanghai (China)	26
4	Mexico city (Mexico)	22
5	Sao Paulo (Brazil)	22

Consequences of Urbanisation

a) Housing and Slums: There is a lack of space for housing and a marked reduction in the quality of housing in the urban areas due to increase in population. This problem may increase in the years to come. Rapid rate of urbanisation results the development of slums.

b) Over Crowding: Over-crowding leads to unhealthy environment in the urban areas. It also the cause of many diseases and riots.

c) Water supply, Drainage and Sanitation: No city has round the clock water supply inthe world. Drainage situation is equally bad. The removal of garbage is a Himalayan task for urban local bodies.

d) Transportation and Traffic: Absence of planned and adequate arrangements for traffic and transport is another problem in urban centres. The increasing number of two wheelers and cars make the traffic problem worse. They cause air pollution as well.

e) Pollution: Towns and cities are the major polluters of environment. Several cities discharge their entire sewage and industrial effluents untreated into the nearby rivers. Industries in and around the urban centres pollute the atmosphere with smoke and toxic gases

9th book
6. Man and Environment

Early man depended entirely on nature for food, clothing and shelter. Man has enjoyed a dominant position over the other living organisms around him because of his erect posture, hands and intelligence. From the paleolithic period to the neolithic period, man has invented and developed the wheel, fire, tools and patterns of agriculture and housing to his comfort, which led him to improve the standard of living making himself technologically advanced. Thus, modern man modified the environment where he multiplied in numbers to increase population and has always extended his territories, leading to the exploitation of natural resources.

Classification of Environment: Environment is generally classified as

a. Natural environment
b. Human environment and
c. Man made environment

a. Natural environment: Earlier, we have learnt about the natural components of environment such as lithosphere, atmosphere, hydrosphere and biosphere. In this chapter, we will study about the human and man-made components in a detailed manner.

b. Human Environment: Human environment is defined as the interaction between man as an individual, with his family, occupation and society. It is also related to various cultural aspects such as education, religion, economics and politics.

c. Man-made environment: Man-made environment has been created by man himself for the purpose of fulfilling his needs and to make his life more convenient and easy. For example, building, transport, park, industrie, monument, etc. To bring an equilibrium between man and the environment, man has to study the distribution of population, availability of resources, development in technology, alternate means of fulfilling the increasing demand created by the growing population and other man-made features.

Population

Can you imagine a world without human beings? Humanbeings are important to develop the economy and society. The Latin word 'populus' means 'people'. Population is the total number of people living together in a particular place at the given point of time.

Population Growth

'It is easy to add but difficult to maintain'

Population is a dynamic phenomenon where the number, distribution and composition are constantly changing. Human population increases as babies are born and decreases as people die. For most of human history, births have only slightly exceeded deaths every year. As a result, human population grow slowly. About the time of Industrial Revolution, it began to increase rapidly.

Natural increaseof population is the difference between the birth rate and death rate. In fact population is always increasing but only in very rare cases it may decrease through natural or man-made disasters such as famine, landslides, earthquakes, tsunami, epidemics, extreme weather conditions and war.

Population changerefers to an increase or decrease in the population of an area influenced by the number of births, deaths and migration. The population of the world doubled from 500 million in 1650 to 1000 million in1850.The projected population for 2025 and 2050 is about 8 billion and 9 billion respectively.

Population growthrefers to an increase in the number of people who reside in a particular area during a particular period. Population increases when there are more births and immigration. It decreases when there are more deaths and emigration. Population growth, can be calculated asPopulation growth = (Birth rate + Immigration) - (Death rate + Emigration).

The important features associated with the population studies in Tamil Nadu are as follows:

S. No	Term	Definition	Data for Tamil Nadu
1.	Birth Rate	Indicates the number of live births per 1000 people in a year	15.4% (2014)
2.	Population Growth	The average annual growth of population	15.6% (2011)
3.	Population Density	The average number of people per square kilometer	555/ Km2 (2011)
4.	Total Fertility Rate	The average number of children born per woman during her child bearing years (usually ages 15 to 44)	1.6 Birth Per Woman (2016)
5.	Infant Mortality	The number of deaths under one year of age for every 1000 live births in a year	17 per 1000 live births (2016)
6.	Life Expectancy at Birth	The average number of years an individual is expected to live	70.6 years (2010-14)

7.	Literacy Rate	The percentage of people in a given population who can read and write a language	80.09% (2011)
8.	Sex Ratio	The number of females for 1000 males in a given population	996:1000 (2011)

Distribution of Population

Population distribution refers to the way in which people are spread out across the earth's surface. The world population is not uniformly distributed, owing to the following factors.

A. **Physical Factors**: Physical factors include temperature, rainfall, soil, relief, water, and natural vegetation, distribution of minerals and availability of energy resources.
B. **Historical Factors**: Regions with historical importance (river valley civilizations), war and constant invasions fall under historical factors responsible for population distribution.

Density of population

Density of population refers to the number of people living per square kilometer. An area is said to be sparsely populated when it has a large area with less number of people. Similarly, smaller the area with a large number of people, it is said to be densely populated.

$$\text{Population Density} = \frac{\text{Total Population}}{\text{Total land area}}$$

The world's population density is divided into three main groups.

- Areas of high density (above 50 people per sq.km) - East Asia, South Asia, North West Europe & Eastern North America.
- Areas of moderate density (10 to 50 people per sq.km) - The sub tropical regions like Angola, Congo, Nigeria and Zambia in Africa.
- Areas of low density (less than 10 people per sq.km) - Central Africa, Western Australia, Northern Russia, Canada, etc…

Migration

Migration is defined as the permanent or semi-permanent change of home of an individual or a group of people over a significant distance from their place of

origin.The causes of migration may be physical (climate, drought, flood, earthquake, volcanic eruption, epidemics etc.), social inequalities, economic opportunities, technology, education, cultural clashes, war or political issues. There are two types of migration:

1. **Internal Migration:** The movement of people within a country i.e. between states, districts, villages, etc is called as Internal migration.
2. **International Migration:** The movement of people from one country to another, across international borders is called as International migration.

Push and pull factors of migration

Push factors are those factors which force people to move to new areas to live, while pull factors are those factors that attract migrants to a new location. Given below are some of the push and pull factors of migration.

Push Factors of migration	Pull factors of migration
• Insufficient jobs and few opportunities	• Better job opportunities
• Primitive conditions	• Better living conditions
• Desertification	• Fertile land
• Slavery or forced labour	• Socio economic independence
• Poor medical care	• Better health care
• Death threats	• Security
• Pollution	• Clean environment
• Poor infrastructural facilities	• Better infrastructural facilities
• Bullying	• Education
• Natural Disasters	• Living Stability
• War	• Industry
• Lack of political or religious freedom	• Political and religious freedom

Human settlements

A settlement can be described as any temporary or permanent unit area where people live, work and lead an organized life. It may be a city, town, village or other agglomeration of buildings. During the early days, man preferred tree branches, caves, pits or even rock cuts as his shelter. As days passed by, man slowly learnt the art of domesticating animals and cultivating food crops. The evolution of farming took place along four major river basins i.e. the Nile, Indus, Hwang Ho, Euphrates - Tigris. Man built huts and mud houses. Slowly settlements came into existence. A settlement generally consisted of a cluster of houses, places of worship and a place of burial. Later, small settlements developed into villages. Several villages together formed a town. Bigger towns developed into cities. Settlements were formed in different shapes, sizes and locations.

Classification of settlements

On the basis of occupation, settlements may be classified as rural and urban settlements.

Rural Settlements

Any settlement where most of the people are engaged in primary activities like agriculture, forestry, mining and fishery is known as a rural settlement. Most of the world's settlements are rural, that are mostly stable and permanent. The most important and unique feature of rural settlements is the vast, open spaces with green, pollution-free environment.

Patterns of rural settlements:

- **Rectangular pattern:** Rectangular pattern of settlements are found in plain areas or valleys. The roads are rectangular and cut each other at right angles.
- **Linear pattern**: In a linear pattern, the houses are located along a road, railway line and along the edge of the river valley or along a levee.
- **Circular or semicircular pattern**: The pattern of settlement that is found around the lakes, ponds and sea coasts are called circular or semi circular pattern.
- **Star like pattern**: Where several metalled or unmetalled roads converge, star shaped settlements develop. In the star shaped settlements, houses are spread out along the sides of roads in all directions.
- **Triangular pattern:** Triangular patterns of rural settlement generally develop at the confluence of rivers.
- **T-Shaped, Y-Shaped, Cross-Shaped or Cruciform settlements**: T-shaped settlements develop at tri-junctions of the roads (T), while Y-shaped settlements emerge as the places where two roads converge with the third one. Cruciform settlements develop on the cross-roads which extend in all four directions.
- **Nebular pattern:** The arrangement of roads is almost circular which ends at the central location or nucleus of the settlement around the house of the main landlord of the village or around a mosque, temple or church.

Urban Settlements

Urban is the term related to cities and towns where people are primarily engaged in non-agricultural activities, such as secondary, tertiary and quaternary activities. The common characteristic feature of an urban unit is that they are

compact, congested and liable to a large number of population. They comprise of mostly man-made structures that fulfill the requirements of a society's administrative, cultural, residential and religious functions. The factors responsible for urbanization are better employment opportunities, suitable conditions for business, education, transport, etc.

Classification of Urban Settlements

Urban centres are classified as towns, cites, metropolitan cities, mega cities, conurbation, etc., depending on the size and services available and functions rendered to it.

- **Town:** A town is generally larger than a village, but smaller than a city. It has a population of less than 1 lakh. E.g.: Arakkonam near Chennai

- **City:** Cities are much larger than towns and have a greater number of economic functions. The population in cities are estimated to be more than 1 lakh. E.g.: Coimbatore

- **Metropolitan cities**: Cities accommodating population between 10 lakhs and 50 lakhs are metropolitan cities. E.g.: Madurai

- **Megacities:** Cities with more than 50 lakh population are called Megacities. E.g.: Greater Chennai

- **Conurbation:** A conurbation is a region comprising of a number of cities, large towns and other urban areas. E.g.: Delhi conurbation

Economic Activities

Economic activities are those efforts or actions that involve production, distribution and consumption of commodities and services at all levels within a region. Types of Economic Activities

Primary Activities: Primary Activities pertain to the extraction of raw materials from the earth's surface. For example: food gathering, hunting, lumbering, fishing, cattle rearing, mining and agriculture.
Secondary Activities: Secondary Activities transform raw materials into finished goods. For example: Iron and Steel industries, automobile manufacturing etc.

Tertiary Activities: Activities which by themselves do not produce goods, but support the process of production are called tertiary activities. For example: Transport, communication, banking, storage and trade.

Quaternary Activities: The activities related to Research and Development, as well as knowledge are called Quaternary activities. For e.g. Services like consultation, education and banking,

Quinary Activities: The activities that focus on the creation, rearrangement and interpretation of new and existing ideas are called quinary activities. It includes the highest levels of decision making in a society or economy. E.g.: Senior business executives, scientists and policy makers in the Government.

Environmental Issues: Environment is the basic life support system that provides air, water, food and land to all living organisms. But human beings degrade the environment through rapid industrialization.

Human life will be at risk if they don't live in harmony with the environment. Environmental problems are not limited to the local, regional and national level, but there are several global issues. Scientific and technological revolutions has given a lot of facilities to mankind, but at the same time it is responsible for the depletion of resources. Thus, several environmental problems have emerged. Some of the environmental issues that we are going to learn are:

1.Deforestation,
2.Pollution such as air, water ,noise, etc,
3.Urbanization,
4.Fracking,
5.Waste disposal

Deforestation: Deforestation is the cutting down of trees permanently by the people to clear forests in order to make the land available for other uses.

Effects of Deforestation: Deforestation results in many effects like floods and droughts, loss of soil fertility, air pollution, extinction of species, global warming, spread of deserts, depletion of water resource, melting of ice caps and glaciers, rise in sea level and depletion of ozone layer.

The United Nations Conference on Environment and Development (UNCED) by name Earth Summit Conference held at Rio de Janeiro, Brazil, on June 1992 concluded that all member countries should reduce their emission of carbon dioxide, methane and other green house gases thought to be responsible for global warming.

Conservation of forests

i. Conservation of forests can be done through the regulation of cutting of trees.

ii. **Control over forest fire**: Through regular monitoring and controlling the movement of the people forest fire can be prevented.

iii. **Reforestation and afforestation**: Reforestation involves the replanting or regeneration of areas of forest which have previously been damaged or destroyed. Sometimes forests are able to regenerate naturally. Afforestation is the process of planting trees or sowing seeds on barren land devoid of any trees to create a forest.The term afforestation should not be confused with reforestation, which is the process of specifically planting native trees into a forest that has decreasing number of trees. While reforestation is increasing the number of trees of an existing forest, afforestation is the creation of a new forest.

iv. **Proper use of forest products**: We depend on forests for our survival from the air we breathe, to the wood we use. Besides providing habitats for animals and livelihoods for humans, forest products are one of the most essential things in our day to day life. Therefore we must use forest products properly.

v. **Sustainable forest management**: The use of forest and forest lands in a way and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill the global levels should not cause damage to other eco systems. Forest Management seeks to achieve a balance between the society's increasing demands for forest products, its benefits and the preservation of forest health and diversity too. This balance is critical to the survival of forests and to the prosperity of forest dependent communities.

Pollution

Environmental pollution occurs when pollutants contaminate the natural surroundings. Pollution disturbs the balance of our eco system affecting our normal life styles and gives rise to human illnesses and global warming. The word 'pollute' means to degrade or to make dirty. Pollution is thus, an unfavourable modification of the natural world, caused entirely or partly due to direct or indirect actions of human beings.There are many types of pollution degrading the environment. They are

1. Air pollution
2. Water pollution
3. Land pollution
4. Noise pollution
5. Light pollution

A. Air pollution

Due to some human activities or natural processes, the amount of solid wastes or concentration of gases, other than oxygen increases in air. Air thus becomes polluted and this process is called air pollution. The pollutants are generally grouped as natural and manmade. The natural pollutants are volcanic eruptions,

wind erosion, pollen disposal, evaporation of organic compounds and radioactive elements etc.,

Natural air pollution does not occur in abundance and also creates a little impact on the environment. But, manmade pollutants like vehicular emission, industrial wastes, smoke from thermal power plants and refineries badly affect the environment. The main pathological effects caused by air pollutants, particularly oxides of sulphur, nitrogen and carbon-di-oxide, include respiratory disorders, jaundice, irritation of eyes and throat, headache, cancer and even death.

Ozone Depletion: Ozone layer is depleted by the pollutants like CFCs, HFCs, methyle bromide, etc. Due to the depletion of ozone layer, UV rays fall on the earth's surface, warming the earth surface and leads to impervious diseases like skin cancer, blindness, loss of plankton etc.,

Ozone layer: Ozone is a poisonous gas made up of molecules consisting of three oxygen atoms (O3). This gas is extremely rare in the atmosphere, representing just three out of every 10 million molecules. The ozone layer is not really a layer at all, but has become known as such because most ozone particles are scattered between 19 and 30 kilometre up in the earth's atmosphere, in a region called the stratosphere. Ozone layer in the atmosphere absorbs most of the harmful ultraviolet radiation from the sun. It also screens out the deadly UV-C radiation the ozone shield is this essential to protect life.

B. Water Pollution:

Water pollution is any chemical, physical or biological change in the quality of water that has a harmful effect on any living thing that drinks or uses or lives in it. The water bodies including ponds, lakes, rivers, ground water and oceans are contaminated by the chemical wastes from industries, domestic wastes and sewage etc.

Major water pollutants

a. The disease – Causing agents; bacteria, viruses, protozoa and parasitic worms that enter sewage – systems and untreated waste.
b. Oxygen demanding bacteria: Wastes that can be decomposed by oxygen requiring bacteria.
c. Water soluble inorganic pollutants: Acids, Salt and toxic metals.
d. Organic compounds: Oil, plastics and pesticides in the water.

Our role in conserving water;

1. Do not dump in or around rivers. Clean up rivers that have a lot of trash in and around them.
2. Never dispose of cooking fats and oils by pouring them down the sink.

3. In the bathroom, take short showers and draw less water for baths. When you buy a new toilet, purchase a low flow model (1.6 gallons or less per flush). Check your toilet for "silent" leaks by placing a little food coloring in the tank and see if it leaks into the bowl.
4. Turn off water while brushing teeth, washing, gardening and shaving.
5. Keep a gallon of drinking water in the refrigerator, rather than running the tap for cold water. Run your washing machine with a full load of clothes. Wash with warm water instead of hot water, rinse with cold water instead of warm water.

Causes of Water Pollution: Main pathological problems caused due to water pollution include diarrhoea, liver cirrhosis, lung cancer, kidney diseases, paralysis, chronic pain, bone deformities, cancer and even death and so on.

C. Land Pollution

Land pollution is contaminating the land surface of the earth through dumping of urban waste matter. It arises from the breakage of underground storage tanks, application of pesticides and percolation of contaminated surface water, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil.

Preventive Measures

1. Things used for domestic purposes can be reused and recycled.
2. Organic waste matter should be disposed off far away from the settlements.
3. Inorganic wastes can be separated, reclaimed and recycled.

D. Noise Pollution

Noise pollution is basically a problem of urban areas, industrial areas, transport areas due to bombardment, traffic etc. It has an impact on the habitat of animals migration and health of inhabitants. E.g. Chandipur Missile Launching Centre has created migration of sea birds. Hearing loss, hypertension, stress and mental illness are the major health hazards that human beings face.

The control measures of noise pollution

1. Development of green belt vegetation.
2. Installation of decibel meters along highways and in places of public gatherings.
3. Planting trees along the compound wall to protect houses.

E. Light pollution

Light pollution is an unwanted consequence of outdoor lighting and includes such effects as sky glow, light trespass and glare. It is caused by streetlights, parking lot lights, floodlights, signs, sports field lighting decorative and landscape lights. It affects the environment, energy resources, wildlife, humans and astronomy research.

Urbanization

Urbanization refers to the process of increase in urban population and urban areas in a country.

Problems of urbanization

As the town expands, it mounts more pressure on transport system, water supplies, sewage and profuse disposal. The overall development creates problems like air pollution, water pollution, traffic congestion and noise pollution etc., This disturbed environment affects the human beings as mental illness, heart troubles, breathing problems etc.

Fracking:

The modern technology applied to extract oil and gas while fracturing the rocks artificially with the use of pressurized liquid is called fracking. Fracking fluid is a mixture of water, sand and thickening agents. The first successful implementation of the process was done in 1950.Methane is one of the most important chemicals used in fracking process. It is estimated that four percent of methane escapes into the atmosphere during extraction. Methane is 25 times stronger than carbon di-oxide in terms of trapping heat. The spills of this gas is detrimental to the air quality of the surrounding fracking sites. Pollutants decrease the availability of clean air for workers and local residents.

Other Environmental Concerns

Fracking not only pollutes water and air but also pollutes the soil. The oil spills during fracking can harm the soil and the surrounding vegetation. The use of high pressure at the time of oil extraction and the storage of waste water on site may cause earthquakes.

Waste disposal

Things become waste when their purpose of consumption is over. Wastes can be classified into five types, which are commonly found around the house. These include liquid waste, solid rubbish, organic waste, recyclable rubbish and hazardous waste like e-waste.

How to dispose of waste:

- Do not litter your surroundings. Use a proper waste bin to store your wastes.
- People should practise to segregate degradable and non-degradable wastes and should dispose them in proper coloured bins. Wastage is generally classified into three types. They are

1. Wet Waste: Which comes from the kitchen/cooking/food, etc.
2. Dry Recyclable Waste: Such as newspapers, cardboard, packing plastics, bottles, cans, etc., should go to a different bin.
3. Rejected Waste: Which does not belong to the above two categories, including bio waste like diapers and bandages, etc..

Sewage sludge is produced by waste water treatment processes. Due to rapid urbanization, there has been an increase in municipal waste water. Common disposal practices of sewage should be send to sewage treatment plant through proper drainage pipes.

Electronic Waste (e-waste):

It can be defined as any electrical goods, devices or components that you no longer want or have already thrown away. For example, computers, televisions, mobiles and fax machines. This waste can take many years to break down, if at all and can contain toxic chemicals such as mercury, lead and lithium that leach into the ground and cause illness. Even short-term exposure to high levels of lead can result in vomiting and diarrhea. Instead of sending e-waste to the dump, components from electronics can be reused to make new products.

Sustainable Development

Humans on earth are facing many problems, such as pollution, climatic changes, poverty, war and uneven distribution of resources. These problems directly affect the survival of mankind. Therefore to sustain mankind, we have to educate people on what sustainable development is.In 1987, the Brundtland Commission cited the definition of sustainability.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generation to meet their own needs".For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social aspects and environmental protection. These elements are interconnected and are crucial for the well-being of individuals and societies. To achieve true sustainability, we need to balance the economic,social and environmental factors of sustainability in equal harmony.

Social Sustainability

The ability of a social system such as a country, family or organization to function at a defined level of social well-being and harmony is called social

sustainability. Problems like war, endemic poverty, widespread injustice and low education rates are symptoms of a system in socially unsustainable. The balancing capacity of a government in maintaining peaceful existence towards other countries and at the same time providing the requirements of its citizens without affecting the environment creates social sustainability.

Economic Sustainability

The people on earth consume far more than what is their fair share.

1. The economic sustainability is successfully implemented through strong Public Distribution System.
2. Economic sustainability ensures that our economic growth maintains a healthy balance with our ecosystem.

Environmental Sustainability

Environmental sustainability is the ability of the environment to support a defined level of environmental quality and natural resource extraction rates forever to mankind. Unnecessary disturbances to the environment should be avoided whenever possible.

Why is sustainability important?

The excessive usages of natural and manmade resources deplete its availability for the future generation. We need to look after our planet, our resources and our people to ensure that we can hand over our planet to our children to live in true sustainability. Hence conservation and awareness are the two important terms that can bring sustainability to our living. When we use the word sustainability to mean maintain, it means to maintain it forever. This is because our actions have a lasting effect on the environment and we should protect it for our future generations.

How to help the value of sustainability grow among students?

1. **Lifestyle:** Your lifestyle is your choice and you can change it. For example, when you go to the grocery store, make sure you always carry a cloth bag. This way the shopkeeper does not have to give you many plastic bags.

2. **Fixing:** If your watch or a toy or a camera is broken or not working, try getting it fixed before you buy yourself a new one.

3. **Recycle:** Try and be conscious about the things around you. When you consume something, see if you can re-use it later.

4. **Needs vsWants :** Before you buy something, ask yourself the question- do I NEED this or do I WANT it?Remember sustainability begins with you. So act locally and think globally.

Case Study

The Mangroves of Palk Bay towards Sustainable Development

The sections above have discussed environmental degradation and climate change along with the concept of sustainable development. The connection between environment protection and restoration and sustainable development has also been presented. As an example, the case of the Mangroves of Palk Bay will help demonstrate these concepts in more practical terms.

Palk Bay is the area located roughly between Kodiakkarai or Point Calimere and Rameshwaram Island in Tamil Nadu on the southeastern coast of India. Palk Bay is home to mangrove ecosystems or tidal swamps. Characterised by plants and trees that can withstand high salinity, these swamps are rich in biodiversity. The Mangrove trees themselves, offer coastal protection by checking erosion. Erosion affects not just the coastline, but also coral reefs. The tangled roots of mangrove trees help retain and trap loose soil and thereby protect coral reefs and seaweed meadows from siltation. Coral reefs are important ecosystems in maintaining healthy fish population. Mangrove forests also help fish population by providing space which act as nurseries for juvenile fish.

In the recent decades, the mangroves of Palk Bay have been heavily degraded due to the Tsunami of 2004, land encroachment, rapid urbanisation, cattle grazing and agriculture. The degradation of mangroves resulted in the reduction of nursery space for juvenile fish, impacting fish populations in the region and as a result,the livelihood of the fishing communities of the region.

Given the scale of the problem, solutions needed to be multipronged and involve multiple stakeholders. Local communities, government and civic organisations all came together not just to conserve the remaining mangroves, but also to restore it. Saplings of native species of plants and trees are being grown, planted and cared for. Live colonies of coral from the Gulf of Mannar Biosphere Reserve are being transplanted to Palk Bay. The existing mangroves and the region are being mapped and the way land is used around the mangrove is being studied.
The local communities are actively involved in the conservation and restoration of the mangroves. Education and awareness programmes about mangrove ecosystem are being undertaken.

Along with awareness programmes, the communities are also being provided with livelihood training, so they can earn an income in more ways than just fishing. All of these efforts are on-going. The health of the mangroves are

improving and as it does, the fish population will improve in quality and quantity, improving the lives of the communities. As one can see, sustainable solutions take the needs of the people into consideration and the environment because both are interconnected.

1. POPULATION GEOGRAPHY

Introduction

- Do you know that 3, 60, 000 persons born every day in the world? Four births take place every second in the world. 'Professor Stephen Hawking thinks the human species will have to populate a new planet within 100 years if it is to survive,' the BBC confirmed.

- 'With climate change, overdue asteroid strikes, epidemics and population growth, our own planet is increasingly precarious,' the news outlet continued.

- Human being is an important element of the environment and is probably the latest occupant of the earth, as its evolution took place less than two million years ago. Although distribution and growth of human population are influenced greatly by the physical environment, they have tremendous capacity to modify the physical environment.

- **Demography** is the statistical study of human population. It includes the study of size, structure and distribution of population as well as changes in time and location in response to birth, migration, aging and death. **'Population explosion'** is one of the greatest challenges that we are facing today.

Distribution of world population

- People have inhabited the earth for several thousands of years, but for a long period of time, their numbers remained limited. It is only during last few hundred years that human population has increased at an alarming rate. Population is spread unevenly across the continents. Only a few areas support large concentration of people while vast areas support the factors influencing the distribution few people. A large number of factors influence the distribution and growth of population over the earth's surface.

The factors influencing the distribution of population

1. Relief

- Rugged mountains pose various obstacles such as unsuitable conditions for the construction of rail-roads and highways, unfavorable conditions for agricultural crops because of short growing season, lack of cultivable land and snowy winters do not encourage large settlement areas. Hence, the mountainous areas support a few people. On the other hand, a large concentration of population is found in the fertile lowlands such as the Ganges and Brahmaputra in India, Hwang-Ho in China and plains of North-Western Europe and the USA. This is mainly due to flat level land which is fertile, favorable conditions for agriculture, long growing seasons and suitable condition for the settlement.

2. Accessibility

- Areas with well-developed transport infrastructure and links through road, rail, shipping, canals and air are likely to be more densely populated than areas which are poorly connected with transport network.

- In earlier times, in the absence of water transport, all islands remained virtually uninhabited. One of the reasons why mountains are not inhabited by people is lack of accessibility.

3. Adequate water supply

- Population distribution is affected very much by the presence or absence of water in any region. Water supply is essential for human survival and development. Areas which have sufficient water tend to have denser population than areas which are dry or suffer from regular drought. Well watered regions of the Great Northern plains of India are densely populated whereas drought prone areas of Sahara are sparsely populated.

4. Soil

- Fertile alluvial soils of river valleys throughout the world have encouraged dense settlement of population because they support Agricultural activities. The high density of population in parts of East and South-East Asia is dependent mainly on fertile soil. For example, dense population is found in the Ganges valley of India, in Indus valley of Pakistan and Hwang-Ho valley of China. On the other hand, desert soil of Sahara region is sparsely populated.

5. Economic and political factors

- Unfavorable economic condition, unemployment, religious intolerance, conflicts and wars do not favour more population.

The patterns of Population Distribution

- The analysis of the pattern of population distribution and density is fundamental to the study of demographic characteristics of any area. The population distribution refers to the way the people are spread over the earth's surface. The population distribution is uneven worldwide. Ten most populous countries of the world together make up nearly 60% of the world's population.

Density of Population

- Absolute numbers do not give any indication of the impact of population on the land and its resources. The number of persons living per unit of land areas gives

a better picture. This is expressed in the form of density of population per sq.km of land area.

$$\text{Density of population} = \frac{\text{Total population}}{\text{Total area of the country}}$$

- It is obtained by dividing the total land area by the total population, the quotient being the number of people per square kilometer. Compared with simple arithmetic density, physiological or nutritional density is a more refined method of calculating man-land ratios.
- **Physiological or Nutritional** density is the ratio between total population and total cropped area. The total arable land in the world is **13.3%** and the nutritional density of the world is 325 per sq.km of land. The total percentage of arable land is 48.83 in India and its nutritional density is 753 per sq.km of land. Singapore has the highest nutritional density of population of **440,998 per sq.km** of land the world. The areas of density of population can be divided into three as follows:

1. High density areas of population

- Fertile plains with favorable climate and highly industrialised and urbanised areas are generally densely populated. There are four major areas of high density of population with more than 100 persons per sq.km. Areas include:

    a. Eastern Asia, including china, Japan and Republic of Korea.
    b. Southern Asia, comprising India, Bangladesh and Sri Lanka.
    c. North-Eastern part of the United States of America.
    d. Central and North-Western Europe. Of the four regions given, the first two i.e. Eastern Asia and South Asia have high density of population due to favourable environmental conditions such as favourable climate, fertile soil and large areas of plains which encourage the growth of agriculture. The plains and river valleys of India and China are densely populated. In the last two groups i.e. North Eastern United States of America and North – Western Europe which are densely populated due to the concentration of manufacturing industries.

HOTS

- Why has Singapore the highest physiological/nutritional density of population in the world?

2. Moderate density areas of population

- The areas of moderate density of population have between 10 and 80 persons per sq.km. The areas of moderate density of population include Central part of the United States of America, Tropical Western Africa, Western blocks of Russia, Eastern Europe, Deccan Plateau of India, Central China, Southern portion of the

Plateau of Mexico, North-Eastern Brazil and Central Chile, The above areas are characterized by the well-developed agricultural activities, favorable climate, fertile soils, fishing, etc.,.

3. Low density areas of population

- About half the area of the world has population less than 10 persons per sq.km. Certain vast areas remain completely uninhabited. The main areas are

  a. Amazon forest region of South America and Congo forest region of Africa.
  b. Arctic area of Canada, Greenland and the Polar regions.
  c. Great deserts of the world i.e. Sahara, Kalahari, Arabia, Great desert of Australia, Atacama Desert of South America, desert regions of Western United States and Thar Desert of India.
  d. High mountainous regions in all continents.
  e. Antarctica.

- **Australia** with an average density of population of 2 persons per sq.km is one of the most sparsely populated countries of the world. However, inhabitants of these areas have high standard of living. The reasons for low density of population are

  a. Bad and unfavorable Environment conditions for human settlement.
  b. Lack of economic activities.
  c. Lack of transport and communication.
  d. Government policy.

Terms related population

1. Population: A group of individuals of the same species occupying a particular geographic area.

2. People: The members of a particular nation, community, or ethnic group.

3. Crude Birth rate (Natality Rate): Number of live births per thousand people in a year.

4. Crude Death Rate (Mortality Rate): Number of deaths per thousand people in a year.

5. Net Migration Rate: the formula for net migration rate is simple:

$$N = 1000 \times (I - E) / P$$

N= net migration rate
E= number of people emigrating out of the country
I= number of people immigrating into the country
P= the estimated mid-year population

6. Fertility Rate: is the number of live births expected per 1000 women in their life times in a specified geographic area and for a specific point in time, usually a calendar year. Niger has the highest fertility rate of 6.49 while Singapore has the lowest fertility rate of 0.83. Can you guess why there is variation between these

countries?
7. Dependency ratio: Number of dependents in a population divided by the number of working age people. It's a calculation which groups those aged under 15 with those over 65 years as the 'dependants' and classifying those aged 15-64 years as 'the working-age population'.
8. Growth Rate: = CBR – CDR +/- Net Migration Rate/ 1000

South Sudan has the highest population growth rate of 3.83% in 2017.
9. Rate of Natural Increase (RNI) = CBR-CDR (No Migration) CBR>CDR = ↑ population RNI usually expressed as % e.g., 2% = 2/100 = 20/1000 RNI ≠ population growth if migration significant 10. Adult Literacy Rate: The Adult literacy index (ALI) is a statistical measure used to determine how many adults can read and write in a certain area or nation. Adult literacy is one of the factors in measuring the Human Development Index (HDI) of each nation, along with life expectancy, education, and standard of living. Burkina faso has the lowest literacy rate of 21.8% (2015). How does literacy rate affect the standard of living of a country? 11. Life expectancy rate: Life expectancy equals the average number of years a person born in a given country is expected to live. As of 2015, the country with the highest life expectancy is Monaco at 89.52 years; the country with the lowest is Chad at 49.81 years.

Growth of world population

- After the introduction of agriculture about 8,000 to 12,000 years ago, the size of population was small, roughly 8 million. In the first century (C.E) it was below 300 million. The expanding world trade during the sixteenth and seventeenth Century set the stage for rapid population growth. Around 1750, at the dawn of Industrial Revolution, the world population was 550 million. World population exploded in the eighteenth century after the Industrial Revolution. Technological advancement achieved so far helped in the reduction of birth rate and provided a stage for accelerated population growth.

- The current world population of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100, according to a new United Nations report being launched. With roughly 83 million people being added to the world's population every year, the upward trend in population size is expected to continue, even assuming that fertility levels will continue to decline.

- The current world population, according to UN Department of Economic and Social Affairs, Feb, 2019, is 7,685,036,620.

- The new projections include some notable findings at the country level. China **(with 1.4 billion inhabitants) and India (1.3 billion inhabitants) remain the two most populous countries, comprising 19% and 18% of the total global population respectively**. In roughly seven years, or around 2024, the population of India is expected to surpass that of China.

- Among the ten largest countries worldwide, **Nigeria** is growing the most rapidly. Consequently, the population of Nigeria, currently the world's 7th largest, is projected to surpass that of the United States and become the third largest country in the world shortly before 2050.

- Most of the global increase is attributable to a small number of countries.

- From 2017 to 2050, it is expected that half of the world's population growth will be concentrated in just nine countries: India, Nigeria, Congo, Pakistan, Ethiopia, the United Republic of Tanzania, the United States of America, Uganda and Indonesia (ordered by their expected contribution to total growth).

- The group of 47 least developed countries (LDCs) continues to have a relatively high level of fertility, which stood at 4.3 births per woman in 2010-2015. As a result, the population of these countries has been growing rapidly, at around 2.4 % per year. Although this rate of increase is expected to slow significantly over the coming decades, the combined population of the LDCs, roughly one billion in 2017, is projected to increase by 33 % between 2017 and 2030, world population will reach 9.7 billion in 2050.

- Similarly, Africa continues to experience high rates of population growth. Between 2017 and 2050, the populations of 26 African countries are projected to expand to at least double their current size.

- The concentration of global population growth in the poorest countries presents a considerable challenge to governments in implementing the 2030 Agenda for Sustainable Development, which seeks to end poverty and hunger, expand and update health and education systems, achieve gender equality and women's empowerment, reduce inequality and ensure that no one is left behind.

- Population in the world is currently (2019) growing at a rate of around 1.09% per year (down from 1.12% in 2017 and 1.14% in 2016). It is estimated to reach 1% by 2023, less than 0.5% by 2052, and 0.25% in 2076. In 2100, it should be only 0.09% or an addition of only 10 million people to a total population of 11.2 billion. World population will, therefore, continue to grow in the 21st century.

Doubling Time of population

- **Doubling time** is the amount of time it takes for a given quantity of population to double in size at a constant growth rate. We can find the doubling time for a population undergoing exponential growth by using the Rule of 70. It is because the population of a country becomes double in 70 years if the growth rate is 1%. Thus, we divide 70 by the growth rate and we get the doubling time of population growth rate. For example if the growth rate is 2.08, divide 70 by 2.08 and we get 33.6 years as the doubling time of population.

- World population has doubled in 40 years from 1959 (3 billion) to 1999 (6 billion). It is now estimated that it will take another nearly 40 years to increase by another 50% to become 9 billion by 2037. The latest world population projections indicate that world population will reach 10 billion persons in the year 2055 and 11 billion in the year 2088.

World Population Milestones

- According to the United Nations, the 6 billion figures were reached on October 12, 1999 (celebrated as the Day of 6 Billion). World population reached 7 Billion on October 31, 2011. The current world population is 7.7 billion as of Feb 2019 according to the most recent United Nations estimates. The United Nations projects world population to reach 8 billion in 2023 and 10 billion in the year 2056.]

Regional division on the basis of growth rate

- On the basis of the growth rate of population the world can be divided into the following three types of areas:

1. Areas of Low Growth Rate

- Developed countries like US, Canada, Japan, Australia, New Zealand and countries of western Europe have a low growth rate of population in these countries is due to low birth rates and low death rates. The difference between the birth rate and the death rate in these countries is the lowest.

2. Areas of Moderate Growth Rate

- This category includes the developing countries like Pakistan, Afghanistan, Brazil, Bolivia, Mongolia, Indonesia and many other Africa and South American countries, where the growth rate of nearly 2 % is also included among these countries though the growth rate here has started declining.

3. Areas of High Growth Rate

- Countries like Mexico, Iran, Colombia, Venezuela, Peru, Libya, Algeria, Sudan, Kenya and Kuwait make this category. In fact, most of the African countries with a growth rate of 3% fall in this category.

Population Concepts

i. **Over population:** situation whereby the population is considered too large for the available resources.

ii. **Under – population:** a situation where the population is less than the available resources of a country.

iii. **Optimum – population:** a situation where the number of people that can be supported is the same as the available resources.

FACT FILE

India - Population

- The current population of India is 1,363,413,725 as of Feb 19, 2019, based on the latest United Nations estimates.
- India population is 17.74% of the total world population.
- India ranks number 2 in the list of countries (and dependencies) by population.
- The population density in India is 455 per Km2.
- 33.6 % of the population is urban (460,249,853 people in 2019)

Composition of Population

- Composition of Population includes sex ratio, literacy rate, age pyramids etc.

Sex Ratio

- The sex ratio is the ratio of males to females in a population.

FACT FILE

Qatar-315 Males per 100 females (2019)

With an astounding ratio of 315 males to a 100 females, Qatar holds the number one spot among **countries with the highest male to female ratio in the world in 2018.**

- As of 2014, the global sex ratio at birth is estimated at 107 boys to 100 girls (1000 boys per 934 girls).

The sex ratio of India is 933 females for every 1000 males according to 2011.

- Kerala has the highest sex ratio in the country with 1084 females for 1000 males followed by Puducherry with 1037 females for 1000 males and Tamil Nadu with 996 females for 1000 males.

Do you know?

Cisgender (often abbreviated to simply cis) is a term for people whose gender identity matches the sex that they were assigned at birth. It is the opposite of the term **transgender.**

What Are Population Age Pyramids?

- **Population pyramids** are graphical representations of the age and sex of a population. For this reason, population pyramids are also referred to as **age-sex** pyramids. We refer to these graphs as pyramids because they are usually shaped like triangles and population pyramids also take other shapes. Population pyramids usually have males on the left side and females on the right. There is also a vertical line in the middle of the graph that separates the males from the females.

FACT FILE

Latvia, country with the highest sex ratio in the world.

Latvia is a former Soviet Union country and experienced a great decline in male population during World War two. By 2015, there were 84.8 males for every 100 females. The proportion of the female was 54.10% of the total population. Men in Latvia have a high mortality rate due to issues such as alcoholism, smoking, and careless car driving. Around 80% of suicides in Latvia are committed by men, often because of unemployment and unrealized financial goals. Women enjoy a longer life expectancy living 11 years more than men.

Literacy Rate

- Total number of literate persons in a given age group, expressed as a percentage of the total population in that age group.

- Literacy rates continue to rise from one generation to the next. Yet according to new data from the UNESCO Institute for Statistics, there are still 750 million illiterate adults, two-thirds of whom are women. These numbers are a stark reminder of the work ahead to meet Sustainable Development Goals (SDGs) 4 and 5 and the Education 2030 targets.

Literacy rate variations between states in India

India's literacy rate is at 74.04%. **Kerala** has achieved a literacy rate of **93.91%. Bihar** is the least literate state in India, with a literacy of **63.82%.** Several other social indicators of the two states are correlated with these rates, such as life expectancy at birth (71.61 for males and 75 for females in Kerala, 65.66 for males and 64.79 for females in Bihar), infant mortality per 1,000 live births (10 in Kerala, 61 in Bihar), birth rate per 1,000 people (16.9 in Kerala, 30.9 in Bihar) and death rate per 1,000 people (6.4 in Kerala, 7.9 in Bihar).

Six Indian states account for about 70% of all illiterates in India: Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, Andhra Pradesh and West Bengal. Slightly less than half of all Indian illiterates (48.12%) are in the six Hindi-speaking states of Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, Jharkhand and Chhattisgarh.

Age - Sex pyramids

- There are three types of Age - Sex pyramids: expansive, constrictive, and stationary

- **Expansive Age - Sex pyramids** depict populations that have a larger percentage of people in younger age groups. Populations with this shape usually have high fertility rates with lower life expectancies. Many third world countries have expansive Age - Sex pyramids. Such a population pyramid is a characteristic of newly developing countries such as Afghanistan, Bangladesh, Kenya, and some countries of Latin America.

- Constrictive **Age - Sex pyramids** are named so because they are constricted at the bottom. There are a lower percentage of younger people. Constrictive Age - Sex pyramids show declining birth rates, since each succeeding age group is getting smaller and smaller. **The United States has a constrictive Age - Sex pyramid.**

Tripura Literacy success

Presently **Tripura** has the **highest** literacy rate in India**, 94.65 percent.** According to the 2011 census, literacy level was 93.91 percent in Kerala and 91.58 percent in Mizoram, among the most literate states in the country. The national literacy rate, according to the 2011 census, was 74.04 percent. The Tripura success story is attributed to the involvement of local government bodies, including Gram panchayats, NGOs and local clubs under the close supervision of the State Literacy Mission Authority (SLMA) headed by the chief minister. Tripura attained 87.75 percent literacy in the 2011 census, from the 12th position in the 2001 census to the 4th position in the 2011 census. Among projects implemented by the state government to increase literacy in the state are

- 10,000 anganwadi centres have 100 percentenrollment.
- Policy of no fail till class VIII to prevent children from dropping out.
- Midday meals in all schools with an eclectic menu for all days of the week to attract more students.
- No tuition fee in government colleges.

The holistic education system, implemented with equal interest in Agartala, remote areas and the tribal autonomic areas makes sure that people in Tripura do not just become literate but educated, officials emphasized. One pointer to the government's interest in education is the near-total absence of child labor in Tripura.

Stationary Age-sex pyramids

- **Stationary Age - Sex pyramids** are those that show a somewhat equal proportion of the population in each age group. There is not a decrease or increase in population; it is stable. **Austria has a stationary**

Age - Sex pyramid.

The Purpose of the Age - Sex Pyramid

- The purpose of making this Age - Sex pyramid is to find out the comparison between the number of men and women, the number of workers, and the structure of the population in a country quickly. In addition, the creation of the Age - Sex Pyramid also has a purpose to assist the government in taking development policies.

Migration

- Migration means the movement of people from one place to the other. It is an important control of population growth after fertility and mortality. Migration of people into an area from outside is called immigration or in-migration while movement out of an area to other regions is called emigration or out-migration.

- Immigration leads to an increased growth rate of population, emigration lowers the growth rate of population in the source region. Mexico's emigration problem is a unique one, with more than 98% of all Mexican migrants living in the U.S.A, the country with which Mexico shares a border that runs 3110 km in length. The Mexican emigration rate increased substantially since the 1960s and, with more than 11% of Mexicans living abroad, **Mexico is the country with the largest number of emigrants in the world.** According to estimates from the UN 2015 report, in 2013, the **United States, Germany** and **Russia** had the largest number of immigrants of any country, while **Tuvalu** and **Tokelau** had the lowest immigrant.

Types of migration
1 Net Migration

- Net Migration is the difference between immigration (in-migration) and emigration (out-migration).

- Positive value of net migration is that more people coming in and population growth, for example, 44% of North America and 88% of Europe. Negative value of migration is more people coming out and population decline.

2 International Migrations

- Emigration is an indicator of economic and or social failures of a society. It is a crossing of a national boundary. It is easier to control and monitor. There are laws to control or inhibit these movements. Between 2 million and 3 million people emigrate each year. Between 1965 and 2000, 175 million people have migrated: it accounts for 3% of the global population.

3 Internal Migrations

- It occurs within a country. It is crossing of population within domestic jurisdictional boundaries. It is the movement of people between states or provinces. There is little government control over internal migration.

4 Local Migrations

- Local migrations are the migration of the people within state or district. No state boundaries are crossed in the local migration. It happens for several reasons such as buying a new house in the same town or city, difficult to research since they are usually missed in census data. It is based on change of income or lifestyle. Americans change residence every 5 to 7 years.

5 Voluntary migrations

- Voluntary migrations are where the migrant makes the decision to move. Most migration is voluntary.

6 Involuntary migrations

- It is a forced migration in which the migrant has no role in the decision-making process. It includes mostly slavery. It is estimated that about 11 million African slaves were brought to the Americas between 1519 and 1867. In 1860, there were close to 4 million slaves in the United States. People involve in the involuntary migration are refugees due to military conscription, children of migrants, people in the situations of divorce or separation.

Brain Drain

- Brain drain is related to educationally specific selective migrations. Some countries are losing the most educated segment of their population. It can be both a benefit for the receiving country and a problem to the country of origin.

- **Receiving country**: it is getting highly qualified labor which is contributing to the economy right away. It promotes economic growth in strategic sectors: science and technology. It does not have to pay education and health costs, for example, 30% of Mexicans with a PhD are in the US.

- **Country of origin:** Education and health costs are not paid back to the country of origin. It is losing potential leaders and talent: Between 15 and 40% of a graduating class in Canada will move to the US. It has long term impact on economic growth. It has the possibility of getting remittances. Many brain drain migrants have skills which they can't use at home: The resources and technology may not be available there. The specific labor market is not big enough.

Causes of Migration

- We can divide factors causing migrations into two groups of factors as push and pull Factors.

- Push and Pull factors Push and pull factors are those factors which either forcefully push people into migration or attract them. A push factor is forceful, and a factor which relates to the country from which a person migrates. A pull factor is something concerning the country to which a person migrates. It is generally a benefit that attracts people to a certain place. Push and Pull factors are usually considered as north and south poles on a magnet.

- **Push Factors:** Not enough jobs, few opportunities, desertification, famine/ drought, political fear/ persecution, poor medical care, loss of wealth, natural disasters, death threats, slavery, pollutions, poor housing, landlords, bullying and poor chances of finding courtship

- **Pull Factors:** job opportunities, better living conditions, political and or religious freedom, enjoyment, education, better medical care, security, family links, industry, better chances of finding courtship.

Overpopulation

- Overpopulation is the state whereby the human population rises to an extent exceeding the carrying capacity of the ecological setting. In an overpopulated environment, the numbers of people might be more than the available essential materials for survival such as transport, water, shelter, food or social amenities. This regularly contributes to environmental deterioration, worsening in the quality of life, or even the disintegration of the population. Due to immigration, the decline in mortality rates, medical breakthroughs, and increased birth rates, populations will always increase and eventually gives rise to overpopulation.

Impacts of Overpopulation

- Overpopulation thus contributes to some of the most compelling environmental problems which encompass:

1. Depletion of Natural Resources

- As human population keeps on increasing, exhaustible natural resources such as arable land, coral reefs, fresh water, fossil fuels, and forests continue to drop sharply. This creates competitive demands on the vital life-sustaining resources and contributes to an incredible decline in the quality of life.

2. Accelerated Habitat Loss

- The increased loss of the ecosystems including wetlands, wildlife, rainforests, coral reefs, aquatic life forms, and grasslands are highly influenced by overpopulation. For example, rainforests originally covered 14% of the entire earth's surface. Today, rainforest only cover about 6% of the earth's surface and scientists' project it may even become less in the next four decades judged by the current rate of vegetation removal, logging, and deforestation. Besides, due to environmental pollution, 30% of the ocean reefs have been lost because of acidification and global warming since 1980. Also, more than half of the original wetlands have been lost.

3. Amplified Climate Change and Global Warming

- The more the number of people, the more the number of vehicles and industries would be. Furthermore, more population tends to increased use of energy sources such as coal and firewood which contributes to increased greenhouse gas emissions.

- Hence, because of the accumulation of human generated greenhouse gases and carbon footprint in the atmosphere, the planet has continued to witness amplified global warming and climate change. The effects of climate change and global warming are resulting in extreme hunger, drought, flooding, and loss of habitat.

4. Loss of Biodiversity

- Overpopulation has caused encroachment into frontier forests and destruction of natural ecosystems that has led to the mass extinction of species. The number of threatened species persists to multiply in number whereas some have completely gone extinct. This is because of human activities such as acidifying water, over exploitation of natural resources, pollution, over fishing, poaching, and destruction of natural systems which are necessary for the survival of different species.

5. Decrease of fresh water

- The unrelenting nature of overpopulation on the earth has destroyed most of the world's fresh systems. Most of the lakes, streams, rivers and ground water making up fresh water have been polluted. According to the global outlook of water resources, these activities influenced by over population have only left less than 1% of the planet's fresh water readily accessible for human utilization.

- Water vulnerability is already affecting many overpopulated nations, especially in some developing countries, as the demands for water tend to be more than the accessible water. Millions of fish species from freshwater ecosystems are on

the verge of extinction. Thus, as human inhabitants rise in number, so will the problem of quality freshwater accessibility.

6. Lower Life Expectancy and Diminished Quality of Life

- Overpopulation lowers the standards of living since it creates stress on the vital resources for survival and increases the difficulty of accessing the consistent supply of quality food, water, energy, health, security and shelter. Consequently, it makes the poor to become poorer, and they often opt for poor living conditions to survive.

- Eventually, it gives rise to lower life expectancy. The situation is serious in developing nations such as southern Asia and sub-Saharan Africa where most of the poor populations submit to inadequate and poor diets.

7. Rise in Unemployment, Crime Rate, and Violence

- In overpopulated nations, the available jobs are fewer than the overall job seeking population. This contributes to high levels of unemployment. In turn, lack of unemployment leads to elevated crime rates because of theft, drug cartels, and militia groups which are exploited as options for attaining basic resources and necessities such as food, good living standards, and wealth. Violence and conflicts arise when people start competing for the available limited resources.

8. Increased Intensive Farming

- As population has grown over the years, farming practices have evolved to produce enough food to feed larger numbers of people. However, intensive farming methods also cause damage to local ecosystems and the land, which may pose problems in the future.

Measures to control overpopulation

- Here are some unique solutions to overpopulation:

1. Creating Awareness Campaigns

- Using both social and mainstream media, we can clearly tell people around the world the truth about overpopulation crises and what must be done to solve them the right way.

2. Promotion of adopting child

- Adoptions become a consideration for family planning, particularly among socially conscientious communities. And today, it has become a de-facto

solution for people who are interested in starting a family, yet having concerns about overpopulation.

3. Aiming for Single-Child Families

- According to statistics, hundreds of thousands of people are being added to the planet every day, which is an unsustainable rate. Hence, it is need of hour we should aim for single-child families.

4. National Security issue

- Over populated countries should treat population boom as an issue of national security. As you can see, similar to food insecurity and climate change, uncontrolled and rapid population growth can be a national security threat in a way that it results to instability.

5. Changing Social Norms

- Some couple chooses not to have children and we have to respect their decision. This way we will be able to help curb the problem of overpopulation.

6. Providing Tax Benefits or Concessions

- Governments of various countries can come up with various regulations and policies related to tax exemption to help solve overpopulation. For example, they can waive certain parts of income tax or lower income tax rates for couples who have one or two children.

12th Unit 5 Cultural and Political Geography

Introduction

An interesting traditional Chinese custom says that a husband should carry his bride over a pan of burning coals before crossing the threshold of their home as husband and wife. According to tradition, the ritual ensures that the wife will have an easy and successful labour. Fire walking is also performed by some Chinese people as a means to prevent natural disaster'. 'In Cypriot culture, do not give white lilies as they are used at funerals. It is polite to finish everything on your plate. If you have not finished eating, cross your knife and fork on your plate with the fork over the knife'. It indicates you have finished eating by laying your knife and fork parallel across the right side of your plate'. Do you know some interesting custom practiced in our culture?

- Culture is the total way of life that characterizes a group of people. There are thousands of cultures existing today and each contributes to global diversity. There are so many ways that people can be culturally different. Specifically, a culture consists of numerous cultural components that vary from one culture group to the other. Some of the cultural parameters are religion, language, architecture, cuisine, technology, music, dress, gender roles, law, education, government, agriculture, economy, sport, values, and many more.

Culture Region

- A culture region is a portion of Earth that has common cultural elements and has distinct cultural authority from other regions. Any number of cultural components may be used to define culture regions. A map of world religions, for example, includes a shaded area in South Asia where Hinduism is dominant.

- Culture regions differ greatly in size. Some are exceedingly large, like the Islamic culture region that encompasses millions of square km of North Africa and Southwest Asia. Some are very small, like Spanish Harlem, which encompasses about three square km of Manhattan. Many others are of intermediate size, like the Corn Belt, which occupies a portion of the mid-western United States.

Cultural Diffusion

- Cultural diffusion is the spread of cultural beliefs and social activities from out group of people to another. Mixing of world culture through different ethnicities, religions and nationalities has only increases with advanced communication, transport and technology.

Cultural Landscape

- Cultural Landscapes have been defined by the World Heritage Committee as "cultural properties representing the combined works of nature and of man".

- The World Heritage Committee has identified and adopted three categories of cultural landscape. The three categories extracted from the Committee's Operational Guidelines, are as follows:

  (i) "A landscape designed and created intentionally by man".
  (ii) An "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
  (iii) An "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element".

Cultural Interaction

- Cultural interaction focuses on the relationships that often exist between cultural components that characterize a given community. Different factors interact with each other and give rise to prevalent trait.

- What language do you speak? What dress do you wear? What food do you like? What is the structure of the house you live in? For the above question by searching the answer we can learn the culture of a human society.

- Culture shapes our identity and influences our behaviours. Culture refers to the sharing language, beliefs, values, norms, behaviors and material objects, which are passed from one generation to the next generation. Cultural geography is the branch of human geography which deals about the areal organization of various cultural aspects in relation to total environment. Some of the cultural aspects are as follows:

Language

- Language plays great force in socialization and historical transmission, which is the primary instrument for transmitting culture. Human can bind any group of people through the network of interaction. Languages are in written or oral form. India (780) has the world's second highest number of languages, after Papua New Guinea (839).

Customs

- Custom in law is the established pattern of behavior that can be objectively verified within a particular social setting. A claim can be carried out in defense of what has always been done and accepted by law. It becomes characteristic of the group of people performing the act.

- Habit is a similar word which is adopted by an individual and it has been adopted by most of the people of the ethnic group or society.

Norms

- Norms refers to attitude and behaviours that are considered normal, typical or average within the group. Cultural norms are the standards we live by. They are the shared expectations and rules that guide behaviour of people within social groups. Cultural norms are learned and reinforced from parents, friends, teachers and others while growing up in a society. Norms often differ across cultures, contributing to cross-cultural misunderstandings.

Values

- Values refer to intangible quality or beliefs accepted and endorsed by a society. A culture's values are its ideas about what is good, right, fair, and just. Sociologists disagree, however, on how to conceptualize values. Conflict theory focuses on how values differ between groups within a culture, while functionalism focuses on the shared values within a culture.

Cultural Heritage u

- Cultural Heritage is an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions and values. Cultural Heritage is often expressed as either Intangible or Tangible Cultural Heritage. As part of human activity Cultural Heritage produces tangible representations of the value systems, beliefs, traditions and lifestyles. As an essential part of culture as a whole, Cultural Heritage, contains these visible and tangible traces form antiquity to the recent past.

Cultural Heritage types

- Cultural Heritage can be distinguished in: Built Environment (Buildings, Townscapes, and Archaeological remains), Natural Environment (Rural landscapes, Coasts and shorelines, agricultural heritage) and Artefacts (Books & Documents, Objects, and Pictures).

Cultural diversity

- Cultural diversity refers to having different cultures, respect to each other differences. Cultural diversity is important; because of work place and show increasingly consist of various cultural, racial and ethnic groups. We can learn from one another but first we must have a level of understanding. Cultural diversity exists in many countries around the world, but it can be challenging

and, at times, problematic. Through this lesson, you will learn how to define cultural diversity and explore some of the ways in which it influences society.

Cultural Traits

- A cultural trait is a characteristic of human action that's acquired by people socially and transmitted via various modes of communication. Cultural traits are things that allow for a part of one culture to be transmitted to another. There are millions of culture traits, a trait can be an object, a technique, a belief or an attitude. Culture traits are interrelated with each other, their collective function forms culture complex.

Cultural Realms of the World

- Cultural realm refers to a type of cultural region. Cultural region is a continuous geographical area characterized by cultural homogeneity. It may be classified into three categories as macro, meso and micro region. Cultural realm is classified based on the attitude, religious belief, language, racial group, technological development, etc. There are twelve Cultural realms in the modern world. Let us discuss some of them briefly.

Occidental Realm

- Occidental culture is the culture of the European society. It is influenced, to a great extent, by Christianity. It has regional modifications on the basis of varying levels of industrialisation, political and economic thought, colonisation, commercialisation, urbanisation, and development of transport system, land development of social, political and economic institutions.
- In many parts of the occidental culture, the impact of non-religious factors, particularly the effect of modernisation, is so great that the religious values are sidelined. Post- industrial Europe is fast emerging as a society where traditional values are nearly abandoned. The occidental culture covers a vast area. It is further divided into six sub-regions considering the impact of regional environment.

(i) West European is the most industrialised and urbanised culture.

(ii) Continental European culture is influenced by different political and economic thoughts, while Christianity remains an important influence.

(iii) Mediterranean Europe includes countries lying to the south of the Alps. It is the region of dominance of Christianity.

(iv)Anglo-American and

(v) Australian cultural realms are practically the offspring's of west European culture. Both are inhabited by migrants from west Europe. There are only some regional differences.

(vi)Latin American culture is very similar to the Mediterranean culture. It is the only region of occidental culture which lies in the tropics and is underdeveloped. It became a part of the occidental culture as a result of conversion of tribes into Christianity. The colonial languages, Spanish and Portuguese, have become the state languages. Regional architecture has been influenced by the Spanish and Portuguese styles. Practically all countries maintain economic, cultural and social ties with the Mediterranean countries.

Islamic Cultural Realm

- The Islamic Cultural Realm is influenced by Islamic values. It covers a vast geographical area from Morocco in the west to Pakistan in the east. The population is sparsely distributed due to inhospitable environment. The coasts, river basins and oases have been the cradles of Arabian culture in this realm. The British call it the Middle-East while the Germans call it a region of oriental culture. This cultural realm lies between the traditional Indian culture in the east and the modernised European culture in the west.

- Islamic culture is highly orthodox and based on traditional beliefs, the impact of which can be seen in high female illiteracy rates. These countries have very high per capita incomes, but the level of modernisation is very low.

Indie Cultural Realm

- Indie Cultural Realm is the culture of the Indian sub-continent. Baker called it a sub-continental culture, while D. Stamp used the term paddy culture. This cultural realm is well-defined; it lies between Himalayas in the north, Indian Ocean in the south and Hindukush Mountains in the west.

- This cultural realm is characterized by joint family, village community, caste system, semi-feudal land relations, subsistence agriculture, paddy farming, seasonal climate changes and agricultural season coming at the same time all over the region. The culture of this region is greatly influenced by Vedic values. Though the region is inhabited by various communities, the social system has the hidden impact of Vedic cultural values.

East Asian Culture

- This culture is basically a Buddhist culture with regional modifications. True Buddhist culture can be seen in South Korea and Japan. Even these two countries have felt the impact of industrialisation, urbanisation and modernisation. The culture of mainland China has modified the Buddhist system. This culture was adopted after the Second World War.

South-East Asian Culture

- It is a transitional culture lying at a place where different cultures have intermingled. Dominance of Buddhism can be seen in Myanmar, Thailand and Vietnam. Influence of Christianity can be seen in the Philippines and of Indie culture over islands of Indonesia. The Islamic influence is evident in Malaysia and the Indonesian islands. No other region has such peculiarities.

Meso-African Culture

- This culture is also known as the Negro culture. It principally includes tropical Africa. Similar cultural systems can be seen among the American Red Indians, Latin American tribes, Australian aboriginals and several tribes of Asia-Pacific region.

- Historian Toynbee has used the term 'marginalised culture' for these traditional culture units. Some geographers even include Eskimos under this cultural realm. Thus, it is a widely scattered cultural realm characterised by marginalised and relatively isolated communities.

Major Culture Hearths

- Areas from which important culture traits, including ideas, technology, and social structures, are originated.

Folk Culture

- Culture traits that are traditional, no longer widely practiced by a large number of people, and generally isolated in small, often rural, areas.

Races

- The race is a group of people with more or less permanent distinguishing characteristics. There are skin colour and hair colour to which persons concerned attach certain interpretations. Objectives and scientific classification are the division of mankind in to racial groups should be done on the basis of measurable physical features and qualities inherited from a common ancestor. The important features on the basis of which the races are identified and classified include skin colour, stature, shape of head, face, nose, eye, type of hair, and blood group. Human races are classified in to four broad groups:

  1. Negroid, 2. Caucasoid, 3.Mongoloid and 4.Australoid.

HOTS
If human being originated from one point, Africa and spread to rest of the world, how could they become different races?

1. The Negroid

- They are usually called as "black race". They have the darkest skin tone than other races, and other common characteristics are the slopped forehead, thick lips, wide nose, and dark hairs. They are living in Sub-Sahara Africa.

2. The Mongoloid

- They have the folding eye lids, almond shaped eyes, yellowish skin tone, and V shaped cheeks. Native Americans and Eskimo are also classified as Mongoloid. Compared to the other races, they have the least body hair, least body odour, and smallest limb ratio. Their facial structure is likely to adapt cold mild wind. They are living in East Asia.

3. The Caucasoid

- The Caucasoid is known as "white people" characterised by the pointy nose, vertical forehead, pinkish/orange skin tone, visible brow ridge, and colorful eyes/hair. Some believe that their light skin tone is meant to receive more sunlight due to Europe's climate. Some believe that their nose structure is meant to keep the nose moisture from getting dried by the wind. They are living in Europe and Middle East.

4. Australoid Race

- They have visible eye ridge, wide nose, curly hair, dark skin tone, and short in height. Some believe that their visible ridge helps them to eat stiff foods. They are living in Australia and Papua New Guinea.

Characteristic of Major Races

Feature	Caucasoid	Monogoloid	Negroid
Skin colour	Pale reddish white to olive brown.	Saffron to yellow brown, reddish brown.	Brown to black brown yellow brown.
Stature	Medium to tall.	Medium tall to medium short	Tall to very short.
Face	Narrow to medium broad, tends to high no prognathism.	Medium broad to very broad malars high and flat tends to medium.	Medium broad to narrow tends to medium high strong prognathism.
Head form	Long-broad and short medium, high-very high	Medium height, predominantly broad.	Predominantly long low height.
Hair colour	Light blonde to dark brown,	Brown to brown black, straight.	Brown black light curl and wooly.

	straight to wavy.		
Body build	Linear to lateral slender to refuge.	Tend to be lateral, some linearity evident.	Tend to be linear and muscular.
Nose	Usually high, narrow to medium broad.	Low to medium form, medium broad.	Low, medium to very broad.
Blood group	more A than B	High in B	High is Rh(D)
Eye	Colour: light blue to dark brown, lateral eye –fold occasional.	Colour: brown to dark brown, medial epicanthic fold very common.	Colour: brown to brown block, vertical eye-fold common.

Ethnicity

- Ethnicity is a concept referring to a shared culture and a way of life. This can be reflected in language, religion, material culture such as clothing and cuisine, and cultural products such as music and art. Ethnicity is often a major source of social cohesion and social conflict. The world is home to thousands of different ethnic groups, from the Han Chinese (the largest ethnic group in the world) to the smallest indigenous groups, some of which include only a few dozen people. Almost all of these groups possess a shared history, language, religion, and culture, which provide group members with a common identity.

- India is a unique country with great diversity in ethnicities, race, religion, language, culture, cuisine and in every other aspect of the human society. Indian civilization is one of the oldest in the world and primarily consists of the Indo-Aryans of North India and the Dravidians of South India, the people of the Indus Valley Civilization while the former migrated to the country at about 1800 BC. As India has such a diverse cultural demographic, it makes sense that the country is also.

Dravidians

The Dravidian people are any native speakers of the Dravidian languages in the Indian Subcontinent. Almost all the Dravidians live in the southern part of India. The five major ethnic groups of Dravidian people in India are Tamil, Telugu, Kannada, Malayalam, and Tulu.

The ancient Indus Valley civilization in India was believed to have been of Dravidian origin in northern India, but then the Dravidian people were pushed south when the Indo- Aryans came in and the Kuru Kingdom in northern Indian arose. Later South India was dominated by the three Dravidian kingdoms of the Cheras, Cholas, and the Pandyas. These three kingdoms have been shown to sponsor the growth of literature, music, and the arts and to have done extensive trading. The three kingdoms also supported and were tolerant of Buddhism, Jainism, and Hinduism. The major languages spoken by the Dravidian people are Tamil, Telugu, Kannada, Malayalam, and Brahui.

Do you know?

Arabic script Brahui is the only Dravidian language which is not known to have been written in a Brahmi based script, instead, it has been written in the Arabic script since the second half of the 20th century in Iran Pakistan and Afghanistan.

Religion

- Religion is not a vague fear or unknown powers not the child of terror, but rather a relation of all the members of a community to a power that has the good of the community at heart and protects its law and moral order. Religion produces a distinct attitude towards life which affects the further development of the society. Indeed most cultural situations show the mutual interaction between religion and socio-economic and politico-cultural factors.

Classification of religion

- Religion may be classified based on the belief in god. Monotheistic: the followers of monotheism believe in a single god (Islam, Christianity). Polytheistic: the followers of polytheism believe in many gods (Hinduism). Another classification is on the basis of areas of origin such as Eastern religion, Western religion, far Eastern religion, African religion, Indian religion, etc. Geographers generally classify religions into following;

    - Universalizing religions – Christianity, Islam, and Buddhism.
    - Ethnic religions – Hinduism, Shintoism (Japan), Chinese faiths, Judaism.
    - Tribal or traditional religions – animism, shamanism, secular (non-religious and atheists).

Major religions of the world

- Major religions of the world are classified based on the followers. They are Christianity, Islam, Hinduism, Buddhism, and Judaism. Other important religions include Chinese folk religions, Sikhism, Confucianism, Shintoism etc.

- Christianity is a universal religion which has the largest number of followers in the world. They are spread in Europe, Anglo America, Latin America, Africa, Asia and Oceania. Its sacred book is "Bible". Islam is the second largest religion of the world. The largest concentration of the Islam is in the South West Asia, Central Asia, South Asia and South East Asia Followed by the North Africa. Shia and Sunni are its two main sects. Its sacred book is Kuran.

- Hinduism is the oldest ethnic religion of the world which was founded about 3000 B.C (B.C.E) in India. Today it has over 8 million followers in the world but main concentration is in India and Nepal. Nearly 99 percent of the total Hindu population is concentrated in south Asia. Its sacred books include the Vedas, the

Upanishads, the Epics, the Ramayana and Mahabharata, and the Bhagavad Gita. Buddhism is also one of the oldest religions of India which was founded by Lord Buddha around 525 B.C (B.C.E). Its spread in several Asian countries (China, Myanmar, India, Srilanka, japan, Mangolia, Korea and South East Asian countries) due to its liberal philosophy. Its two main sects are Hinayana and Mahayana.

- Judaism is the oldest Monotheistic faith which is regarded as the parent of Christianity. It originates 4000 years ago in the Middle East. At present it has about 14 million followers living in U.S.A, Europe and Asia. Chinese religions include two main beliefs called Confucianism and tao-ism. Confucianism was established by Confucious (551-479 B.C (BCE)). Taoism was established by Lao Tse (604-517 B.C (BCE)).

- Jainism is also born in India as a reaction to orthodox Hinduism. It was founded by Lord Mahavir who was a Contemporary of Lord Buddha. Its followers are mostly concentrated in India. It is an offshoot of Hinduism which was established in the 15th century by Guru Nanak. It remained confined to Punjab state and has accepted Gurumukhi as its language.

Tribal Religions

- Tribal religions are the special forms of ethnic religion. The tribal people are generally in the Neolithic stage of social development. Tribal people are strikingly different and diverse in their culture, social and economic life. They cherish their own distinct and have maintained a close relationship to the land and natural environment. Most of them live according to their traditions and are engaged in food gathering, hunting, fishing, primitive agriculture etc, there are about 300 million indigenous people worldwide, constituting about four percent of the total population of the world living in more than sixty countries.

Do you know?
The percentage of tribal to total population is as high as over 90 percent in Greenland, 66 percent in Bolivia and 40 percent in Peru. In India share of tribal people to total population is 8.2 percent.

- Sometimes the tribal people are being termed as the fourth world. The first – second and third world believed that "the land belongs to the people" whereas the fourth world believes that "the people belongs to the land

Tribal Distribution in world

- Sme major tribal group of the world particularly who are living and struggling

1. Equatorial Forest region: Pigmy, Semang, Sakai, Boro, Papuan, etc.

2. Grasslands: Masai, Kyrghizs, etc.

3. Tropical deserts: Bedowin, Bushman, Aborigines etc.

4. Mountainous region: Bhotia, gujjar, Naga etc.

5. Monsoon regions: Gonds, Santhals, Todas, Bhils, etc.

6. Arctic cold regions: Eskimo, Lapp, Alute, Chukchi etc.

Pigmies

- The pigmies are Negroid people and are also called Negrillos. They are the nearest approximation of human being to animal. They are short stature, flat nosed, wooly haired, long headed and black people. The average height of men and women are found 150cm. So they are also called dwarf. The pigmies are those who live in scattered parts of tropical Central Africa. They are found in many sub-groups in the equatorial forest region of Africa mainly in Congo basin 3^oN and 3^oS latitudes along both sides of the equator. In addition some groups of Pigmies are also found in the forests of Philippines and New Guinea.

Masai

- The Masai of east Africa belong to the pastoral society and are known as the best and most typical cattle herders not only of Africa but also of the world. Masai people are tall and slender with ling feet, hands and fingers. Their skin colour ranges from light chocolate to dark brown. They have high and long head, thin face and nose. Their lips are less thick than that of Negroid people. Masai occupy the interior plateau of the equatorial Africa. The territory of the Masai lies between 1^oN and 6^oS latitudes and covers all the rift valleys in this region.

Bedouin

- In Arabic, Bedouin means desert dwellers. The Bedouins are most important among the tribal of South West-Asia and North Africa. They are pastoral nomads and keep camel, sheep, goats, horse etc. The Bedouins occupy the desert areas of the Arabian Peninsula including Saudi Arabia, Yemen, Oman, Syria and Jordan. The Bedouins belongs to the mixture of Mediterranean and Armenian races. They are medium stature people with long narrow face, prominent nose, dark eyes and hair. Their complexion is wheatish to pale.

Bushman

- Bushman is the tribal people of Kalahari Desert in southern Africa who are still engaged in hunting and gathering economics. They are on constant run for both food and water. Their homeland Kalahari Desert lies in Botswana, Namibia and

southern Angola. The bushman territory is a wide plateau about 2000 meters above the sea level with sub-tropical climate. The bushman are including in the Negroid stock. They are very short in stature and have long head, short and flat ears, and yellowish brown complexion. On the whole the Negroid characteristics prevail among the Bushman.

Eskimos

- Eskimos also called Inuits are tribes of tundra cold region in Canadian northland, Alaska, Greenland and north-eastern Siberian coastal region. The Eskimos are Mongoloid race. The main physical characteristics of the Eskimos are short stature, Flat narrow face, small snub nose, yellow –brown complexion and coarse straight black hair. Hunting and fishing are the main occupations of the Eskimos. They live in igloo and practice hunting way known as Maupak. The Eskimos wear clothes of caribous or reindeers skin and other furs.

- Eskimos are migratory by nature and construct ice houses called Igloos. For travelling on ice shield the Eskimos use sledge which is usually built either of whale bone or of wood whichever is available. It is drawn by two or more dogs, caribous or rain deer.

Tribal in India

- India is the home to large number of indigenous people, who are still untouched by the lifestyle of the modern world. With more than 84.4 million, India has the largest population of the tribal people in the world. These tribal people also known as the adivasis are the poorest in the country, which are still dependent on haunting, agriculture and fishing. Some of the major tribal groups in India include Gonds, Santhals, Khasis, Angamis, Bhils, Bhutias and Great Andamanese. All these tribal people have their own culture, tradition, language and lifestyle. There are more than 50 tribal groups in India. Most of the tribal belong basically to the Negrito, Australoid and Mongoloid racial stocks.

Bhils

- Bhils are popularly known as the bow men of Rajasthan. They are the most widely distributed tribal groups in India. They form the largest tribe of the whole South Asia. Bhils are mainly divided into two main groups the central or pure bills and eastern or Rajput Bhils.

Gonds

- The Gonds are the tribal community mostly found in the Gond forests of the central India. They are one of the largest tribal groups in the world. Gonds have been largely influenced by the Hindus and for the long time have been practicing the Hindus culture and traditions.

Santhals

- Santhals are the third largest tribe in India. They are mostly found in the states of West Bengal, Bihar, Odisha, Jharkhand and Assam. They belong to the pre-Aryan period and have been the great fighters from the time of the British.

Munda

- Munda tribe mainly inhabit in the region of Jharkhand, although they are well spread in the states of West Bengal, Chhattisgarh, Odisha and Bihar. Munda generally means headman of the village. Hunting is the main occupation of the Mundas tribe.

Khasi

- Khasi tribe is mainly found in the KhasiJaintia hills in Meghalaya and in the states of Punjab, Uttar Pradesh, Manipur, West Bengal and Jammu and Kashmir. They form the large part of the population in the state of Meghalaya.

Angami

- Angami tribe belongs to the extreme north eastern part of the country, in the state of Nagaland. The total population of the Angamis is around 12 million. They are quite popular for their woodcraft and artwork. Sekrenyi is the main festival celebrated among the Angamis in Nagaland.

Bhutia

- Bhutia tribes are of the Tibetan origin. They migrated to Sikkim around 16th century. In the northern part of the Sikkim they are known as the Lachenpas and Lachungpas. Bhutias forms 14% of the total population of Sikkim. Losar and Losoong are the main festivals celebrated among the Bhutia tribes.

The Sentinelese tribe, the most dangerous tribe in the world!

Located far into Andaman and Nicobar Islands, the Bay of Bengal in the Indian Ocean, North Sentinel Island is one of the most isolated places on earth. This remote island is home to the Sentinelese tribe, the most dangerous tribe in the world. The Sentinelese is hunter-gatherers, as agriculture is not known to them. Their diet consists mainly of coconuts and fish that can be found in the shallow waters around their shores. The Sentinelese would be described as Stone Age people. The women wear fibre strings tied around their waists, necks and heads. The men also wear necklaces and headbands, but with a thicker waist belt. The men carry spears, bows and arrows. Sometimes the Sentinelese appeared to make friendly gestures at others they would take the gifts into the forest and then fire arrows at the contact party. The population of North Sentinel Island is estimated at 250 individuals. The Sentinelese does not want help from outsiders.

Chenchu

- Chenchu inhabit in the Nallamalai hills, which have been the part of the Nagarjuna Segar Tiger Sanctuary for centuries in Andhra Pradesh, India. They are mainly found in the districts of Mahabubnagar, Nalgonda, Praksham, Guntur, and Kurnool.

Great Andamanese

- Great Andamanese is the Negrito tribe inhabitant in the Andaman group of Islands. They form the largest population among the other tribes found in these islands. According to the census the population of Great Andamanese is now limited to few individuals.

Tribals in Tamil Nadu

- Tribes of Tamil Nadu are concentrated mainly in the district of Nilgiris. Of all the distinct tribes, the Kodas, the Thodas, the Irulas, the Kurumbas and the Badagas form the larger groups, who mainly had a pastoral existence. Other tribes include, Kattunayakan and Paliyan amongst others.

- According to census 2011, tribal population in Tamil Nadu is 7, 94,697. There are around 38 tribes and sub-tribes in Tamil Nadu. The tribal people are predominantly farmers and cultivators and they are much dependent on the forest lands.

- Toda**:** Men from the family of the tribes are occupied in milking and grazing their large herds of buffaloes. Their settlements are known as 'Munds'. They do not worship any god and their consciousness is cosmic. They live in Nilgiris. Today, there are about a thousand Todas left.

- **Badaga**: The Badagas belong to the backward class and are not classified as tribal. They are an agricultural community, dwelling in the higher plateau of the Nilgiris district in the state of Tamil Nadu. They are engaged in tea cultivation and potato growing. They form the largest group of tribes and boast a rich oral tradition of Folk tales, songs and poetry. These tribes are Hindu and belong to the Shiva sect.

- **Kota:** The Kotas are mainly concentrated in the Tiruchigadi area in the Nilagiri hills. They are distinguished by their colorful Folk dances and are basically musicians, who play at Badaa funerals. They are mainly engaged in producing handicrafts. These tribes of Tamil Nadu are expert iron smiths, potters and carpenters. In order to maintain distance and status in society, the Kotas implement elaborate tattoos.

- **Kurumbas**: The Kurumbas tribes of this state inhabit the intermediate valleys and forests in Villages and were known for their black magic and witchcraft in the past. Their way of living today has changed from their original gathering and hunting existence to working in Coffee and Tea plantations as laborers. Kurumbas are perhaps the only main caste in southern India that has a specialized and distinctive Kurumbas Language.

- **Irula**: The Irula tribes of Tamil Nadu occupy the lower slopes and forests at the base of the Nilgiri Hills. They constitute the second largest group of tribes after the Badagas and are similar to the Kurumbas in many ways. This tribe produces honey, fruits, herbs, roots, gum, dyes etc., and trades them with the people in the plains. In the recent times the Irulas help in catching snakes and collect the snake venom.

- **Paliyan:** They are of the food gathering communities of Tamil Nadu. It is believed that the Paliyan originally belonged to the Palani hills. They are distributed in the districts of Madurai, Tanjavour, Pudukkottai, Tirunelveli and Coimbatore.

Language

- Language is an identification mark for different cultures. Because language is essential to communication, it strongly influences the sort of political, social and economic we create. As a result, economic and religious system frequently follows patterns of language distribution and political borders quite often parallel linguistic boundaries. In modern times linguistic diffusion has been facilitated by trade, tourism, media and international organizations. It has helped in the development of the linguistic pluralism. The greatest linguistic diversity is attributed to heterogeneous societies.

Do you know?
Tamil is one of the longest-surviving classical languages in the world. The earliest period of Tamil literature, Sangam literature, is dated from 300 BC (BCE) – AD (CE) 300. It has the oldest extant literature among Dravidian languages.

Major linguistic Families of the World

- The classification of languages by origin and historical development is known as a genetic classification. The languages which are the descendants of common ancestral language are called proto – language.

- G.L. Trage has classified the languages of the world into 7 linguistic phylum and 30 linguistic families. Linguistic families are further classified in to sub families of languages, which denote major languages.

- 1.Indo-European - a. Indo-Iranian, b. Latin or Romantic, c. Germanic, d. Balto –Slavic, e. Celtic, f. Hellenic
- Sino-Tibetan - a. Chinese, b. Tibetan, c. Burman
- Afro-Asiatic – a. Semitic, b. Egyptian, c. Cushitic, d. Chadic
- African – a. Niger – Congo (Atlantic, Voltaic, Benu-Nagar)
  b. Sudanic (Chari-Nile, Saharan,)
  c. Click Languages (Khoisan)
- Ural-Altaic - a. Finno-Igric, b. Turkic, c. Mangolic, d. Tunguzic
- Dravidian- malayo – Polynesian- - a. Dravidian, b. Malayan, c. Melanesian, d. Micronesian, e. Polynesian, f. Austro- Asiatic.
- Palaeo Asiatic- a.Yukaghir

Do you know?
As many as half of the world's 7,000 languages are expected to be extinct by the end of this century; it is estimated that one language dies out every 14 days.

Major Languages of India

- India has a rich Linguistic heritage and has heterogeneous ethnic and social groups, which have their own languages and dialects. According to census of India 1961, there were 187 languages spoken by various sections of Indian society. 23 major languages were spoken by about 97 percent population of the country. 22 languages excluding English are mentioned in the eighth schedule of the constitution of India as follows; Kashmiri, Punjabi, Hindi, Urdu, Bengali, Assamese, Guajarati, Marathi, Kannada, Tamil, Telugu, Malayalam, Sindhi, Sanskrit, Oriya, Nepali, Kongani, Manipuri, Bodo, Dogri, Maithili and Santali of these languages, 14 were initially included in the Constitution. Subsequently, Sindhi was added in 1967 by 21st constitutional amendment act; Konkani, Manipuri and Nepali were added in 1992 by 71st Constitutional Amendment Act; and Bodo, Dogri, Maithili and Santali were added in 2003 by 92nd Constitutional Amendment Act. Indian Languages belong mainly to four linguistic families

  - Austric – Munda, Mon-Khmer
  - Dravidan – Tamil, Telugu, Kannada, Malayalam, Gondi, kurukh, orean, etc.
  - Sino- Tibetan- Bodo, Karen, Manipuri, etc.
  - Indo - Aryan – Hindi, Urdu, Sans.

Dialect

- A distinct linguistic form peculiar to a region or social group but which nevertheless, can be understood by speakers of other forms of the same language. The two main types of dialects are the **geographic dialect,** spoken by the people of the same area or locality, and the **social dialect** used by people of the same social class, educational level or occupational group.

Major dialects **in India**

- More than 40 languages or dialects in India are considered to be endangered and are believed to be heading towards extinction as only a few thousand people speak them officials said.

- According to a report of the census Directorate, there are 22 scheduled languages and 100 non –scheduled languages in India. The scheduled languages are 11 from Andaman and Nicobar, Seven from Manipur and Four from Himachal Pradesh. There are 42 languages spoken by less than 10,000 people. Some other languages also are in endangered position in India.

Major dialects in Tamil Nadu

- Tamil is an interesting language with a range of native dialects. The language has several charming improvisations in different regions of the state. Many people are familiar with the old and familiar dialects of Tamil such as Chennai, Coimbatore, Madurai and Tirunelveli

UNESCO'S five levels of language risk:
Safe: Widely spoken
Vulnerable: Not spoken by children outside the home (600 languages)
Definitely endangered: Children not speaking (646 languages)
Severely endangered: Only spoken by oldest generations (527 languages)
Critically endangered: Spoken by only a few members of the oldest generation, often semi-speakers (577 languages)

Political Geography - Concept of Nation and State
Nation

- A nation is a group of people who see themselves as a cohesive and coherent unit based on shared cultural or historical criteria. Nations are socially constructed units, not given by nature. Their existence, definition, and members can change dramatically based on circumstances. Nations in some ways can be thought of as "imagined communities" that are bound together by notions of unity that can pivot around religion, ethnic identity, language, cultural practice and so forth.

State

- A State is an independent, sovereign government exercising control over a certain spatially defined and bounded area, whose borders are usually clearly defined and internationally recognized by other states.

Do you know?

Vaishali was established as a republic by the 6th century B.C (BCE), prior to the birth of Gautama Buddha in 563 B.C (BCE), making it the world's first republic.

Nation-State

- The nation state is a system of organization defined by geography, politics and culture. The nation is cultural identity that is shared by the people, and the state is the governing administration. A nation state must have a shared national identity, physical borders, and a single government.

- A nation-state is a political unit with a well-defined territory, inhabited by a people who are well-organised, possess sufficient powers and consider them to be a nation by virtue of certain binding factors which may be emotional and which are reflected in law and governance.

Frontiers and Boundaries

- **Frontiers:** International frontiers and boundaries separate land, rivers and lakes subject to different sovereignties. In 1900 frontiers had almost disappeared and had been replaced by boundaries that are lines. A Frontier is a politico geographical area, lying beyond defined borders of a political unit into which expansion could take place.

Types of Boundaries

- Boundaries can be classified according to their relationship with the cultural landscape. Some boundaries were established prior to the permanent occupation of areas by the present inhabitants. In some cases patterns of settlement were already developing so that the boundary ultimately established has a different relationship to the cultural realities of the area involved. This classification is known as the functional or genetic classification of boundaries.

Different between Frontier and Boundary

Frontier	Boundary
1. Natural	1. Mostly Anthropogenic.
2. Areal Concept	2. Linear Concept.
3. Frontiers have no political dispute.	3. Boundaries vary often disputable by the rival nations.
4. Frontiers generally have mountainous area, desert, marshes, etc. Thus, inhabitable.	4. But boundaries have no such criteria.
5. Frontiers are dynamic.	5. Boundaries are static because once fixed, they hardly change.

Boundaries: A boundary is a line demarcating the recognised limit of an established political unit, administrative region or geographical region e. g a state, country or district.

Do you know?
China has the maximum number of neighbors touching its border. The 14 countries touching its border are: India, Pakistan, Afghanistan, Tajikistan, Kyrgyzstan, Kazakhstan, Mongolia, Russia, North Korea, Vietnam, Laos, Myanmar, Bhutan and Nepal

Do you know?
Canada, the world's second largest country, shares the longest international land border with the United States. The Canada- US land border is 8,893 km long.

Genetic Classification of the boundaries

1. Antecedent Boundaries
The boundaries drawn before the cultural-political realm.

Such boundaries were non-contentious.
E .g, N. Africa and the state boundaries of USA.

2. The Subsequent Boundaries
When the cultural realms are fully developed & political boundaries are contentious.

Such boundaries are irregular or amorphic boundaries.
E.g. the countries of Europe.

3. Superimposed Boundaries

When a political boundary divides a homogenous cultural region and across the boundary the people with similar ethnicity are found.
E.g. Pok

4. Relict Boundaries

Historical boundaries which only exist in the books.

E .g. Persia, the boundary between east & West Germany.

Geopolitics: Global Strategic views

- The study of the way a country's size, position, etc, influence its power and its relationships with other countries. Political activity is influenced by the physical features of a country or area of the world. Geo politics is concerned with how geographical factors including territory, population, strategic location, and natural resources endowments as modified by economics and technology affect

the relations between states and the struggle forward domination. It is battle between land power and sea power which is going to lead the world continents by one.

- Mackinder described the political history of the world as continuous struggle between land and sea powers. According to him, the Columbian era of sea powers, which gave Europe its pivotal position for four centuries is coming to an end. And in the struggle between land and sea powers, the ultimate victory is going to be of one possessing land powers. He divided the earth into 3 tiers.

1) The Heartland - area of interior and Arctic drainage in the Eastern Europe, covered by mountains on three sides and Arctic in north. This is a natural fortress on earth, inaccessible to sea powers.

2) The Inner or Marginal Crescent - area of Europe and Asia adjoining the Heartland and Africa, north of Sahara.

3) The Outer or Insular Crescent - It includes North and South America, Africa (south of Sahara) and Australia. Besides, it also includes the Great Britain and Japan because of their insularity from Eurasia.

- According to Mackinder, one with control over Heartland will be in an unstoppable position to rule the world. Heartland, with its agricultural and industrial resources would conquer the inner crescent and Outer crescent would follow later. He conceptualized his theory as:

Who rules East Europe commands the Heartland.

Who rules Heartland commands World Island.

Who rules World Island commands the World.

- Mackinder later argued that key to control Heartland lays in Eastern Europe, reflecting a powerful strand of pre and post- Versailles geographical thinking concerning the news to separate the powerful states of Germany and Russia by the creation of 'buffer states'.

- Influence - His theory was put to test during the World War II when the Heartland could become the power center of the world if either Germany unites with Russia or China or Japan thrashes Russia. But the shattering defeat of Germany turned Heartland into a power vacuum.

- The area highlighted in red is the heartland, blue is rim land and the encircled area is the world island.

- The heartland is inaccessible from top because North Sea, Norwegian Sea, Barents Sea, Kara Sea, Laptev Sea, East Siberian Sea are all frozen throughout the year. The hearland is inaccessible from the bottom because of Middle Eastern desert, Iranian Plateau, Himalayas, Plateau's of Tibet and Siberian mountains. This makes heartland immune to any conquests from any other side than Eastern Europe.

- The only gateway to the heartland is through Eastern Europe. So, protecting one gateway would be far easier than protecting the whole land. Moreover, the heartland was self-sufficient with most of the resources and wasn't dependent on trade from outside world.

- So, Mackinder believed that the one who controls the heartland would be able to control the Rimland and as a result the world-Island, and the one, who rules the world Island, would rule the world. Although this theory made sense at that time (1904), when there was no significant aviation and naval power, it does not make much sense now.

Century Geopolitics of the multipolar world order

- To put it succinctly, the unipolar world is characterized by the US' predominant hegemony in a wide variety of spheres, whether exercised directly through unilateral initiatives or indirectly ("Lead From Behind") through its regional and institutional partners. The Multipolar forces in the world are working to replace the US-led international order with a diversified array of multiple stakeholders in order to bring balance to International Affairs. Importantly, they seek to do this through progressively reforming international institutions such as the UN, IMF, World Bank, and others, as well as creating their own counterparts to some of them like the BRICS New Development Bank or outright forming entirely new and unprecedented organizations like the SCO.

- One of the latest proposals has been to broaden the BRICS format through what has now been called the "BRICS-Plus" strategy, which essentially seeks to have each of the five member states encourage multilateral cooperation between each other's respective regional integration organizations. As Russian Valdai Club expert YaroslavLissovolik describes it, this could see Mercosur, the SADC, and the Eurasian Economic Union, SCO, SAARC, and ASEAN all cooperating with one another in changing the world order.

Missile Defense Shield, Prompt Global Strike, and the Naval Race

- The basis of American control over the world is through economic means as enforced by military ones. In certain cases, though, the US is unable to directly attack its rivals such as Russia and China without suffering unacceptable damage through a nuclear second strike, ergo why Washington is pushing to build anti-missile installations all around Eurasia in order to ring in these Great

Powers and diminish their most credible deterrent capability. Complementary with this are the US' space weapons, whether based in this theatre (X37-B and the policy of "Prompt Global Strike") or directed towards it (anti-satellite weapons, whether kinetic such as missiles or non-kinetic like lasers).

- Neither the US' missile shields nor its space-related weaponry are sufficient enough for ensuring that the country is defended from submarine-launched ballistic missiles, which form a crucial component of any country's nuclear triad. This explains why there's an ongoing naval race across the world as the US seeks to ensure its dominance in the high seas in the face of rising competition from Russia, China, and others. The global ocean is also important for another reason as well, and this one relates back to the economic basis of American dominance over the world. China depends on the international waterways for the vast majority of its trade, which makes it inordinately vulnerable to any US efforts to block certain chokepoints such as the Strait of Malacca and Suez Canal.

OBOR's Global Reorganization

- Understanding the sudden systemic-shaking consequences that any hostile action like this could inflict for China's domestic socio-economic stability, the People's Republic prudently foresaw the need to pioneer ambitious trans-continental trade routes to its crucial European partner, as well as secure the Sea Lines Of Communication (SLOC) along its existing maritime ones in order to safeguard its access to the growing economics of Africa. The latter are exceptionally important nowadays because their growth is expected to allow Beijing to relieve itself of its industrial overproduction so long as it can succeed in building up these marketplaces and stabilizing them. As for the Western Hemisphere, China wants to increase its soft presence here as a means of competing with the US and asymmetrically countering America's moves in the South China Sea.

- Altogether, the above stratagem explains the essence of China's One Belt One Road (OBOR) global vision of New Silk Road connectivity, which is designed to transform the world's trading networks so as to facilitate the transition from a unipolar American-led international order to a diversified Multipolar one safeguarded by a host of Great Powers. It also, however, provides the blueprint for how the US will oppose the greatest threat thus far to its worldwide hegemony, as all that Washington has to do is encourage identity-centric Hybrid Wars in the geostrategic transit states along these corridors in order to disrupt, control, or influence them in ways which remove their Multipolar game-changing impact.

Geopolitics and the New World Order

- The global elite–leading academics, intellectuals, foreign policy analysts, foundation heads and corporate power brokers, as well as many Western

leaders–may largely have forgotten about it. But what we're witnessing now is geography's revenge in the East-West struggle for control of the buffer state of Ukraine, in the post–Arab Spring fracturing of artificial Middle Eastern states into ethnic and sectarian fiefs and in the unprecedented arms race being undertaken by East Asian states as they dispute potentially resource-rich waters. Technology hasn't negated geography it has only made it more precious and claustrophobic.

- Whereas the West has come to think about international relations in terms of laws and multinational agreements, most of the rest of the world still thinks in terms of deserts, mountain ranges, all-weather ports and tracts of land and water. The world is back to the maps of elementary school as a starting point for an understanding of history, culture, religion and ethnicity–not to mention power struggles over trade routes and natural resources.

- Europe's modern era is supposed to be about the European Union triumphing over the bonds of blood and ethnicity, building a system of laws from Iberia to the Black Sea–and eventually from Lisbon to Moscow. But the E.U.'s long financial crisis has weakened its political influence in Central and Eastern Europe. And while its democratic ideals have been appealing to many in Ukraine, the dictates of geography make it nearly impossible for that nation to reorient itself entirely toward the West.

- Russia is still big, and Russia is still autocratic after all it remains a sprawling and insecure land power that has enjoyed no cartographic impediments to invasion from French, Germans, Swedes, Lithuanians and Poles over the course of its history. The southern Crimean Peninsula is still heavily ethnic Russian, and it is the home of Russia's Black Sea fleet, providing Russia's only outlet to the Mediterranean.

- In short, Russia will use every geographical and linguistic advantage to weaken Ukraine as a state. Ukraine is simply located too far east, and is too spatially exposed to Russia, for it ever to be in the interests of any government in Moscow–democratic or not–to allow Ukraine's complete alignment with the West.

- To live in a world where geography is respected and not ignored is to understand the constraints. Many obstacles simply cannot be overcome. That is why the greatest statesmen work near the edges of what is possible. Geography establishes the broad parameters– only within its bounds doe's human agency have a chance to succeed.
- While our foreign policy must be morally based, the analysis behind it must be cold-blooded, with geography as its starting point. In geopolitics, the past never dies and there is no modern world.

Disaster management	**6 th term 3**	**Unit 3. Understanding Disaster**
	8 th term 2	**Unit 2 - Hazards**
	9 th book	**Unit 8 – Disaster Management**
	10th Volume 2	**Unit 7 – Human Geography of Tamil Nadu**
	11th Geography	**Unit 8 - Culture and Political Geography**
	12th geography	**Man Made Disasters**

6th term 3

6. Understanding Disaster

Disaster is a very common phenomenon in the human society. It has been experienced by people since time immemorial. Though its form may be varied, it has been a challenge for society. The latest development which has been discovered in the World Disaster Reports recently is that, the disasters have increased in frequency and intensity. India is one of the most disaster prone countries in the world. It has some of the world's most severe droughts, famines, cyclones, earthquakes, chemical disasters, rail accidents and road accidents. The high density of population in the developing countries, especially in the high risk coastal areas, results in millions of people getting affected by natural disasters, especially in recurring disasters like floods, cyclones, storm surges, etc.

Disaster	
Natural Disasters	**Man- Made Disasters**
✓ Earthquakes ✓ Volcanoes ✓ Tsunamis ✓ Cyclones ✓ Floods ✓ Landsides ✓ Avalanches ✓ Thunder & Lightning	✓ Fire ✓ Destruction of buildings ✓ Accidents in industries ✓ Accidents in transport ✓ Terrorism ✓ Stampede

Disaster:

'A disaster is a serious disruption of the functioning of a society involving human and material loss. Disaster is broadly classified into natural and man-made disasters.

Natural Disaster:

1. **Earthquake:** The sudden shaking of the earth at a place for a short spell of time is called an earthquake. The duration of the earthquake may be a few seconds to some minutes. The point where an earthquake originates is called its 'focus'. The vertical point at the surface from the focus is called 'epicentre'.
2. **Volcanoes:** Volcanoes are openings or vents where lava, small rocks and steam erupt onto the earth's surface.
3. **Tsunami:** Tsunami are waves generated by earthquake, volcanic eruptions and underwater landslides.
4. **Cyclones:** A low pressure area which is encircled by high-pressure wind is called a cyclone.
5. **Floods :** An overflow of a large amount of water, beyond its normal limits, especially on the rainfed areas is called a flood.
6. **Landslide:** The movement of a mass of rocks, debris, soil etc., downslope is called a landslide.
7. **Avalanche:** A large amount of ice, snow and rock falling quickly down the side of a mountain is called an Avalanche.
8. **Thunder and lightning:** Thunder is a series of sudden electrical discharge resulting from atmospheric conditions. This discharge results in sudden flashes of light and trembling sound waves which are commonly known as thunder and lightning.

Man Made Disasters:

1. **Fire:** Massive forest fires may start in hot and dry weather as a result of lightning, and human carelessness or from other causal factors.
2. **Destruction of buildings:** Demolition of buildings by human activites.
3. **Accidents in industries:** Chemical, biological accidents that occur due to human error. (e.g.) Bhopal gas tragedy
4. **Accidents in Transport:** Violation of road rules, carelessness cause accidents.
5. **Terrorism:** The social unrest or differences in principles leads to terrorism.
6. **Stampede:** The term stampede is a sudden rush of a crowd of people, usually resulting in injuries and death from suffocation and trampling.

Tsunami and floods

A killer Tsunami hit the south east Asian countries on the 26th of December, 2004. A massive earthquake with a magnitude of 9.1 -9.3 in the Richter scale epicentre in the Indonesian island of Sumatra. It triggered one of the biggest Tsunamis the world had ever witnessed. The massive waves measuring up to 30

metres that killed more than 2,00,000 people of Asia. In India, over 10,000 people were killed by this disaster. Tamil Nadu alone accounted for 1,705 deaths. All the coastal districts were affected, Nagapattinam was the worst hit in the state of Tamil Nadu. Fishermen, tourists, morning walkers, children playing in beach and people living on the coast were unprepared for the waves. So they lost their life and the most of the loss of lives and damage to property was within 500 metres of the shore. After that the Indian government set up a Tsunami Early Warning System at Indian National Centre for Ocean Information Services (INCOIS), Hyderabad in 2007.

Tsunami - Do's and Don'ts

- ✓ You should find out if your home, school etc., are in vulnerable areas along sea shore.
- ✓ Know the height of your street above sea level.
- ✓ Plan evacuation routes and practise your evacuation routes.
- ✓ Discuss tsunamis with your family. Review safety and preparedness measures with your family.
- ✓ If you see the sea water receding, you must immediately leave the beach and go to higher ground far away from the beach.
- ✓ Don't go to the coast to watch the Tsunami.
- ✓ Don't try to surf the tsunami waves.
- ✓ Be aware facts about tsunami.

Floods: Floods are high stream flows, which overlap natural or artificial banks of a river or a stream and are markedly higher than the usual flow as well as inundation of low land.

Types of floods

- **Flash floods**: Such floods that occur within six hours during heavy rainfall.
- **River floods**: Such floods are caused by Precipitation over large catchment areas or by melting of snow or sometimes both.
- **Coastal floods**: Sometimes floods are associated with cyclone high tides and tsunami.

  - ✓ Causes of floods
  - ✓ Torrential Rainfall.
  - ✓ Encroachment of rivers bank.
  - ✓ Excessive rainfall in catchment.
  - ✓ Inefficient engineering design in the construction of embankments, dams and canals.

- **Effects of floods**

  - ✓ Destruction of drainage system
  - ✓ Water pollution
  - ✓ Soil erosion
  - ✓ Stagnation of water
  - ✓ Loss of agricultural land and cattle
  - ✓ Loss of life and spread of contagious diseases.

Do's

To find out if the settlement area is to be affected by flood or not. Keeping radio, torch and additional batteries, storing drinking water, dry foods items, salt and sugar. Safeguarding materials like kerosene, candle, match box, clothes and valuable things.

- ✓ Keeping umbrella and bamboo poles.
- ✓ Keeping first aid box and strong ropes to bind things.
- ✓ To dig canals from the farm land, to drain the excessive water keeping sand bags etc.,

Don'ts

- ✓ Try to connect electricity once it is cut.
- ✓ Operate vehicles
- ✓ Swim against floods
- ✓ Avoid going on excursions.
- ✓ Neglect flood warning messages

During floods

- ✓ Cut off gas connection and electricity.
- ✓ Keep sand bags on drainage holes and bathroom holes.
- ✓ Leave immediately through the known passage or prescribed passage
- ✓ Drink hot water.
- ✓ Use bleaching powder to keep your environment hygienic.
- ✓ Before using match sticks and candles, ensure that there is no gas leakage.
- ✓ Don't eat more food when you are affected by diarrhoea.
- ✓ Don't try to take anything that floats in flood.

Disaster Risk Reduction (DRR)

Disaster Risk Reduction: The practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters. There are

four key approaches to public awareness for disaster risk reduction. Campaigns, participatory learning, informal education, and formal school based interventions.

Forecasting and Early Warning

- ✓ Weather forecasting, Tsunami early warning system, cyclonic forecasting and warning provide necessary information which help in reducing risks during disasters.

- ✓ School Disaster Management Committee, Village Disaster Management Committee, State and Central government institutions take mitigation measures together during disaster.

- ✓ Newspaper, Radio, Television and social media bring updated information and give alerts on the vulnerable area, risk, preparatory measures and relief measures including medicine..

Unit 2
Hazards

Introduction

Teacher : Good morning students.
Students : Good morning teacher.
Teacher : Are all present today?
Krithika : No teacher, Shruthi is absent today.
Teacher : Why is she absent today?
Pavithra : Teacher, don't you know what happened to her?
Teacher : No my dear child, what happened to her?
Theshmitha : Teacher, Yesterday, while returning home, she was struck by a big branch of a tree due to heavy rain and got injured.
Teacher : Oh my God….what a pity? Students, you all must be very careful while moving around to avoid the problems from hazards.
Kamalesh : Teacher, what do you mean by hazards? You mean the Belgian football player **'Hazard'**?
Teacher : No…no, it is an event which can affect the living and non-living things of earth. I think today is the right day to get into the interesting chapter 'hazards'.

Hazards

In the beginning of twenty-first century, the earth supported a human population that was more numerous and found healthier and wealthier than ever before. At the same time, there were a lack of awareness on the risks that faced by the people. By keeping this in mind, the present lesson of hazards is intended to familiarise the different types of hazards to promote awareness among students regarding hazards.

Hazards are defined as a thing, person, event or factor that poses a threat to people, structures or economic assets and which may cause a disaster. They could be either humanmade or naturally occurring in the environment. The word 'hazard' owes its origin to the word 'hasart' in old French meaning a game of dice (in Arabic – az-zahr; in Spanish – azar).Though the society experiences several types of hazards, it is important for a region to be aware of those threats that are most likely to affect the community most severely.

A natural hazard is a natural process and event that is a potential threat to human life and property. The process and events themselves are not a hazard but become so because of human use of the land.

A disaster is a hazardous event that occurs over a limited time span in a defined area and causes great damage to property/ loss of life, also needs assistance from others.

A catastrophe is a massive disaster that requires significant expenditure of money and a long time (often years) for recovery

Types of Hazards

Some hazards occur frequently and threat the people. Hazards are classified in different ways.

I. Based on their causes of occurrence.
II. Based on their origin.

I. Based on their causes of occurrence

Hazards can be broadly classified into three types: natural, human-made and socio-natural hazards.

1. Natural hazards: These are the results of natural processes and man has no role to play in such hazards. The main examples of natural hazards are earthquakes, floods, cyclonic storms, droughts, landslides, tsunamis and volcanic eruptions.

2. Human-made hazards: these are caused by undesirable activities of human. It can result of an accident, such as an industrial chemical leak or oil spill, or an intentionalact. Such hazards can disturb the safety, health, welfare of people and cause damage or destruction to property. The following are the examples of human-made hazards. They are explosions, hazardous wastes, pollution of air, water and land, dam failures, wars or civil conflicts and terrorism.

3. Socio-natural hazards (Quasi-natural hazards):these are caused by the combinedeffect of natural forces and misdeeds of human. Some of the examples are:

- The frequency and intensity of floods and droughts may increase due to indiscriminate felling of trees, particularly in the catchmentareas of the rivers.

- Landslides are caused by natural forces and their frequency, and impact may beaggravated as a result of construction of roads, houses etc., in mountainous areas,excavating tunnels and by mining andquarrying.

- Storm surge hazards may be worsened by the destruction of mangroves.

- Smog is a serious problem in most big urban areas. The emissions from vehicles and industries, combustion of wood and coal together combined with fog leads to smog.

II. Based on their origin

Hazards can be grouped into eight caregories

1. Atmospheric hazard – Tropical storms, Thunderstorms, Lightning, Tornadoes, Avalanches, Heat waves, Fog and Forest fire.
2. Geologic/Seismic hazard – Earthquakes, Tsunamis, Landslides and Land subsidence.
3. Hydrologic hazard – Floods, Droughts, Coastal erosion and Storm surges
4. Volcanic hazard – Eruptions and Lava flows.
5. Environmental hazard – Pollution of soil/ air/water, Desertification, Global warming and Deforestation.
6. Biological hazard – Chickenpox, Smallpox, AIDS [HIV] and Killer bees.
7. Technological hazard – Hazardous material incidents, Fires, Infrastructure failures [Bridges, Tunnels, Dams] and Nuclear/ Radiological accidents.
8. Human-induced hazard – Terrorism, Mass shootings, War, Transportation accidents and Civil disorder

1) Earthquakes

Earthquake is a violent tremor in the earth's crust, sending out a series of shock waves in all directions from its place of origin. Earthquake prone regions of the country have been identified on the basis of scientific inputs relating to seismicity, earthquakes occurred in the past and tectonic setup of the region. Based on these inputs, Bureau of Indian Standards has grouped the country into four seismic zones: Zone II, Zone III, Zone IV and Zone V (No area of India is classified as Zone I).

Seismic Zones of India

Seismic Zones	Level of Risk	Regions
Zone V	Very High	Comprises entire northeastern India, parts of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Rann of Kutch in Gujarat, part of North Bihar and Andaman &Nicobar Islands
Zone IV	High	Covers remaining parts of Jammu and Kashmir and Himachal Pradesh, National Capital Territory (NCT) of Delhi, Sikkim, northern parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan
Zone III	Moderate	Comprises Kerala, Goa, Lakshadweep Islands, remaining parts of Uttar Pradesh, Gujarat and West Bengal, parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Odisha, Andhra Pradesh, Tamil Nadu and Karnataka.

Zone II	Low	Covers remaining parts of country.

2) Floods

Flood is an event in which a part of the earth's surface gets inundated. Heavy rainfall and large waves in seas are the common causes of flood

The major causes of floods are:

A. Meteorological factors

i) Heavy rainfall
ii) Tropical cyclones
iii) Cloud burst

B. Physical factors

i) Large catchment area
ii) Inadequate drainage arrangement

C. Human factors

i) Deforestation
ii) Siltation
iii) Faulty agricultural practices
iv) Faulty irrigation practices
v) Collapse of dams
vi) Accelerated urbanisation

The following map shows the major flood prone areas in India. Gangetic plains covering the states of Punjab, Haryana, Uttar Pradesh, North Bihar, West Bengal and Brahmaputra valley are the major flood prone areas in north and northeast India. Coastal Andhra Pradesh, Odisha and southern Gujarat are the other regions which are also prone to flood often.

3) Cyclonic Storms

A cyclonic storm is a strong wind circulating around a low pressure area in the atmosphere. It rotates in anti-clockwise direction in Northern Hemisphere and clockwise in the Southern Hemisphere.

Tropical cyclones are characterised by destructive winds, storm surges and exceptional levels of rainfall, which may cause flooding. Wind speed may reach upto 200 km/h and rainfall may record upto 50 cm/day for several consecutive days.

A sudden rise of seawater due to tropical cyclone is called storm surge. It is more common in the regions of shallow coastal water.

East coastal areas vulnerable to storm surges

i) North Odisha and West Bengal coasts.
ii) Andhra Pradesh coast between Ongole and Machilipatnam.
iii) Tamil Nadu coast (among 13 coastal districts, Nagapattinam and Cuddalore districts are frequently affected).

West coastal areas vulnerable to storm surges

The west coast of India is less vulnerable to storm surges than the east coast.
i) Maharashtra coast, north of Harnai and adjoining south Gujarat coast and the coastal belt around the Gulf of Cambay.
ii) The coastal belt around the Gulf of Kutch.

4) Droughts

Any lack of water to satisfy the normal needs of agriculture, livestock, industry or human population may be termed as a drought. Further, the drought could be classified into three major types as,

i) **Meteorological drought:** it is a situation where there is a reduction in rainfall for a specific period below a specific level.

ii) **Hydrological drought:** it is associated with reduction of water in streams, rivers and reservoirs. It is of two types, a) Surface water drought, and b)Groundwater drought.

iii) **Agricultural drought:** it refers to the condition in which the agricultural crops get affected due to lack of rainfall

Drought

Droughts in India occur in the event of a failure of monsoon. Generally monsoon rainfall is uneven in India. Some areas receive heavy rainfall while other regions get moderate to low rainfall. The areas which experience low to very low rainfall are affected by drought.

The major areas highly prone to drought are:

1) The arid and semi-arid region from Ahmedabad to Kanpur on one side and from Kanpur to Jalandhar on the other.

2) The dry region lying in the leeward side of the Western Ghats.

5) Landslides

Landslide is a rapid downward movement of rock, soil and vegetation down the slope under the influence of gravity. Landslides are generally sudden and infrequent. Presence of steep slope and heavy rainfall are the major causes of landslides. Weak ground structure, deforestation, earthquakes, volcanic eruptions, mining, construction of roads and railways over the mountains are the other causes of landslides. belt around the Gulf of Cambay.

About 15% of India's landmass is prone to landslide hazard. Landslides are very common along the steep slopes of the Himalayas, the Western Ghats and along the river valleys. In Tamil Nadu, Kodaikanal (Dindigul district) and Ooty (The Nilgiris district) are frequently affected by landslides.

6) Tsunamis

Tsunami refers to huge ocean waves caused by an earthquake, landslide or volcanic eruption. It is generally noticed in the coastal regions and travel between 640 and 960 km/h. Tsunamis pose serious danger to the inhabitants of the coastal areas.

The word 'Tsunami' is derived from Japanese word 'tsu' meaning harbour and 'nami' meaning wave (Harbour wave).

Indian Ocean Tsunami of 2004

- On December 26, 2004, at 7:59 a.m. local time, an undersea earthquake with amagnitude of 9.1 struck off the coast of the Indonesian island of Sumatra.
- The tsunami killed at least 2,25,000 people across a dozen countries, with Indonesia, Sri Lanka, India, Thailand, Somalia and Maldives, sustaining massive damage.

7) Hazardous Wastes

The wastes that may or tend to cause adverse health effects on the ecosystem andhuman beings are called hazardous wastes. The following are the major hazardous wastes.

i) Radioactive substance: tools and unused fuel rods of nuclear power plants.
ii) Chemicals: synthetic organics, inorganic metals, salts, acids and bases, and flammables and explosives.
iii) Biomedical wastes: hypodermic needles, bandages and outdated drugs.
iv) Flammable wastes: organic solvents, oils, plasticisers and organic sludges.
v) Explosives: the wastes resulting from ordnance manufacturing and some industrial gases.
vi) Household hazardous wastes:pesticides, waste oil, automobile battery and household battery.

Chernobyl nuclear disaster site (near Pripyat) to become an official tourist spot
Before:

- Chernobyl (then Soviet Union) nuclear accident was happened on 26th April,1986.
- The radiation emitted was more than 400 times than that released by the atomicbomb dropped on Hiroshima (Japan) in 1945. This accident remains the largest nuclear accident in history.
- More than 3,50,000 people were evacuated from the area and severe restrictions onpermanent human settlement are still in that place.

Now:

- 33 years after the accident, the Exclusion Zone, which covers an area now in Ukraine and Belarus is inhabited by numerous animals and more than 200 bird species.
- In 2016, the Ukraine part of this zone was declared as a radiological and environmental biosphere reserve by the government.

8) Pollution of Air

Air is a mixture of several gases. The main gases are nitrogen (78.09%) for forming products such as, fertilisers for plants and for making the air inert, oxygen (20.95%) for breathing and carbon dioxide (0.03%) for photosynthesis. Some other gases like argon, neon, helium, krypton, hydrogen, ozone, zenon and methane are also present. Besides, water vapour and dust particles make their presence felt in one way or the other.

Air pollution is the contamination of the indoor or outdoor air by a range of gases and solids that modify its natural characteristics and percentage. Air pollutants can be categorised into primary and secondary pollutants.

A **primary pollutant**is an air pollutant emitted directly from a source. A **secondarypollutant**is not directly emitted as such, but forms when other pollutants (primary pollutants) react in the atmosphere.

Primary Pollutants

i) Oxides of Sulphur
ii) Oxides of Nitrogen
iii) Oxides of Carbon
iv) Particulate Matter
v) Other Primary Pollutants

Secondary Pollutants

i) Ground Level Ozone
ii) Smog

9) Pollution of Water

Water pollution may be defined as alteration in the physical, chemical andbiological characteristics of water, which may cause harmful effects in human and aquatic life.

In India, water pollution has been taking place on a large scale and since a long period. Both surface and groundwater bodies are polluted to a great extent. The major causes of water pollution in India are:

i) Urbanisation
ii) Industrial effluents
iii) Sewages
iv) Agricultural runoff and improper agricultural practices
v) Seawater intrusion
vi) Solid wastes.

Need for PreventionMeasures

Prevention is defined as the activities taken to prevent a natural calamity or potential hazard from having harmful effects on either people or economic assets.

- Prevention planning consists of i) hazard identification, and ii) vulnerability assessment.
- Delayed actions may increase the economic losses.
- For developing countries like India, prevention is perhaps the most criticalcomponents in managing disasters.

Nature is emerging as a new weapon of mass destruction, do you agree?
Around 22,000 people have died in India in 10 years until 2017 due to major environmental disasters - Indian Meteorology Department. In the past two decades (1998-2017) over 5,00,000 people have died due to extreme weather events around the world - stated by Global Climate Risk Index Report Published by Germanwatch (German-based non-profit organisation).

9th

8. Disaster Management: Responding to Disasters

Case Study - Tsunami

Shortly before 8 am on 26 December 2004, the cicadas fell silent and the ground shook in dismay. The Moken, an isolated tribe on the Andaman Islands in the Indian Ocean, knew that the Laboon, the 'wave that eats people', had stirred from his ocean lair. The Moken also knew what was next: a towering wall of water washing over their island, cleansing it of all that was evil and impure. To heed the Laboon's warning signs, elders told their children, run to high ground. 'If the water recedes after an earthquake, run immediately to high ground' The tiny Andaman and Nicobar Islands were directly in the path of the tsunami generated by the magnitude 9.1 of earthquake off the coast of Sumatra. Final total put the islands' death toll at 1,879 alone with another 5,600 people missing. The islanders who had heard the stories about the Laboon or similar mythological figures survived the tsunami essentially unscathed.

Most of the casualties that occurred in the southern Nicobar Islands were outsiders, leaving them with no indigenous tsunami warning system to guide them to higher ground.So, humans have passed down stories through the ages that helped cultures to cope when disaster inevitably struck. These stories were fodder for anthropologists and social scientists, but in the past decade, geologists have begun to pay more attention to how indigenous people understood and prepared for disaster. These stories, which couched myth in metaphor, could ultimately help scientists prepare for cataclysms to come. In this lesson, you will learn about how to respond to certain disasters to become resilient. A disaster is "a catastrophe that causes great damage or loss of life and property".

Disaster Response

Disaster response entails restoring physical facilities, rehabilitation of affected population, restoration of lost livelihoods and reconstruction efforts to restore the infrastructure lost or damaged. The Response Phase focuses primarily on emergency relief: saving lives, providing first aid, restoring damaged systems (communications and transportation), meeting the basic life requirements of those impacted by disaster (food, water and shelter) and providing mental health and spiritual support and care.

Who are the first responders?

No matter how large or small, local communities are expected to provide immediate disaster response. On a daily basis, police officers, firefighters, and

emergency medical technicians are a community's first responders, whether during fire, flood or acts of terrorism. Mental health professionals and the community's hospitals may also be activated in those early minutes and hours after disaster. Disaster management includes Prevention, Mitigation, Preparedness, Response and Recovery.

Disaster management involves all levels of government. Non-governmental and community based organizations play a vital role in the process. Modern disaster management goes beyond post-disaster assistance. It now includes pre-disaster planning and preparedness activities, organizational planning, training, information management, public relations and many other fields. Crisis management is important, but is only a part of the responsibility of a disaster manager.The traditional approach to disaster management has a number of phased sequences of action or a continuum. These can be represented as a disaster management cycle. We mainly focus on the way how the community should respond to disasters.

Earthquake

An earthquake is a sudden vibration of the part of the earth caused by plate movements. It occurs along the plate boundaries. The place inside the earth where an earthquake originates is focus. The point on the earth's surface above the called a focus is called an epicentre. The damage caused by the earthquake is the highest near the epicentre. The earthquake is measured by an instrument called a Seismograph. It is recorded in Richter scale. Let us now see how the communities can better respond to earthquakes.

What to do during an earthquake?

Be aware that some earthquakes are actually foreshocks and a larger earthquake might occur later. Minimize your movements to a few steps that reach a safe place nearby and stay indoors until the shaking has stopped and you are sure exiting is safe.

If indoors

DROP to the ground; take COVER by getting under a sturdy table or other piece of furniture and HOLD ON until the shaking stops. If there is no table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.

Protect yourself by staying under the lintel of an inner door, in the corner of a room, under a table or even under a bed.Stay away from glass windows, outside doors and walls and anything that could fall (such as lighting fixtures or furniture).Stay inside until the shaking stops and go outside.

If outdoors

1. Move away from buildings, trees, streetlights and utility wires.
2. If you are in open space, stay there until the shaking stops. The greatest danger exists directly outside buildings at exits and alongside exterior walls. Most earthquake-related casualties result due to collapsing walls, flying glass and falling objects.

If in a moving vehicle

1. Stop as quickly as safety permits. Avoid stopping near or under buildings, trees, overpasses and utility wires.
2. Proceed cautiously once the earthquake has stopped. Avoid roads, bridges or ramps that might have been damaged by the earthquake.

Tsunami

A tsunami can kill or injure people and damage or destroy buildings and infrastructure as waves come forth and recede. A tsunami is a series of enormous ocean waves caused by earthquakes, underwater landslides, volcanic eruptions or asteroids. Tsunamis can travel 700-800 km per hour, with waves 10-30 meter high. It causes flooding and disrupts transportation, power, communications, and water supply.

How to respond to Tsunami?

1. You should find out if your home, school, workplace or other frequently visited locations are in tsunami hazard areas along the sea-shore.
2. Plan evacuation routes from your home, school, workplace, or any other place you could be, where tsunamis poses a risk.
3. Use a weather radio or stay tuned to a local radio or television station to keep informed of local watches and warnings.
4. Discuss tsunamis with your family. Everyone should be aware of what to do when tsunami strikes. Discussing tsunamis ahead of time will help reduce fear and save precious time in an emergency. Review flood safety and precautionary measures with your family.

What to do after a Tsunami?

1. You should continue using a weather radio or staying tuned to a Coast Guard emergency frequency station or a local radio or television station for updated emergency information.
2. Check yourself for injuries and get first aid if necessary, before helping injured or trapped persons.
3. If someone needs to be rescued, call professionals with the right equipment to help.

4. Help people who require special assistance, like Infants, elderly people, those without transportation, large families who may need additional help in an emergency situation, people with disabilities, and the people who care for them.
5. Stay out of a building if water remains around it. Tsunami water, like floodwater, can undermine foundations, causing buildings to sink, floors to crack, or walls to collapse.
6. Check for gas leaks. If you smell gas or hear a blowing or hissing noise, open a window and get everyone outside quickly.

Riot

Though riot may seem dramatic, an angry mob can be just as dangerous and unpredictable as just about any natural disaster. Thousands of people are killed in riots all over the world each year, and these riots erupt from a number of racial, religious, economic, political, or social causes that cannot be predetermined. As per Pew Research Center analysis of 198 countries on April 11, 2015. Syria tops in riot in the world followed by Nigeria, Iraq and India.If you've found yourself in the middle of a riot, you may not be able to run away immediately, but you can take some measures to protect yourself from harm. If you want to know how to survive a riot, just follow these steps.

Surviving a Riot

At Travel Destination: What to Do

1. Keep abreast of the current news if you are in a volatile area.
2. If you come across a demonstration, don't become inquisitive, just leave the area and find another route to your intended destination.
3. Avoid any place where police or security forces action is in progress.

If caught in a riot:

1. If you find yourself caught up in a demonstration, keep to the edge of the crowd where it is safer. At the first opportunity, break away and seek refuge in a nearby building or find a suitable doorway or alley and stay there until the crowd passes.
2. When leaving the fringe of the demonstration, just walk away – don't run as this will draw attention to you.
3. In the event that you are arrested by the police/military, do not resist. Go along peacefully and contact your law advisor to help you resolve your predicament.
4. If you are caught up in the crowd, stay clear of glass shop fronts, moreover, move with the flow.
5. If shooting breaks out, drop to the ground and cover your head and neck, and lie as flat as you can.

Fire

1. Wildfires occur when vegetated areas are set alight and are particularly common during hot and dry periods. They can occur in forests, grasslands, bush and deserts, and with blowing wind, can spread rapidly.
2. Fires can lead to the destruction of buildings, wooden bridges and poles, power, transmission and telecommunication lines, warehouses containing oil products and other fuel. It causes injury to people and animals.
3. The most common causes of fires are lightning strikes, sparks during arid conditions,eruption of volcanoes and man-made fires arising from deliberate arson or accidents.
4. A side-effect of wildfires which also threatens inhabited areas is smoke. Fires create large quantities of smoke, which can be spread far by wind and poses a respiratory hazard.
5. On an average, in India, every year, about 25,000 persons die due to fires and related causes. Female accounts for about 66% of those killed in fire accidents. It is estimated that about 42 females and 21 males die every day in India due to fire.

Fire Safety Do's and Don'ts

1. Know your building's evacuation plan.
2. Evacuate calmly and quickly, whenever a fire alarm or carbon monoxide alarm sounds.
3. Before opening a door, feel it with the back of your hand. If the door is hot, do not open it.
4. If you encounter smoke during your evacuation, stay low to the floor.
5. Know the outside rally point for your building.
6. Know the locations of fire extinguishers, fire alarm pull stations and exits.

What you should do during a fire:

1. Stay calm.
2. Pull the nearest fire alarm or call 112.
3. Give your name and location of the fire. Do not hang up until the police dispatcher tells you to do so.
4. Leave the building immediately.
5. Inform others as you pass them to leave the building immediately.
6. Walk—don't run—to the nearest exit.
7. Never use elevators—an elevator may become a trap.

NOTE

- Japan is in a very active seismic area and it has the densest seismic network in

the world.

- Which country actually has the most number of earthquakes? Indonesia is in a very active seismic zone also, but because it is larger than Japan, it has more earthquakes.
- Which country has the most earthquakes per unit area? This would probably be Tonga, Fiji or Indonesia, since they are all in extremely active seismic areas along subduction zones.

APPOLO STUDY CENTRE

10th

Unit – 7 -Human Geography of Tamil Nadu

Learning Objectives

- To understand the agricultural factors, major crops and theirdistribution in Tamil Nadu
- To learn about the water resources of Tamil Nadu
- To study the mineral and industrial resources of Tamil Nadu
- To analyze the population and its composition in Tamil Nadu
- To learn about the man made disasters in Tamil Nadu

Introduction

Human geography refers to the study ofways of development of human societies andtheir operation in relation to their physicalenvironment. This chapter focuses on thedistribution, characteristics and utilisation ofdifferent resources in Tamil Nadu. We havestudied earlier that the earth is endowedwith a variety of natural resources such aslandforms, rivers, soil, natural vegetation,water and wildlife. These resources are usefulonly when they are utilised. Human beingsuse these resources using their intelligenceand skill. Thus, the human beings are themost significant resource on the earth surface.They turn all these natural resources intouseful products with their skills and abilities.

Agriculture

The word "agriculture" is derived from theLatin words "ager and cultura", which meansfield and growing. Agriculture is a practice offarming that includes the cultivation of crops,rearing of animals, birds, forestry, fisheriesand other related activities. Agriculture is themajor occupation in Tamil Nadu. Agriculturehas been the mainstay of the state's economysince independence with more than 65% of thepopulation depends upon this sector for theirliving. Agriculture provides employment forrural people on a large scale. There is a stronglink between agriculture and economic growth.Agriculture constitutes about 21% of the state'seconomy. However, it fluctuates from one yearto another. Paddy, millets and pulses are theprincipal food crops of the state. Sugarcane,cotton, sunflower, coconut, cashew, chillies,gingelly, groundnut, tea, coffee, cardamom andrubber are the major commercial crops.

Geographical determinants of Agriculture

Landform, climate, soil and irrigationare the factors that determine the growth ofagriculture.

Landform

Tamil Nadu is a land of diverse landscapecomprising of hills, plateaus and plains.Among them the plains are most suitablefor agriculture. The plains with alluvial soilenhances agricultural productivity. Example:Plains of cauvery. Agriculture in the plateau ismoderate and is poor on the hills.

Climate

Tamil Nadu is situated in the tropicalzone, which is nearer to the equator. The stateexperiences a tropical climate. Hence, thetemperature in Tamil Nadu is relatively highalmost throughout the year. So, only the tropicalcrops are cultivated. Water is another limitingfactor of agriculture. Northeast monsoon isthe major source of rainfall for Tamil Nadu.Therefore, the major cropping season beginswith this season. The rainfall in this season andthe irrigation facilities affect agriculture to alarge extent.

Soil

Soil is one of the most essential elementsof agriculture. It provides essential minerals ornutrients for the growth of crops and vegetation.The regions of river valleys and the coastal plainsare the most agriculturally productive regions of thestate as they are covered with fertile alluvial soil.

Types and regions of Agriculture Practices in Tamil Nadu

Farming type	**Area practiced**
Subsistenceintensiveagriculture	Practiced all overTamil Nadu with fewexceptions.
PlantationAgriculture	Hill slopes of Easternand Western Ghats.
Mixed farming	Banks of RiverCauvery andThenpennai.

Irrigation

Monsoon rainfall in the state is highlyirregular. Further it is seasonal. Hence,irrigation becomes necessary for successfulcultivation of crops in the state. In the dryregions, rain-fed crops are cultivated.

The Tamil Nadu RiceResearch Institute (TRRI) is anIndian research institute workingin the field of rice under TamilNadu Agricultural University(TNAU).It is situated at Aduthurai, in Thanjavurdistrict, it was established in April, 1985 in TNAUto meet the research requirements of the regionwith the help of existing Agricultural Collegesand Research centres and perform lead functionfor rice and rice based cropping system research.

Cropping Seasons in Tamil Nadu

Farmers select different crops fordifferent seasons of cultivation. It is based onthe temperature and availability of moisturein the soil. Accordingly, the state has thefollowing cropping seasons.

Name	Sowing	Harvesting	Major crops
Sornavari (chittirai pattam)	April-May	August-September	Millets and cotton
Samba (Adipattam)	July-August	January-February	Paddy and sugarcane
Navarai	November - December	February-March	Fruits, vegetables, cucumber and watermelon

Distribution of major crops in Tamil Nadu
Paddy

Paddy is the most important staple foodcrop of Tamil Nadu. Ponni and kichadi sambaare the major varieties of paddy grown inTamil Nadu. About 3 million hectares of thestate is under rice cultivation. Though it iscultivated all over Tamil Nadu, its cultivationis highly concentrated in Thanjavur, Tiruvarur,Tiruvallur, Kancheepuram, Villupuram,Cuddalore and Tirunelveli districts. It ranksthird in the production of rice among the statesof India. The deltaic region of river cauvery(the undivided Thanjavur district) is the majorrice-producing region of Tamil Nadu. So, thisregion is rightly called as the "Granary ofTamil Nadu."

Millets

Millets form staple food of nearly onethirdof human population of Tamil Nadu.Sorghum/jowar (cholam), ragi (kezhvaragu)and bajra (kambu) are the major millets. Theseare grown not only in drier areas but also inthe coastal plains. Sorghum is grown in theCoimbatore plateau and Kambam valley. Ragi isgrown in Coimbatore, Dharmapuri, Vellore andCuddalore districts. Bajra is mostly cultivatedin Ramanathapuram, Tirunelveli, Karur,Perambalur and Salem districts.

India observed 2018 asnational year of millets. FAOhas decided to observe 2023 asthe International year of millets.

Pulses

Pulses are the major source of protein.Bengal gram, black gram, green gram, cowpeaand horse gram are the important pulses grownin Tamil Nadu. Pulses are grown in a wide rangeof climatic conditions mostly in drier regionswith or without

irrigation. Mild cool climateand a low to moderate rainfall are best suitedfor these crops. Pulses serve as excellent fodder.Pulses are grown in almost all districts in thestate except Chennai, Nilgiris and Kanyakumari.Coimbatore leads in the production of Bengalgram. Vellore and Kanyakumari districtsproduce red gram.

To promote organicfarming a central scheme named'National Project on OrganicFarming' was launched Apartfrom general things (creatingawareness, promoting organic fertilizers,training, capacity building etc.), the schemeprovides financial assistance through CapitalInvestment Subsidy Scheme for agro-wastecompost production units, bio-fertilizers/bio-pesticides production units, developmentand implementation of quality controlregime, human resource development etc.

Tiruvarur, Nagapattinam and Thoothukudidistricts are the principal producers of greengram and black gram. Horse gram is widelycultivated in Dharmapuri and Krishnagiridistricts.

Oil Seeds

Groundnut, gingelly castor, coconut,sunflower and mustard are some of the oilseedsthat are grown in Tamil Nadu. Apart from itsuse in food preparation, it is used in industriesas a lubricant, in the manufacture of varnish,soaps, candles, cosmetics and pharmaceuticals.Groundnut is the major oilseed of the state. Thecultivation of groundnut is mostly concentratedin Vellore, Tiruvannamalai, Villupuram, Salemand Pudukottai districts. It is also grown to someextent in Dharmapuri, Cuddalore, Perambalurand Madurai. Erode, Ramanathapuram,Sivagangai and Virudhunagar districts areits minor producers. Coconut is grown inCoimbatore, Thanjavur and Kanyakumaridistricts.

Sugarcane

It is one of the major cash crops of thestate. It is an annual crop. It requires hightemperature and heavy rainfall. It grows well inthe tropical region. Major sugarcane-producingdistricts are Tiruvallur, Kancheepuram, Vellore,Cuddalore, Tiruchirapalli, Coimbatore, Erodeand Tirunelveli.

Cotton

Cotton is a fibre and cash crop. It requiresblack soil, long frost-free condition and warmand humid weather for its cultivation. Humidweather in the early stages and hot, dry weatherduring harvest period is suitable for this crop.It is predominantly cultivated in Coimbatoreplateau and Vaigai-Vaippar river basins. It isalso cultivated in Madurai, Ramanathapuram,Virudhunagar, Tirunelveli, Thoothukudi,Salem and Dharmapuri districts.

Plantation crops

Tea, coffee, cashew, rubber and cinchonaare the major plantation crops of the state.Tamil Nadu ranks second in area andproduction of tea in India next to Assam. Teaplantations are found in the hills of the Nilgirisand Coimbatore. The Nilgiris is the notableregions for tea plantations. Coffee plants aregrown in the hills of Western Ghats as wellas Eastern Ghats. It is also found in the hillyslopes of Dindigul, Madurai, Theni and Salemdistricts. Yercaud, Kolli Hills and Kodaikanalare notable for coffee plantations. Tamil Nadustands second in area and production ofcoffee next to Karnataka. Rubber plantationsare significant in Kanyakumari. Pepper isconfined to the warm and wet slopes of Easternand Western Ghats of Tamil Nadu. Cashew isextensively cultivated in Cuddalore district.

Cinchona is planted at heights varyingfrom 1060 to 1280 metres in Anaimalai hills.Cardamom estates are located at few places inthe hills of Madurai region at an elevation of915 to 1525 metres.

TANTEA (TANTEATamilNadu Tea PlantationCorporation Limited) isone of the Biggest Black TeaProducers in India with highquality clonal tea. Its plantation spreadsover nearly 4500 hec.Tamil Nadu Dairy DevelopmentCorporation Ltd. was transformed into thenewly registered Tamil Nadu Co-operativeMilk Producers Federation LimitedPopularly known as "Aavin".

Livestock/Animal Husbandry

Livestock has remained an integral partof socio-economic fabric of rural people.The number of cattle found in Tamil Nadu is88,92,473. There are 47,86,680 sheep, 81,43,341goats and 11,73,48,894 poultry animals.

Goat

Goat is also known as 'poor man's cow'in India. It forms a very important componentin dry land farming system. In the marginal orundulating lands unsuitable for rearing of othertypes of cattle like cow or buffalo, goat is the bestalternative. With very low investments, goatrearing can be made into a profitable venturefor small and marginal farmers.

Sheep

Sheep is used for multiple purposes likewool, meat, milk, skins and manure, andforms an important component of the ruraleconomy, particularly in the arid, semi-aridand mountainous areas of Tamil Nadu. Itprovides a dependable source of income tothe shepherds through the sale of wool andanimals.

A variety of cattle breeds are reared in thestate for the milk and forms a major componentof the rural economy. The poultry hub of

Tamil Nadu are Namakkal, Salem, Erode andCoimbatore districts.

Fishing

Since Tamil Nadu is a coastal state, fishingis one of the major occupations in the state.With widespread reservoirs and rivers, inlandfishing also is also seen to a considerableextent. There are about 2500 species of fishesfound in different aquatic environments.

Marine Fishing

The length of the coastline of TamilNadu is 1076 km (13% of the country'scoastline). The coastal region of the statecovers an area of 0.19 million sq.km. Anarea of 41,412 sq.km of continental shelvesof the state favours coastal fishing and TamilNadu is one of the leading states in marinefish production. Marine fishing is also calledinshore fish or neritic fishing, carried out inoceans and seas. Large mechanised boats areused for fishing. In ocean or seawaters, fishingwithin few kilometres from the shoreline iscalled inshore fishing and the fishing far fromthe shore typically 20–30 miles out in waterhundreds and thousands of feet deep is calledoff-shore fishing. The fish varieties caughtare sharks, flying fish, counch, catfish, silverbellies, and crabs. Chennai, Kanyakumari,Tirunelveli, Nagapattinam, Thanjavur andRamanathapuram districts contribute about40% to marine fish production in the state.Their coastal location favours fishing in theseregions. The state has three major fishingharbours, three medium fishing harboursand 363 fish landing centres. The export ofmarine products from the state during 2007–08 accounted for 72,644 metric tons.

Inland Fishing

Inland fishing is carried out in lakes,rivers, ponds, estuaries, backwaters andswamps. Oysters and prawns are culturedin original nurseries. Catamaran, dieselboats and floating nets are used in fishing.Tamil Nadu Fisheries Department hasintroduced several programmes forthe betterment of fishing. The majorprogrammes are aquaculture in farmponds and irrigation tanks, fish seed bank,fish seed rearing, ornamental fish cultureand the establishment of Fish FarmerDevelopment Agency. Vellore district leadsin the production of inland fish productionwith 10% of state's production. Cuddalore,
Sivagangai and Virudhunagar districts standsecond with 9% of inland fish catch each.Fishing sector contributes 1.25% of state'seconomy.

Second Green Revolution (Eco-Farming or Organic Farming)

In organic farming synthetic fertilizers,pesticides, growth regulator and livestockfeed additives are not used. This type offarming rely on crop rotation, crop residues,animal manure, off-farm organic wastesand biological pest control to maintain soilproductivity. This farming method is beingadopted by very few

farmers in the state. Ithas to be increased in number.

Water Resource

Water is the preciousgift of nature to humankindand millions of other speciesliving on the earth.

Tamil Nadu constitutes4% of India's land area and is inhabited by6% of India's population, but has only 2.5%percent of India's water resources. More than95% of the surface water and 80% of theground water have already been put into use.Major uses of water include human/animalconsumption, irrigation and industrial use.The state is heavily dependent on monsoonrains. The annual average rainfall is around930 mm (47% during the northeast monsoon,35% during the southwest monsoon, 14% insummer and 4% in winter).

Surface Water Resources	**Numbers**
River Basin	17
Reservoirs	81
Tanks	41,127
Tube wells and other wells	4,98,644
Open wells	15,06,919
Total (Million Cubic metres)	2046788 MCM
Source: Statistical handbook of Tamil Nadu – 2017	

Multipurpose River Valley Projects

Multipurpose river valley projects arebasically designed for the development ofirrigation for agriculture and hydropowergeneration. However, they are used for manyother purposes as well.

Mettur Dam

The Mettur Dam was constructed ina gorge, where river Cauvery enters theplains. It is one of the oldest dam in India.It provides irrigation to Salem, Erode, Karur,Tiruchirappalli, Thanjavur, Tiruvarur andNagapattinam districts for about 2,71,000acres of farmland. The dam, park, majorhydroelectric power stations and hills on allsides make this dam an important touristspot.

Bhavani Sagar Dam

The Bhavani Sagar Dam is located 80 kmaway from Coimbatore city in the district ofErode. It has been constructed across the riverBhavani. This dam is one of the biggest earthendams in the country.

Amaravathi Dam

The Amaravathi dam is situated 25 kmaway from Udumalpet in Tirupur district. Thedam has been constructed across the riverAmaravathi, a tributary of Cauvery. The damwas built primarily for irrigation and floodcontrol. A small hydropower station has alsobeen installed recently. This reservoir is notablefor the significant population of muggercrocodiles. It is also a familiar tourist spot.

Krishnagiri Dam

Krishnagiri dam is situated at a distance of7 km from Krishnagiri towards Dharmapuri.This dam drains an area of 5428 sq.km. This isa famous tourist spot too. This dam is floodedwith tourists during the weekends.

Sathanur Dam

Sathanur Dam was constructed acrossthe river Thenpennai in Chengam taluk. It isin the midst of Chennakesava hills. The waterholdingcapacity of the dam is 7321 millioncubic feet (full level: 119 feet). About 7183hectares of land is drained by the left bank canaland 905 hectares by the right bank canal of thisdam. It irrigates the land in Thandrampet andTiruvannamalai blocks. There is also a largecrocodile farm and a fish grotto. Parks aremaintained inside the dam for tourists and thegardens are used by the film industry.

Mullaiperiyar Dam

Mullaiperiyar dam was built by theBritish administration in 1895. It has beenconstructed on the Periyar river, whichoriginates from Thekkady hills of Kerala. Thedam was built mainly for watering the farmingland of Tamil Nadu, which is perenniallydrought-prone. Though the dam is located inthe state of Kerala, most of its water is usedto irrigate Tamil Nadu. The dam is 175 feet inheight and 1200 feet in length.

Vaigai Dam

This dam built across the river Vaigainear Andipatti. The dam with a height of 111feet can store water up to 71 feet. It is located 7km from Andipatti and 70 km from Madurai.This dam was opened on 21 January, 1959.The dam has a unique garden that deservesthe surname 'Little Brindavan'. It is a popularpicnic spot in Theni district.

Manimuthar Dam

Manimuthar dam is located about 47km from Tirunelveli. The gorgeous garden ofthe dam is located about 5 km from the damand is accessible through a zig-

zag ghat road.Pleasure boating and waterfalls are additionaltourist attractions near the dam.

The Papanasam Dam

It is also known as Karaiyar dam and islocated about 49 km away from Tirunelveli.The dam is used to irrigate 34,861 hectares ofland in Tirunelveli and Thoothukudi districts.It generates 28 MW of hydro power.

Parampikulam Aliyar Project

It is a joint venture of Tamil Nadu andKerala states. It envisages the construction ofseven interconnected reservoirs by harnessingthe water of seven rivers, which include majorrivers of Parambikulam and Aliyar.

Parappalar project is located nearOttanchatram. Its storage capacity is 167million cubic feet of water. It is about 75 kmfrom Madurai and is in Palani taluk.

Surface water Resources

The total surface water potential of thestate is about 24,864 mcm (million cubicmetre). There are 17 major river basins inthe state with 81 reservoirs and about 41,262tanks. Most of the surface water has alreadybeen tapped, primarily for irrigation, wherewater use is largest. An area of 24 lakhhectares of the land are irrigated by surfacewater through major, medium and minorschemes.

Ground Water Resources

The utilizable groundwater resource ofthe state is 22,423 mcm. The current levelof utilization of water is about 13,558 mcmwhich is about 60 percent of the availablerecharge, while about 8875 mcm (40 percent)is the balance available for use.

Water Resource Management

Water resource management is theactivity of planning, developing, distributingand managing the optimum use of waterresources. The demand for water in TamilNadu is increasing at a fast rate both due toincreasing population and also due to largerper capita needs triggered by economicgrowth. The per capita availability of waterresources is just 900 cubic metres whencompared to the national average of 2,200cubic metres. Agriculture is the largestconsumer of water in the state using 75% ofthe state's water resources. Demands fromother sectors such as domestic and industrieshave been growing significantly. The state isheavily dependent on monsoon rains. Sincethe state is entirely dependent on rains forrecharging its water resources, monsoonfailures lead to acute water scarcity and severedroughts. So, it is important to save water forus and the future generation.

Mineral Resources

Tamil Nadu is the leading holder ofcountry's resources of vermiculite, magnetite,dunite, rutile, garnet, molybdenum andilmenite. The state accounts for the country's55.3% of lignite, 75% of vermiculite, 69% ofdunite, 59% of garnet, 52% of molybdenumand 30% of titanium mineral resources.

Important minerals are found inthe state are as follows: Neyveli has largelignite resources. Coal is also availableinRamanathapuram. Oil and gas are found inthe Cauvery basin.

Iron deposits are found in Kanjamalairegion in Salem district and Kalrayan Malairegion of Tiruvannamalai district. Magnesiteores are available near Salem. Bauxite is foundin Servarayan Hills, Kotagiri, Udagamandalam,Palani and Kollimalai areas. Gypsum is obtainedin Tiruchirappalli, Tirunelveli, Thoothukudiand Virudhunagar districts. Ilmenite andrutile are found in the sands of Kanyakumaribeach. Limestone is available in Coimbatore,Cuddalore, Dindigul, Kancheepuram, Karur,Madurai, Nagapattinam, Namakkal, Perambalur,Ramanathapuram, Salem and Tiruvallurdistricts. Magnesite is obtained in Coimbatore,Dharmapuri, Karur, Namakkal, the Nilgiris,Salem, Tiruchirapalli, Tirunelveli and Velloredistricts. Feldspar, quartz, copper and lead arealso found in some parts of the state.

Industries

Industries use rawmaterials and convert theminto usable product or goods.Textiles, sugar, paper, leather,cement, electrical equipment,automobiles, informationtechnology and tourism arethe major industries of Tamil Nadu.

Textile Industry

Textile industry is one of the traditionallywell-developed industries in Tamil Nadu. Thetextile mills are concentrated in Coimbatore,Tirupur, Salem, Palladam, Karur, Dindigul,Virudhunagar, Tirunelveli, Thoothukudi,Madurai and Erode. Tamil Nadu has about3,50,000 power looms manufacturing cottonfabrics and accounts for 30% of India's exportsof textiles products. Erode in Tamil Nadu iswell known for marketing of handloom, powerloom and readymade garments. Coimbatore isalso known as the 'Manchester of Tamil Nadu'.Coimbatore, Tirupur and Erode contributea major share to the state's economy throughtextiles. So, this region is referred as 'TextileValley of Tamil Nadu'. Karur is known as 'TheTextile capital of Tamil Nadu'.

Silk Textiles

Tamil Nadu occupies fourth position inthe country in silk production. Kancheepuramsilk is unique in its quality and is known for itstraditional value all

over the world. The annualsilk production in Tamil Nadu is around1200 metric tons. Kancheepuram, Arani,Kumbakonam, Salem, Coimbatore, Maduraiand Tirunelveli are the important silk-weavingcentres in Tamil Nadu. Ramanathapuram hassome specialised areas for the manufacturingof synthetic silk clothes.

Leather Industry

Tamil Nadu accounts for 60% of leathertanning processes of India and 38% of all leatherfootwear, garments and components. Hundredsof leather tanneries are located around Velloreand nearby towns, such as Ranipet, Ambur andVaniyambadi. The Vellore district is the topexporter of finished leather goods in the country.Vellore leather accounts for more than 37%of the country's export of leather and leatherrelatedproducts (such as finished leathers, shoes,garments and gloves). Central Leather ResearchInstitute (CLRI), a CSIR research laboratory, islocated in Chennai.

GI Tag

GI(Geographical Indication)is a name orsign used on products which corresponds toa specific geographical location. It providesrights and protection of holders.

Some important GI Tags of Tamil Nadu are:

Place	Products
Aranl	Silk
Kancheepuram	Silk
Coimbatore	Wet Grinder and Coracotton
Thanjavur	Paintings, Art plate,Doll and veenai
Nagercoil	Temple Jewellery
Erode	Turmeric
Salem	Venpattu(salem silk)
Bhavani	Jamakkalam
Madurai	Sungudi
Swamimalai	Bronze Icons
Nachiarkovil	Kuthuvilakku
Pattamadai	Mat
Nilgiri	Orthodox Embroidery
Mahabalipuram	Stone sculpture
Sirumalai	Hill banana
Eathomozhi	Coconut

Paper Industry

Many paper industries are located inthe state. Tamil Nadu Newsprint and PapersLimited (TNPL) is a government of TamilNadu enterprise producing newsprint andprinting and writing paper at its mill locatedat Kagithapuram in Karur district. It wasstarted in 1979 with an installed capacity of2.45 lakh MT of production per annum. TNPLis one of the most accomplished mills in theworld, producing different varieties paper ofacceptable quality primarily from bagasse

andpulpwood. Other paper mills of the state arefound in Pukkathurai of Kancheepuram district,Bhavanisagar, Pallipalayam, Paramathi Vellore,Coimbatore, Udamalaipet, Thoppampatti,Nilakkotai and Cheranmahadevi.

Cement Industry

Cement production and consumptioncontinue to grow despite the general recession inthe economy. India is one of the largest cementproducers and ranked second in the world withan annual production capacity of 181 milliontons. Tamil Nadu Cements Corporation Limited(TANCEM) is one among the major cementproducers in Tamil Nadu operating two cementunits: one at Ariyalur and another at Alangulam.Asbestos cement sheet plant at Alangulam andstoneware pipe unit at Virudhachalam are theother units of TANCEM. Sankar Cement, ZuariCement, Ultratech Cement, Madras Cementand Dalmia Cement are the major privatecement brands produced in Tamil Nadu.

Information Technology

According to National Association ofSoftware and Services Companies (NASSCOM),the southern states continue to account formore than half of the country's total exportof software. Tamil Nadu and Andhra Pradeshtogether account for 59.6% of India's totalsoftware exports. Tamil Nadu is the secondlargest software exporter in the country next toKarnataka.

A special economic zone (SEZ) is anarea in which the business and trade laws aredifferent from the rest of the country. SEZs arelocated within a country's national borders,and their aims include increased tradebalance, employment, increased investment,job creation and effective administration.

Special Economic Zones

Special economic zones (SEZs) providean internationally competitive and hasslefreeenvironment for exports. Units in SEZmanufacture goods and provide a range of services.SEZs are located in Nanguneri, Ennore, Hosurand Perambalur. IT & ITES SEZ named TIDEL-IIand TIDEL-III and Bio-Pharmaceuticals SEZ arelocated in Chennai and Coimbatore SEZ calledthe TIDEL Park–IV is located in the city.

The list of IT parks in Tamil Nadu

Tidel Park, Ascendas, Mahindra worldcity 4 IT & ITES SEZ TIDEL-II, IT & ITESSEZ TIDEL-III, Coimbatore SEZ - Tidel Park

Manufacturing & Engineering Industry

The manufacturing industry is one ofthe vibrant sectors of the state economy andcontributes significantly to the industrial output.

The manufacturing industry broadly coversmanufacture of machinery and equipment,motor vehicles, basic metal and alloy industries,metal products and repair of capital goods.Tamil Nadu's share of the industrial outputis around 11–12% of the country's output and15% of the country's exports excluding software.Tamil Nadu accounts for about 17% of India'ssoftware exports.

Automobile Industries

The share of Tamil Nadu in all-Indiaproduction of automobiles and heavy vehicles israther significant. Automobile industry plays acrucial role in the state's economy and has beenone of the key driving factors. Contributing8 percent to state GDP and giving directemployment to 2,20,000 people.

Tamil Nadu accounts for about 21% ofpassenger cars, 33% of commercial vehiclesand 35% of automobile components producedin India. Major automobile manufacturerslike Ford, Hyundai, HM-Mitsubishi, AshokLeyland, and TAFE have their manufacturingbase in Tamil Nadu.

Chemical & Plastic Industry

The chemical industry is one of the fastestgrowing sectors of industry and the economy.The sector contributes 13% to the state's GDPand constitutes 8% of the total exports of thecountry.

Handlooms and Powerlooms

The handloom sector in the state is thesingle largest cottage industry providinglivelihood to a large number of ruralpeople and promoting export earnings. Thehandloom sector and its related economicactivities generate gainful employment formore than 4.29 lakh weaver householdsand 11.64 lakh weavers in the state. Thesesocieties mainly produce the cloth requiredfor the scheme of 'Free Supply of Uniformsto School Children and Free Distribution ofSarees and Dhotis Scheme'.

Sugar Industry

Sugar industry in Tamil Nadu is animportant agro-based industry. It plays avital role in the economic development ofthe state, particularly in rural areas. Thesugar industry provides large-scale directemployment to several thousands and indirectemployment to several lakhs of farmers andagricultural labourers in the rural areas whoare involved in cultivation of sugarcane,harvesting, transporting and other services.There are 34 sugar mills in Tamil Nadu, inwhich 16 are in the cooperative sector and18 in the private sector.

Tourism Industry

Tourism is considered as an industrybecause of its enormous potential in creatingemployment for a large number of people.In recent years, the state has emerged asone of the leading tourist destinations forboth domestic and foreign tourists. Tourismin Tamil Nadu is promoted by Tamil NaduTourism Development Corporation (TTDC).The state currently ranks the highest amongIndian states with about 25 crore arrivals(in 2013). The annual growth rate of thisindustry stood at 16%. Approximately 28 lakhforeign and 11 crore domestic tourists visitour state annually. The presence of ancientmonuments, pilgrim centres, hill stations, avariety of natural landscapes, long coastline,along with rich culture and heritage makeTamil Nadu the best destination for tourists.

Activity

Plan a visit to a manufacturing unit inyour city. Find out how raw materials areconverted into finished products. Talk to theworkers and manager to know more aboutthe industry.

Plan a field visit with your social scienceteacher to visit a variety of geographicalfeatures, pilgrim centres, monuments, hillstations and prepare a field visit report.

Population

The term 'population'refers to the number ofpeople living in a definedarea. The statistical studyof the characteristics ofhuman population is calleddemography. Demographersmake a deep and detailed study of thepopulation. The rapid increase of populationmay be responsible for retarding economicgrowth. Hence, overpopulation is one of themajor problems confronting our nation with allits evil effects.

Growth of Population in Tamil Nadu

The total population of Tamil Nadu is72,140,703 or 7.21 crores as per 2011 Census. Itspopulation was 6.24 crore in 2001 and registereda growth of nearly 1 crore population in a decade.The male and female population of the state in2011 is 36,137,975 and 36,009,055 respectivelyand it was 31,400,909 and 31,004,770 in 2001.It shows that the population of the state is sharedalmost 50% each by male and female. The growthrate of population in the decade 2001–2011was 15.61% while in the previous decade it was11.19%. The population of Tamil Nadu forms5.96% of country's total population as per 2011Census. In 2001, it was 6.07%.

Distribution of Population

Based on the actual size of population,Tamil Nadu is divided into the following regions.

Regions of High Population

Chennai has the highest urban populationwith 4.219 million people, but the city rankssecond in the district-wise count, next toCoimbatore district, which had 4.224 millionpeople as per 2011 Census. Coimbatore,Chennai, Tiruvallur, Kancheepuram,Villupuram, Dharmapuri, Salem, Madurai andTirunelveli are the most populous districts in thestate. Agriculture and industrial developmentare the main causes of high concentration ofpopulation of these districts.

Regions of Moderate Population

Tiruvannamalai, Cuddalore, Tiruchirapalliand Thanjavur districts have a population 30–35 lakh. Vellore, Dindugal, Virudhunagar andThoothukudi districts each have a population of15–20 lakh. Other than agriculture, small-scaleindustries and fishing along the coastal areas arethe major occupations of people in these districts.

Regions of Sparse Population

The coastal districts Nagapattinam,Tiruvarur, Pudukottai, Ramanathapuramand Sivagangai have a less than 15 lakh. TheNilgiris district has a population of less than10 lakh (764,826) population and it is the leastpopulated district as per 2011 Census.

Population Density

The density of population in Tamil Nadu is555 per sq.km as per the 2011 Census, while itwas 480 per sq.km in 2001. The state ranks 12thamong the Indian states in population density.The national average density of populationas per the 2011 Census is 382. Chennai is thedensest district with 26,903 persons per sq.kmfollowed by Kanyakumari (1106), Tiruvallur(1049), Kancheepuram (927), Madurai (823),Coimbatore (748), Cuddalore (702), Thanjavur(691), Nagapattinam (668), Salem (663), Vellore(646) and Tiruchirappalli (602). These are theregions with high density of population. Theleast density of population is recorded in theNilgiris (288 per sq.km) and the other districtshave moderate density of population.

Religion

Hinduism, Christianity and Islam arethe major religions in the state. The Hindusconstitute 87.58% of the population, followedby Christians (6.12%) and

Muslims (5.86%).Jainism (0.12%), Sikhism (0.02%) and Buddhism(0.02%) also have a presence in the state.

People of other religions constitute 0.01%and the percentage of people with unstatedreligion is 0.26%.

Urban and Rural Population

As per 2011 Census, the urban populationof Tamil Nadu is 3,49,17,440, which constitutes48.40% of the total population of the state. Therural population of the state is 3,72,29,590, whichconstitutes 51.60% of the state population.

Sex Ratio

The sex ratio represents the number offemales per 1000 males. The sex ratio of thestate increased from 987 in 2001 to 995 in 2011.
The sex ratio in India is 940 in 2011 as against933 in 2001. It shows that the sex ratio is morefavourable in the state than the country.

As per 2011 Census, 15 out of 32 districtshave recorded the sex ratio of more than 1000and a similar trend was noticed in the 2001Census also. Only Sivagangai has recordedthe sex ratio of exactly 1000. It is noted that12 districts have the sex ratio of less than1000 and it ranges between 980 and 1000.The highest sex ratio is found in the Nilgirisdistrict (1041) followed by Thanjavur district(1031). The lowest sex ratio is reported inDharmapuri district (946) followed by Salemdistrict (954).

Literacy Rate

The literacy rate of Tamil Nadu as per the2011 Census is 80.33%. It was 73.45% in 2001.The male literacy rate is 86.81% and the femaleliteracy rate is 73.86%. The correspondingrates in 2001 were 82.42% for males and64.43% for females. It may be observed thatmore than three-fourths of the population isliterate among males in all the districts (exceptDharmapuri), while more than two-thirdsof the population is literate among femalesin all but eight districts. The districts areDharmapuri (60.03%), Krishnagiri (64.86%),Tiruvannamalai (65.71%), Villupuram(63.51%), Salem (65.43%), Erode (65.07%),Perambalur (66.11%) and Ariyalur (62.22%).

The literacy rate for India as per 2011census is 74.04, of which the male literacyrate is 82.14 and the female literacy rateis 65.46. In 2001, the literacy rate of Indiastood at 64.8. It was 75.3 and 53.7 for malesand females, respectively. The district ofKanyakumari has reported the highest literacyrate (92.14%) while Dharmapuri district hasthe lowest rate (64.71%). A high level ofliteracy rate is also seen in Chennai (90.33%),Thoothukudi (86.52%), the Nilgiris (85.65%)and Kancheepuram (85.29%) districts.

Transport and Communication

Roadways

The State has a totalroad length of 167,000km, In which 60,628kmare maintained by stateHighways Department. Itranks second in India with a share of over 20%in total road projects under operation in thePublic-Private Partnership (PPP) model.

Types of the Roads	Length (Km)
National Highways	4994
State Highways	57291
Corporation & Municipalities Road	23350
Panchayat Union	147543
Village Panchayat Union	21049
Others(Forest Roads)	3348
Commercial	12.13
Non commercial	20.341 Lakhs
Source: Statistical handbook of Tamil Nadu -2017	

Railways

Tamil Nadu has a well-developed rail networkas part of Southern Railway, headquarteredat Chennai. The present Southern Railwaynetwork extends over a large area of India'ssouthern peninsula, covering Tamil Nadu, Kerala,Puducherry, minor portions of Karnataka andAndhra Pradesh. Tamil Nadu has a total railwaytrack length of 6,693 km with 690 railway stationsin the state. The system connects it with most of themajor cities in India. Main rail junctions in the stateinclude Chennai, Coimbatore, Erode, Madurai,Salem, Tiruchirappalli and Tirunelveli. Chennaihas a well-established suburban railway network,a mass rapid transport system(MRTS) and iscurrently developing a Metro system, with its firstunderground stretch in operation since May 2017.

Airways

Tamil Nadu has four major internationalairports. Chennai International Airport iscurrently the third largest airport in Indiaafter Mumbai and Delhi. Other internationalairports in Tamil Nadu include Coimbatore,Madurai and Tiruchirapalli airports. It alsohas domestic airports at Tuticorin and Salemconnecting several parts of the country.Increased industrial activity has given riseto an increase in passenger traffic as well asfreight movement, which has been growing atover 18% per year.

NH - 44 is the longest national highway in Tamil Nadu which runs from Hosur to Kanniyakumari (627.2 km) Via Dharmapuri-Salem-Karur- Dindigul-Madurai-Tirunelveli.

NH - 785 is the shortest nationalhighway in Tamil Nadu which runs fromMadurai to Natham (38 km).

Waterways

Tamil Nadu has three major ports. Theyare in Chennai, Ennore and Tuticorin. It hasan intermediate port at Nagapattinam and15 minor ports. The ports are currently capableof handling over 73 million metric tonnes ofcargo annually (24% share of India). All theminor ports are managed by the Tamil NaduMaritime Board, Chennai Port. This is anartificial harbour and the second principal portin the country for handling containers. It iscurrently being upgraded to have a dedicatedterminal for cars capable of handling 4,00,000vehicles. Ennore intermediate port was recentlyconverted as a major port and handles the majorcoal and ore traffic in Tamil Nadu.

Communication

Communication is derived from the Latinword communicare, meaning 'to share'. Theact of conveying or exchanging information iscalled means of communication. They are masscommunication and personal communication.

Postal Districts and Headquarters in Tamil Nadu

Zone /districts	**Head quarters**
Chennai	Chennai
Western	Coimbatore
Central	Thiruchirapalli
Southern	Madurai

Trade

Export and import are the twocomponents of trade. Export means goodsand services sold for foreign currency. TamilNadu contributes 12.2% to the country'sexports. Import refers to goods and servicesare brought from overseas producers. TamilNadu imports many goods from outside. Thedifference between the values of export andimport is called the balance of trade.

Major Exports of Tamil Nadu	
(i) Agricultural Products	tobacco, cereals, cotton, sugarcane, paddy, groundnut, spices and vegetables.
(ii) Leather Products	wallets, purses, pouches, handbags, belts, footwear and gloves
(iii) Gems and Jewellery	pearls, precious stones, gold jewellery, decorations and antiques

(iv) Chemicals and related products	paper, chemicals, rubber and glass.

Imports of Tamil Nadu

Machineries like transport equipment,machine tools, non-electrical machinery,electrical machinery, pharmaceuticalproducts, petroleum, fertilizers and newsprintare its major imports. The state contributes10.94% to the country's trade through majorports.

The above discussion shows that TamilNadu is an important state of India in termsof size, population, resources and economicdevelopment. People in the state are wellsecured. The new schemes introduced by thestate government periodically have enablednotable progress in various fields.

Man made Disasters in Tamil Nadu

Definition

A disastrous events caused directlyor indirectly by human actions are calledas manmade disaster. Man-made disastercan include hazardous material spills, fires,groundwater contamination, transportationaccidents, structure failures, mining accidents,explosions and acts of terrorism.

Industrial Disaster

Disasters caused by industrialcompanies either by accident, negligence, orincompetence fall under industrial disasters.Electrical faults seem to be the major reasonfor industrial disasters in the country.Overheating, aging of the material and useof sub-standared quality of electrical gadgetshave been the main factors contributing tothe increasing fire accidents in industries.Electricity is not just a life line; It can also takeaway life when handled improperly', Apartfrom these, explosions, leaking of poisonousgases, injuries and deaths caused by machinesare the other causes of industrial disasters.

Sivakasi, is considered the "fireworkscapital"of India. Series of industrial accidentscausing deaths are reporting frequently in theregions of Virudhunagar and Sivakasi wherea number of fireworks and match units arein operation. An explosion occurred on 5September, 2012 in a private firework company.In this incident 40 workers were killed and morethan 70 workers were injured. Various measuresare being taken by the Government to reduce thefire accidents and casualties caused by industries.In another industrial accident which took placeat Coimbatore on 2nd February 2016 in a tyremelting unit, six migrant workers were criticallyinjured.

Stampede

A situation in which a large numberof animals or people running in the samedirection in an uncontrolled way causinginjuries and deaths is called stampingOn 21st April, 2019 seven people werekilled and 10 injured in a stampede during alocal festival at a temple near Thuraiyur in TamilNadu. The incident took place when hundredsof devotees gathered at the Karuppasamy templein Muthiampalayam village for the 'padikasu'(temple coin) distribution ceremony.

Mitigation

Hazard mitigation refers to any sustainedaction taken to reduce or eliminate the longtermrisk to human life and property fromhazardous conditions.

- Regular maintenance of machines andwires may reduce the frequency ofaccidents,
- Creating awareness and training theworkers to be cautious during work hoursmay help them to reduce risk duringdisasters.
- Wearing specially designed dresses andother safety materials would help theworkers to protect themselves from anyserious injuries.
- Conducting periodical medical campswould help them to assess their healthstatus. The Provision of having lifeinsurance policies will secure their future.
- Besides these, the administration shouldbe employees friendly and ready toextend their help in case of any untowardincidents.

Disaster emergency contact number 1077 - Control room of District Collector/Magistrate.

Road Accidents

The road accidents in India is on veryhigh level. Tamil Nadu leads in the number ofroad accidents in the country. Increase in roadtraffic, high speed of vehicles and violation oftraffic rules are the causes of major of accidents.In 2013, 14504 accidents had taken place in thestate which resulted in 15563 deaths. In the tenyears from 2002-2012, Tamil Nadu tops the listin number of road accidents among the statesof India. It is reported that about 15 percent ofaccidents of the country takes place in TamilNadu. The figure of 2017 also puts Tamil Naduon top with recording of 16157 deaths out of147913 deaths recorded in the country. Deathtoll came down rapidly in 2018 to 12213 deaths,a decline of 24.5 percent.

Risk Reduction Measures

Before: Avoid Speeding, Drunk and driving,use helmets and seat belts and follow trafficrules

After: Call police or ambulance; seek medicalattention; make an accurate record andexchange information.

KNOW - RISK...!
NO - RISK...!

Basic Road Safety Rules

- Aware of the road signals
- Stop, look and cross
- Listen and ensure whether a vehicle isapproaching;
- Don't rush on roads;
- Cross roads in pedestrian crossings;
- Don't stretch hands while driving vehicles;
- Never cross road at bends and stay safe ina moving vehicle.

Accelerated changes in demographic andeconomic trends disturb the balance whichleads to increased frequency and the negativeimpact of disaster. At present the society facea challenging mix of demographic, ecologicaland technological condition which makepopulation more vulnerable to the impact ofthe calamities. Though the number of naturaldisasters are in decline than they were in thepast, the increasing level of magnitude posesa threat. Besides the various measures takenby the government and the public, educationon awareness regarding the disasters mayhelp in the reduction of risks during disasters.

For the management of disastersin the state, the following forces andorganizations are in service.

I. State Disaster Management Authority(Chairman-Chief Minister)
II. Relief/ Disaster ManagementDepartment
III. Police
IV. Forest Department
V. Fire and Civil Defence Services
VI. Health Services
VII. Transport Department
VIII. Public Works Department
IX. Veterinary Services
X. Food & Civil Supplied Department.

The Organizations at District Level

(i) District Magistrate (Chairman-District Collector)
(ii) Revenue Department
(iii) Civil Administration,
(iv) Local Police,
(v) Civil Defence,

(vi) Fire & Emergency Services,
Home Guards (also Local Community, Non-Governmental Organisations, Voluntary Agencies

Unit VIII Natural Disasters Public Awareness for Disaster Risk Reduction

Introduction

On an average, 232 million people are affected by different types of disasters every year. In recent years disaster risks have been on the rise due to factors such as population growth, unplanned urbanization, environmental degradation, conflicts and competition for scarce resources, climate change, disease epidemics, poverty and pressure from development within high-risk zones. Hence, disaster risk reduction is the need of hour.

Recognizing the importance of Disaster Risk Reduction in 2005, 168 governments and all leading development and humanitarian actors signed the Hyogo Framework for Action (HFA), committing themselves to a ten-year multi-stakeholder and multi-sector plan to invest in disaster risk reduction as a means to building disaster-resilient societies.

Public awareness campaigns can be started modestly and tailored to meet the needs of specific populations and target groups. These approaches canbe integrated into almost all existing initiatives, whenever and wherever they take place. They can build on and support existing volunteer mobilisation and peer-to-peer communications. To support this, it requires strong and unified disaster reduction messages and clear and targeted information, education and communication materials.

Public awareness for disaster risk reduction

There are four key approaches to public awareness for disaster risk reduction: Campaigns, participatory learning, informal education, and formal school-based interventions.Let's take formal school based interventions to learn in detail.

Formal school-based interventions:

The focus of formal school-based interventions cover two areas: school disaster management and disaster risk reduction in school curricula. These are considered to be formal because accountability and responsibility for school safety and curricula belong exclusively to education authorities, so they require support for long-term planning and capacity building.

School disaster management:

The primary goals of school disaster management are to ensure the safety of students and staff. Sustained school disaster management requires the familiar participatory and on-going process of identification of hazards and risks, mitigation and reduction of risks, and developing response capacity.

A school disaster management plan, developed at the school level, should be the living document that expressesthe awareness of public for disaster risk reduction. Every school has to setup the following school disaster committees:

1. Coordination Committees
2. Awareness generation Team
3. Search Rescue and Evacuation Team
4. Site safety Team
5. First Aid Team
6. Warning and Information Team
7. Bus safety Team
8. Water / Food Arrangement Team.

All the teams should participate in the mock drill.

Mock drillsform a vital part of the school disaster management process, and provide an intensive learning experience. They should be followed by reflection and assessment by all members of the school community. Lessons learned are incorporated into the school disaster management plan, and goals set for improvement next time. Depending on hazards faced, there are several major types of drills that can be practiced:

Disasters and Rules of actions during disasters

Earthquake

An earthquake is sudden, rapid shaking of the ground caused by the shifting of rocks beneath the earth's surface. Earthquakes strike suddenly without warning and can occur at any-time. The impacts of the earthquakes include deaths, injuries and damage of property. You have learnedabout occurrence of the earthquake and other related information in the earlier part of the book.

Nepal - India Earthquake

The April 2015 Nepal Earthquake (also known as the Gorkha Earthquake) killed nearly 9,000 people and injured nearly 22,000. It occurred on 25 April, with a magnitude of 8.1 Richter scale. Its epicentre was east of Gorkha District at Barpak. It was the worst natural disaster to strike Nepal since 1934 Nepal-Bihar earthquake. The earthquake triggered an avalanche on Mount Everest, killing 21 people making April 25, 2015 the deadliest day on Nepal's history. The earthquake triggered another huge avalanche in the Langtang Valley, where 250 people were reported missing.

Mock drill: Earthquake

In case we are inside the class when earthquake occurs, instruct loudly "earth quake position - drop, cover, and hold on". Drop down on your knee. Cover your head, neck and face. Go under a table to protect your head.

Rules of actions during an earthquake:

1. Stay calm, do not panic.
2. If you are in a building, sit down on the floor under a table or any other furniture and firmly hold on to it until the earthquake has stopped.
3. If there is no table nearby, cover your face and head with your hands and sit on the floor in a corner of the room.
4. Keep away from glass windows, glass doors and things that can fall down.
5. Do not try to leave the building quickly; during earthquakes people mostly die because they try to run out of thebuilding and become trapped under ruins if the building is destroyed.
6. Do not go to the staircase, a balcony or an elevator.
7. If you are in the street, keep away from buildings; try to get into an open space and avoid power transmission lines.
8. If you are at home, turn off electrical equipment and gas quickly.
9. If you are in chemistry class or a laboratory where chemicals are stored, try to leave the room because chemicals may cause injuries;

After earthquake:

1. First check if you have any injuries, and then check the condition of the surrounding people. If you cannot do this, wait for the rescue team;
2. After the earthquake when you leave the shelter, do not return for 2-3 hours because the quakes may repeat (an aftershock).
3. Check if there is fire; in case of a mild one try to extinguish it.
4. Be cautious about the possibility of gas leakage and damage caused to electrical wiring.
5. Be careful while opening wardrobe doors to take necessary items;
6. Use only lanterns; do not use an oil lamp or a candle.
7. Listen to the radio to receive information about the earthquake.

Landslide

A landslide is defined as the movement of a mass of rock debris down a slope. Landslides are caused by the directinfluence of gravity. Landslides can be caused by rainfall, snowmelt, stream erosion, and flood, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors.Landslides cause property damage, injury and death and adversely affect a variety of resources. For example, water supplies, fisheries, sewage disposal systems, forests, dams and roadways can be affected.

During a Landslide

1. Listen for any unusual sounds that might indicate moving debris, such as trees cracking or boulders knocking together.

2. If you are near a river, be alert for any sudden increase or decrease in water flow and for a change from clear to muddy water. Such changes may indicate landslide activity upstream, so be prepared to move quickly.
3. Be alert especially when driving. Embankments along roadsides are particularly susceptible to landslides.
4. Disconnect the power supply in the areas of landslide.

After the Landslide

1. Stay away from the slide area. There may be danger of additional slides
2. Check for injured and trapped persons near the slide, without entering the direct slide area.
3. Direct rescuers to their locations.
4. Listen to local radio or television for the latest emergency information
5. Watch for flooding, which may occur after a landslide or debris flow.

Cyclone

The major natural disaster that affects the coastal regions of India is cyclone and as India has a coastline of about 7516 km; it is exposed to nearly 10 percent of the world's tropical cyclones.About 71 percent of flood prone areas are in ten states (Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Pondicherry, Andhra Pradesh, Orissa and West Bengal). The islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones.

Districts in Tamil Nadu which are frequently affected by cyclones: All the 13 coastal Districts of Tamil Nadu are affected by cyclonic storms which occur during May-June and in October-November months. These Districts are: Tiruvallur, Chennai, Kancheepuram, Villupuram, Cuddalore,Nagapattinam, Tiruvarur, Tanjavur, Pudukkottai, Ramanathapuram, Tuticorin, Tirunelveli and Kanniyakumari.

On an average, about five or six tropical cyclones form in the Bay of Bengal and Arabian sea and hit the coast every year. Out of these, two or three are severe. When a cyclone approaches to the coast, a risk of serious loss or damage occurs from severe winds, heavy rainfall, storm surges and river floods. The effect of a storm surge is most pronounced in wide and shallow bays exposed to cyclones such as in the northern part of Bay of Bengal. Most cyclones occur in the Bay of Bengalfollowed by those in the Arabian Sea and the ratio is approximately 4:1. During the cyclonic of cyclonic storms, wind speed is between 65 km/h and117 km/h.

Rules of action before a cyclone

1. Go to high-lying places from low-lying areas
2. Those residing in old buildings should temporarily relocate to safer buildings; Jewels and documents should be kept in safe custody.

3. Battery-operated radio, plastic torchlight, lamp, kerosene, match-box should be kept safely for future use.
4. Keep in ready all the first-aid kit and material available with you.
5. Keep in stock foodstuffs, material, fuel, drinking water and life-saving drugs needed for the next week.
6. It is also important to take cattle and other pets to safer places.
7. It is important to know that if we see quickly approaching storm clouds it is possible to predict strong winds several minutes in advance.

During a cyclone

1. If you are in a building during a strong gust, it is necessary to close and fasten windows and doors. It is better to stay in the rooms.
2. Turn off all electrical devices.
3. Protect yourself with your hands or a scarf. Protect the eyes, nose and mouth from dust.
4. If you are in a wildlife area, try to find a place protected from the wind. If there is no such place nearby, lie down on the ground.
5. If you are in a car it is better to stay there and close the windows. Do not park the car under unstable objects that can break down and fall on the car.

After cyclone

1. Turn off electricity, gas and water and unplug all electric appliances.
2. Beware of snakes and other animals immediately after the cyclone.
3. Do not go for sightseeing.
4. Stay away from damaged power lines, falling trees and flood water.
5. Boil and purify water before drinking.

Flood

Flood destructions have always brought miseries to numerous people, especially in rural areas. Flood results in the outbreak of serious epidemics, specially malaria and cholera. Simultaneously, scarcity of water also arises. It has a drastic effect on agricultural produce. Sometimes, water remains standing over large areas for long span of time hampering the Rabi crops.

India is one of the most flood prone countries in the world. The principal reasons for flood lie in the very nature of natural ecological systems in this country,namely, the monsoon, the highly silted river systems and the steep highly erodible mountains, particularly those of the Himalayan ranges. The average rainfall in India is 1,150 mm with significant variation across the country. The annual rainfall along the western coast and the Western Ghats, Khasi hills and over most of the Brahmaputra valley amounts to more than 2,500 mm. Twenty-three of the states (29) and union territories (6)in the country are subject to floods and 40 million hectares of

land, roughly one-eighth of the country's geographical area, is prone to floods. The National Flood Control Program was launched in the country in 1954.

Mock Drill means Practicing of something that can happen in future so that it can be easily dealt with in.

- Tropical Cyclone Vardha hit Chennai on 12 December, 2016. National Disaster Management Authority (NDMA) reports that at least 10 people have died in Tamil Nadu.
- Maximum sustained wind speeds of over 130 km/h were recorded, and the storm has caused severe damage to parts of the city of Chennai. Over 4,000 trees have been uprooted, power lines downed and buildings damaged.

Do's before flood

1. Keep furniture and electrical appliances on beds and tables
2. Put sandbags in the toilet bowl and cover all drain holes to prevent sewage back flow.
3. Keep your mobile charged
4. Listen to radio or watch television for the latest weather bulletin and flood warnings.
5. Keepstrong ropes, a lantern, battery operated torches, extra batteries ready.
6. Keep umbrellas and bamboo sticks with you for protection from snakes.

Drought

The above map shows most the acute shortage of water in Tamil Nadu in 10 years. (2017)Drought is a period of time (months or years) during which a part of the land has shortage of rain, causing severe damage to the soil, crops, animals, and people. It sometimes causes even death. During drought high temperature is experienced. Such conditions may affect our health.

The primary cause of drought is deficiency of rainfall and in particular, the timing, distribution and intensity. In India around 68 percent of the country is prone to drought. Of the entire area 35 percent receives rain falls between 750 mm and 1,125 mm which is considered drought prone while 33percent areas receive rainfalls less than 750 mm is considered to be chronically drought prone.

Rules of action before, during and after Drought

Before drought:

1. Rainwater harvesting should be followed.
2. Sewage water should be recycled and used for domestic purpose.
3. Building canals or redirecting rivers for irrigation.
4. Utilise water economically.

During drought:

1. Wear cotton clothing and a hat.
2. In case of overheating, immediately move to a shady area.
3. Consume adequate amounts of water stay.

After drought:

1. If anyone faints after sunstroke, emergency medical measures should be taken.
2. Contact local government agencies to receive information about disaster and assistance for the population.

Lightning

Lightning is an atmospheric electrostatic discharge (spark) accompanied by thunder, which typically occurs during thunderstorms, and sometimes during volcanic eruptions or dust storms. Lightning generates 10-20 ampere currentand it is therefore fatal. It is especially dangerous for people in an open area.

- You can hear thunder from about 16 km of its starting point.
- Lightning bolts travel at the speed of up to 80,000 km / second.
- The average length of a single lightning bolt is 3-4km.

Lightning strikes often have fatal consequences. On an average, 2000 people die from lightning in the world every year. Lightning mostly strikes tall things, such as trees that break down and catch fire or it may strike power transmission linesand antennas fastened on roofs and buildings which causing fire. The air temperature, when lightning occurs, is as hot as 9982.2 °C.

Thunder is the sound caused by lightning. A charged, superheated lightning bolt creates a "resonating tube" as it travels. The air in the tube rapidly expands and contracts causing vibrations that we hear as the rumble of thunder.Lightning strikes can explode a tree. Imagine 15 million volts of electricity hitting a tree branch. The heat travels through the tree, vaporizing its sap and creating steam that causes the trunk to explode.

Before lightning

1. If you are planning to go to the countryside, check the weather forecast.
2. If a thunderstorm is expected it is better to postpone the trip.
3. It is good if you can estimate the distance to the front line of a thunderstorm. In order to do this you must check the time interval from the moment you see the lightning until you hear thunder. Lightning always precedes thunder. We know that the sound speed travels on average about 1km every 3 seconds.

Reduction of the time interval between the sight of lightning and the resulting thunder means that the danger is approaching and protective measures must be taken. If there is no interval between lightning and thunder means, it means that the cloud is already over your head.

During Lightning:

1. If you are in a building it is necessary to close windows, doors, ventilation pipes and chimneys.
2. It is necessary to turn off the telephone, TV set, and other electrical equipment because lightning may strike electrical cables and pass through wiring.
3. Do not take a shower because both water and metal conduct electricity.
4. Do not light the fireplace because the heat coming from the chimney may attract lightning.
5. It is better to stay away from electric wires, lightning rods, water pipes, antennas and windows.
6. If you are in an open area during a thunderstorm, do not stand under a tall tree. Lighting is most damaging for tall trees. It is better to stay 30-40 meters away from them. Avoid trees that are standing separately. Remember that lightning does not strike bushes.
7. If the area is open, it is better to find a lower place or a cavity and squat there.It is dangerous to stand or lie down on the ground, because this increases the exposure area.
8. It is necessary to get rid of metal items such as a bicycle, coins etc.
9. Do not stand under an umbrella.
10. Do not run during the occurrence of lightning; move slowly towards a shelter because the air flow may attract lightning;
11. If you are in a car, do not get out. It is better to close the windows and turn of the antenna. Do not park your car under tall trees or any structures that may fall down and hit you.
12. If there is an injured person next to you, remember that the victim may lose consciousness. It is necessary to provide first aid.
13. Cover your mouth with a wet cloth in order to protect your lungs.

Glossary

1. **Disaster:** A serious disruption of the functioning of a society involving human, and material, and impacts that exceed the ability of the affected society to cope using its own resources.
2. **Disaster risk reduction:** The practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters.
3. **Mitigation** : The lessening of the adverse impacts of hazards and related disasters
4. **Preparedness:** The capacity developed by organizations, to effectively anticipate, respond to, and recovers from the impacts of disaster events.

5. **Prevention**: The outright avoidance of adverse impacts of hazards and related disasters.
6. **Public awareness:** The extent of common knowledge about disaster risks, the factors that lead to disastersand the actions that can be taken, to reduce vulnerability to hazards.
7. **Resilience:** The ability of a society exposed to hazards to resist, absorb, adapt to and recover from the effects of a disaster.
8. **Hyogo Framework for Action–** A global blueprint for disaster risk reduction efforts between 2005 and 2015 – by providing specific operational guidance for promoting disaster risk reduction.

12th

8. MAN- MADE DISATERS

Introduction

"Mumbai railway station stampede kills at least 22"

"Rush-hour crush on footbridge connecting two stations was triggered by falling concrete that caused panic!" At least 22 people have been killed and more than 30 injured during a rush-hour stampede on a bridge between two railway stations in Mumbai. The crush occurred on a narrow footbridge connecting Prabhadevi station, formerly Elphinstone, and Parel station during the Friday, September 29, 2017 morning commuter rush and amid heavy rain. "There was a huge crowd on the foot over bridge. Everybody tried to leave at once and it appeared one of them slipped and fell, triggering the stampede," said an Indian Railways spokesman. Another spokesman said the number of people on the bridge was higher than usual because people were using the station to shelter from the rain.The above incident throws some lights on how to be aware of the accidents we encounter in our daily walk of life. Let us try to answer the following questions:

1. Which is more important life or the scheduled journey to be completed?
2. Why rushing in anything may be disastrous?
3. Why timely communication is more important to avoid accident?

The root of the word disaster ("bad star" in Greek and Latin) comes from an astrological theme in which ancients used to refer to the destruction of a star as a disaster.

Terms to know:

1. Hazard is a potentially damaging physical event or human activity which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.
2. Disaster is a serious disruption of a society functioning, causing widespread human, material losses which exceed the ability of the affected society to cope using its own resources.
3. Disaster risk management is a set of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of disaster.
4. Capacity - the assets, resources and skills available within a community that can be used to reduce the risks or effects of a disaster.
5. Disaster risk reduction includes activities that will minimize disaster-related losses of life and property.

Disaster is a serious disruption, causing damage or injury to people, buildings, roads, livelihoods, or the environment, which exceed the community's ability to cope.

The magnitude and impact of disasters are increasing and disasters have disrupted social, economic and environmental community activities worldwide. International data shows that disasters have taken, over the last 10 years, more than 478,000 lives. It has affected 2.5 billion people and caused direct economic losses in the amount of 690 billion US dollars worldwide.

Recent financial studies underline the urgent need for a shift from sole disaster response to disaster risk reduction. Therefore, efforts should be made to ensure that disaster risk reduction is an important aspect of poverty reduction and general development initiatives in the coming years.

Community-Based Disaster Risk Reduction

Community is a group of people living in the same place having homogenous characteristics. It includes shared experiences, locality, culture, language and social interests. Community-based disaster risk reduction is a process within a community and for the community. Reducing risk in communities should address the root causes of risks and address it through local knowledge and expertise. Performance and the arts provide a variety of creative opportunities to communicate. Important messages through live experiences. Examples include: Street theatre, dramatic readings, skits and plays, puppet shows, poetry reading.

Dance, flash mob activities in large urban settings (a group of people who assemble suddenly in a public place, perform an unusual act and then disperse), tapping into oral traditions such as story-telling, music and sing-along, mural-making and other hands-on art and design activities. All of these can involve volunteers and community members, as performers and audiences. Skilled performers find creative ways to engage their audience.

Man - made Disasters

Disasters induced by human beings are man-made disasters. It includes fire accident, transport accident, structure failure, mining accidents, explosions, stampede etc. In this lesson, we study about some of the man-made disasters.

Stampede

The term stampede is a sudden rush of a crowd of people, usually resulting in injuries and death from suffocation and trampling. In stampede, the term mob or crowd is used to refer to a congregated, active, polarized aggregate of people, which is basically heterogeneous and complex. Its most salient features include homogeneity of thought and action among its participants and their impulsive and irrational actions.

Causes of stampede

Incidents of stampedes can occur in numerous socio-cultural situations. These stampede incidents can be categorized into the following types: Entertainment events, escalator and moving walkways, food distribution, processions, natural disasters, power failure, religious events, fire incidents during religious/ other events, riots, sports events and weather related events.

Large religious gatherings are a particular stampede danger in the developing world. A 2013 paper out of India, for example, found that 79 percent of stampedes in that country have taken place at religious events, as opposed to political or entertainment-related events.

Stampede Management

Crowd management is defined as the systematic planning and supervision of the orderly movement and assembly of people. Crowd control is the restriction or limitation of group behavior.

The rules of action for stampede

1. Notice Alternate Exit: First thing to know in such situations is the route out. If you are attending an event, one of the things you can do in preparation is to try and know the topography of the place. This will help you find the exits. So, when struck in a stampede, try to identify these exits.

2. Keep Your Hands by Your Chest: Your hands must be up by your chest like they would be in a boxing position. This makes it easy to move. It also stops your ribs from getting crushed by the crowd on both sides. When the crowd pushes you from front and back, your lungs will be affected. You will suffer of suffocation.

3. How to move when on your feet: In the middle of a moving crowd, do not resist the flow by standing still or sitting down. The force is too much to fight. Like in a wave, there is force and in crowd situation. Keep moving diagonally between the pockets of people whenever there is a lull. Try to move towards the exits but not towards walls or fences where you might be cornered. Keep moving with the crowd to avoid falling.

4. How to move if you fall: If you fall and get back on your feet, cover your head with your hands and hurl up in a fetal position. Basically, avoid exposing your lungs to the crowd. Keep trying to find an opportunity to get up.

5. Communicate smartly: When trapped in the crowd, use sign language such as waving your hands up one side after another so that you will not get exhausted.

6. Conserve energy: Keep calm and do not try to scream. That only increases panic.

7. Set a meeting place: Arrange a meeting place, in case you get separated, one inside and another one outside.
If someone extends his/her hand for help, grab hold to keep them up.

Child safety Tips: Take a second, take a photo.
Before taking children out to any event, pull out your phone and take a photo of each child individually a selfie. That way you have a picture of how they looked that day. The photo can be sent to police to aid in locating the child in case the child is lost in a crowd.

Drowning

Drowning is the 3rd leading cause of unintentional injury death worldwide, accounting for 7% of all injury-related deaths. There are an estimated 3,72,000 annual drowning deaths worldwide. Children, males and individuals with increased access to water are most at risk of drowning. Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid; outcomes are classified as death, morbidity and no morbidity.

Fact File

It is one of our most visceral fears; thrashing in the deep, far below the water's surface, lungs burning for oxygen. Drowning claims hundreds of thousands of lives every year, a great many of whom are young children. Of course, exposure to water is a key factor in drowning, but there is a strong economic correlation as well. Those in poorer countries are far more likely to be drowning. In Bangladesh, 17,000 children drown annually that's 46 a day.

Below are 10 facts about drowning; from a lake that never surrenders its victims to a party for lifeguards that ended in deadly irony.
Fresh Water and Salt Water Drown You Differently.

Males are especially at risk of drowning, with twice the overall mortality rate of females. Studies suggest that the higher drowning rates among males are due to increased exposure to water and riskier behavior such as swimming alone, drinking alcohol before swimming alone and boating. Drowning accounts for 75% of deaths in flood disasters.

Prevention

There are many actions to prevent drowning. Installing barriers (e.g. covering wells, using doorway barriers and playpens, fencing swimming pools etc.) to control access to water hazards, or removing water hazards entirely greatly reduces water hazard exposure and risk. Community-based, supervised child care for pre-school children can reduce drowning risk and has other proven health benefits. Teaching school-age children basic swimming, water safety and safe rescue skills is another

approach. Setting and enforcing safe boating, shipping and ferry regulations is an important part of improving safety on the water and preventing drowning. Building resilience to flooding and managing flood risks through better disaster preparedness planning, land use planning, and early warning systems can prevent drowning during flood disasters.

Fire Accident

Massive forest fires may start in hot and droughty weather as a result of lightning, and human carelessness or from other causal factors. Fires can lead to the destruction of buildings, wooden bridges and poles, power, transmission and telecommunication lines, warehouses of containing oil products and other fuel. It causes injury to people and animals.

Students' activity Mock Drill:

To escape a fire, **stop, drop, and roll.** In case your clothes burn, stop running, drop on the floor and roll to stop fi re spreading.

During droughts or windy weather, fire may destroy low vegetation and trees. The spreading speed of low fire is 1-3 m/sec and high fire may reach up to 100m/sec.

Rule of actions for Fire Accident-Do's

1. When Fire accident occurs, warning should be given by shouting or ringing bell.
2. Extinguish the fire using sand and other fire extinguishers.
3. Main switch should be switched off immediately.
4. If clothes started burning, the victim should roll on the ground to extinguish the fire.
5. The combustible materials found near the fire accident place, have to be discarded so that the fire does not spread to them.
6. If fire breaks out with smoke spreading, cover the nose, crawl and move out.
7. Think that life is more valuable than belongings.
8. Move from the fire accident place to a safe place.

Preventive Measures

1. Create a safe zone between the house and flammable plants.
2. Cut off all the branches of trees with below three meter height standing near your house.
3. Remove moss and dry branches from plants standing near the house.
4. Clean ditches and pits from dry branches, leaves and cones.
5. Keep flammable materials in the checked safe containers.
6. Ask your relative or friend living in a different location to be your contact person.

7. Have a fire extinguisher and know how to use it.

Do you know?
A natural gas vent in Iraq known as The Eternal Fire of Baba Gurgur, meaning 'Father of Fire' has been burning continuously for over 4,000 years, and it has been mentioned by Herodotus, and Plutarch.

During fire accident

1. When water cannot be used (because the equipment is plugged-in) or there is no water and the fire is not strong, you can use cooking soda or calcite soda, washing powder, sand, soil.
2. Keep your head no higher than 30 cm above the floor; above this height accumulation of heavy poisonous gases is possible.
3. If there is no opportunity to leave the room, move towards a window, and try to get the attention of people by giving signals.
4. If your clothing has caught fire do not run because this will intensify burning. Take the clothes off, throw them in a safe place and put out the fire.
5. If you are near a fire in a forest and cannot extinguish the fire by yourself, immediately inform people who are nearby about the necessity to leave the hazard zone.

Things that must never be done during a fire

1. Never pour water on burning electrical equipment if it is switched on. If a TV set, a refrigerator is burning, turn off the electricity from the main switch.
2. Do not jump from windows of upper floors.
3. Do not panic.
4. Do not try to extinguish the fire by yourself.

Industrial Disasters

Industrial hazards consist of four principle hazards. The hazards encountered are fire, explosion, toxic release and environmental damage. This is because industries employ many different processes involving a wide range of different raw materials, waste products and final products. Danger originates from technological or industrial accidents, dangerous procedures, infrastructure failures or certain human activities. It may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Fire: This is the most frequent hazard. Fire can also produce toxic fumes like Acrolein, Carbon monoxide and Cyanides. Physical structures can be damaged either by the intensity of the heat or combustion. It may also have an effect on essential services like power and instrumentation.

Explosion: Explosions is the result of a shock wave. This overpressure can kill people but usually the indirect effects of collapsing buildings, flying glass and debris

causes far more loss of life and severe injuries. There are different types of explosions which include gas explosions and dust explosions. Gas explosions occur when a flammable gas mixes with air. Dust explosions occur when flammable solids, especially metals, in the form of fine powders are intensively mixed with air and ignited.

Chemical release: Sudden release of toxic vapors has the potential to cause death and severe injuries several kilometers from the release point. They are carried by water and air. Their release into public sewage systems, rivers, canals and other water courses, either directly or through contaminated water used in firefighting can result in serious threat to public. The number of casualties depends on the weather conditions, population density in the path of the cloud and the effectiveness of the emergency arrangements.

Environmental Damage: Release of other substances, not directly toxic to humans can cause major pollution problems. It is becoming increasingly recognized that damage to natural resources such as plant and animal life can have serious long term consequences. E.g. destruction of trees is increasing the effect of global warming and extinction of animals are severely disrupting food webs and causing an increase in pests.

Means of reducing the industrial hazards

Process Safety Management: Reliability assessment of process equipment, incorporating safety tips, scrubbing system, etc, should be done before effecting major process changes.

Safety Audits: Periodical assessment of safety procedures, performance of safety systems and gadgets along with follow up measures should be carried out.

Emergency Planning: A comprehensive risk analysis indicating the impact of consequences and practiced emergency procedures should be done. This can be done by communities as well as national or regional corporation authorities.

Training: Proper training of employees and protective services should be done.

Road accident

It is estimated that 1.34 million people are killed in the road accidents every year. Road accident is the 8th leading cause of death globally. Every year, up to 50 million people suffer serious, life-altering injuries which, in many low- and middle-income countries, directly contribute to the poverty cycle.

Primary road safety risk factors in low and middle-income countries include:

1. Speeding
2. Drink-driving

3. Non-use, or improper use of helmets, and
4. Non-use, or improper use of seatbelts

Strengthening the capability of the road traffic police to enforce traffic laws is fundamental to deterring road users from violating the laws, to reduce harm and toreduce inappropriate and unsafe behaviors on the roads.

Basic road safety rules for students:

1. Aware of the road signals

Assist students to learn the traffic lights and signs. Check out the relevance of each color:

- Green light is an indication for "go"- Whenever the signal turns green, the vehicle can move ahead.
- Red light is an indication "to stop"- All the vehicles have to stop, when the red light is on.
- Yellow light is an indication "to slow down"- When the yellow light turns on, you should slow down your vehicle and prepare to stop.
- "Walking man" signal at intersections are constructed for the pedestrians. Recall the fact that you will be authorized to cross the road only when the signal turns green. Ensure that there are no vehicles, both on the left and right side of the road.
- Never attempt to cross the road, if the signboard signifies "Don't walk" message or the walking symbol turns red.

2. Stop, look, and cross

In fact, students will either walk to school or to the bus stop for waiting their respective school bus. The only task of students is to cross the road prudently, right after the school bus drops them off. Hence, we should undertake the responsibility to provide adequate guidance for crossing the road cautiously.

We teach them to be aware of various road signs and recommend them to utilize the zebra crossing while crossing the road. If there are no markings or signs, the following procedures can be worthwhile:

- Check the right side, after that to the left side of the road for the incoming vehicles.
- If you notice a vehicle is approaching, wait for the vehicle to pass and then safely cross the road.
- Do not cross the road at the turns, it is unsafe.
- Never cross the road between the stopped vehicles.

However, accompaniment is required for the children aged below 6 years and you should compulsorily hold their hands while crossing the road.

3. Listen

Educate the child to be extra vigilant while they cross the road at the turns. As a consequence, listening can only aid them. For this reason, instruct your child to listen and ensure whether a vehicle is approaching or not. Ordinarily, vehicles apply horns at turns and at unmanned intersections to providea warning to other road users. Meanwhile, you can interpret the following instances to students:

- If a horn is heard, stop and cross only after ensuring that no vehicle approaches you from left or right side of the road.

4. Don't rush on roads

Students will not be tolerant and have a tendency to dash across the road to reach the other side. In addition, they become absent-minded when they are having fun and henceforth bound across or along the road. Therefore, teach them to remain placid while they are near the road.

5. Relevance of Sidewalks

Persuade students to avail the service of sidewalks whenever they walk on the road. Demonstrate them how to cross the road safely. Motivate them to avail the sidewalks even though it is not a busy street.

6. Crossroads and pedestrian crossings

Students will have a tendency to scoot across the street. This will become particularly perilous since vehicles will never slow down unless there is a cross road or relevant signal. Notify your students to cross only at intersections and avail the pedestrian crossings. If there is no crossroad or pedestrian crossing, you can admonish students to comply the rules mentioned above.

7. Place the hands inside the vehicle

A multitude of students have the habit of placing their hands outside the vehicle while it is moving. They will lay their head out and wave with exhilaration. This is a familiar sight among the school bus students. Nevertheless, these behaviors can have significant consequences. Due to carelessness, they will be injured by vehicles, which advance from the opposite direction.

8. Never cross road at bends

Bends are evidently the blind spot for motorists. When you attempt to cross at bends, the driver will be unable to recognize you and stop the car at the right time. As a result, students will be hurt while crossing at bends.

9. Remain safe on a bicycle

If students ride bicycle to reach the school, ensure that they adhere to the following cycling rules:

- Utilize the bicycle lane. If such a lane does not exist, ride the bike either on the extreme left or right side of the road and glide along with the traffic.
- Never permit your students to ride on congested streets without your supervision.

10. Staying safe in a moving vehicle

In a moving vehicle, you can ensure the student's safety with the assistance of a seat belt. Let them practice the following safety rules in your absence:

- Never stand, stroll or sprint inside a moving vehicle.
- Remain seated and hold the rails on the seats until the school bus halts.
- Do not put your hands outside the moving vehicle.

11. Get off the vehicle at the curb side

Ask your students to memorize the following safety tips and conform to the rules while they get down from the school bus:

- Ensure that you reach the bus stop prior to the scheduled bus timing in order to avert the circumstance of running behind the school bus.
- Form a queue to board or descend the school bus.
- Disembark the school bus at the curbside in order to evade unnecessary endangerment and hindrance to other vehicles.