



HUMAN DISEASES

I. DEFICIENCY

12th std

Introduction

Physiology is the study of functioning of organs and organ systems.

All physiological activities are aimed at maintenance of **homeostasis, living and reproduction**. Homeostasis differentiates a living being from the non-living world. It provides the uniqueness for a self-duplicating, genomized groups of organisms. **Homeostatic mechanisms** involve stabilizing an optimum level of water, minerals and other components of the body fluids and other thermal regulations. **It is achieved by several** bio-physical, bio-chemical processes, hormonal secretions and related metabolic modifications.

The phenomenon of **living** is made possible due to several types of evolved organs and their well-co-ordinated functions. The functioning of heart as a pumping organ being emotionally controlled is astonishing. The oxygen association and dissociation capabilities of blood pigments, cascading effects of minimal amount of hormones at molecular limits, the process of nervous conduction, analyzing and memory maintaining capacities of the brain, the holistic visual perception of the eye are all wonderful inventions of nature towards a simple process of living.

The attainment of a simplified process of **sexual reproduction** for complicated, genetically oriented mechanisms for sex cells production

and procreation is stunningly marvellous. The orientation of reproductive strategies towards social, environmental and futuristic motives is highly precise and purposeful.

Thus all the functionings of a living system are highly complicated mechanisms with a simple outlook. In the forthcoming chapter an attempt has been made to highlight defects in functioning, remedial attempts and life-style modifications. Proper treatment of such an objective will result in a voluminous work. Yet, a simple attempt has been made to provide the information.

While going through the pages of this chapter, the learners may recollect the human anatomy learnt in the previous class. Knowledge and remembrance of anatomy will simplify an understanding of physiological processes.

Nutrition

The survival of all living organisms is due to several types of nutritive processes. The process of nutrition involves ingestion digestion, absorption and assimilation of food materials.

The composition of nutrients varies in different types of feeding. However, for all living organisms, the nutrient comprises the following organic and inorganic components. They are carbohydrates, proteins, lipids, vitamins, minerals and water. Each component has a specific functional role. A well-proportioned intake of nutrients depends on several factors such as stage of growth, sex, health condition, bodily activities and environmental situations.

Carbohydrates (Poly hydroxyaldehydes (or) ketones.)

A carbohydrate is composed of carbon, hydrogen and oxygen in the ratio of 1:2:1 (CH_2O)_n. They are of three types namely monosaccharides, disaccharides and polysaccharides

Monosaccharides:

These are the simplest form of carbohydrates being comprised of a single organic molecule. Depending on the number of carbon atoms they are classified into trioses, tetroses, pentoses, and hexoses.

The **trioses** (C₃H₆O₃) are common intermediary products in carbohydrate metabolic processes. They play an important role in inter conversion of biomolecules. (eg. glyceraldehydes). **Pentoses** (C₅H₁₀O₅) like ribose and deoxyribose are the integral components of RNA and DNA molecules. The **Hexoses**(C₆H₁₂O₆) such as glucose, fructose and galactose are food components commonly consumed.

Carbohydrates are commonly employed by the cells for providing energy. The energy metabolism happens through glycolytic processes involving oxidative, citric acid cycle. The energy liberated is stored in the form of ATPs (Adenosine triphosphate). Each gram of carbohydrate is capable of yielding energy equivalent of 4.1 calories.

Disaccharides

These are the carbohydrates formed by condensation of two monosaccharide monomers. These are found in common food substances such as milk and sugar. There are three common disaccharides namely maltose, sucrose and lactose. They have the following composition

Maltose (<i>In germinating cereals</i>)	□	glucose + glucose
Sucrose (<i>cane sugar</i>)	□	glucose + fructose
Lactose (<i>milk</i>)	□	glucose + galactose

Polysaccharides

These are complex carbohydrates formed by polymerisation of a large number of monosaccharides. Nature abundantly produces various types of polysaccharides. Several of them are structural components in the living world eg. chitin, cellulose. Starch molecules serve as storage food materials trapping enormous amount of energy. In food grains, starch is available as pectin and amylopectin molecules. Glycogen, a polysaccharide is found in liver and muscles.

Proteins (Polypeptides)

Proteins are nitrogenous compounds being made up of carbon, hydrogen, oxygen and nitrogen. Proteins also contain sulphur. In living systems proteins play an important role in the **structural** organisation eg., cell membrane, hairs, nails and muscles. Many of the proteins serve as enzymes. They are named as **functional** proteins.

The building blocks of proteins are aminoacids. There are approximately twenty different types of amino acids, such as glycine, alanine, serine, valine, leucin, proline etc. The amino acids are classified as essential and non-essential amino acids. Essential amino acids cannot be synthesised in our body. Hence they should be made available through food.

The **essential amino acids** are arginine, valine, histidine, isoleucine, leucine, lycine, methionine, phenylalanine, threonine and tryptophan. The nonessential amino acids can be synthesized in our body from other compounds. Such amino acids need not be added in the diet.

A protein (or) a polypeptide chain is formed of several amino acids linked with each other by peptide bonds. This linear arrangement is termed as primary organisation of a protein. However in most of the proteins, the straight chain structure gets complicated, into secondary, tertiary or quaternary stages. These levels are due to several other chemical bonds. The complicated nature of a particular protein is specifically required for its prescribed function.

The amino-acids sequence and level of organisations is determined genetically. Hence the genome gets its importance due to its capability to produce, specific types of protein for bringing out genetically characteristics.

The daily requirement of protein, according to the Nutrition experts committee of ICMR (Indian Council for Medical Research) and

WHO (World Health Organisation) is 1 gm per kg body weight. Reduction in the intake of protein leads to protein malnutritions, such as **marasmus** and **kwashiorkar**.

In marasmas the child loses weight and it also causes severe diarrhoea and the body muscles get wasted. It will appear as though the bones are covered by the skin. In kwashiorkar there is a wastage of muscles. Face and feet will have oedema. The belly region will appear enlarged.

Lipids

Lipids are important cellular constituents. They are energy rich compounds. They form the most important storage food in the body. In our body, it serves as an insulating material. Cosmetically, the presence of limited amount of fat beneath the skin adds to beauty. Further, steroidal hormones are produced from certain lipids.

The most common type of lipids is the simple lipids (or) triglycerides. They are naturally occurring substances (vegetable oils).

In animals it is a main constituent of adipose tissue. Chemically a triglyceride is formed of glycerol and fatty acids.

Fatty acids are of two types namely **saturated** and **unsaturated fatty acids**. The unsaturated fatty acids are capable of easier oxidative breakdown, hence poly unsaturated fatty acids(PUFA) are favoured for persons having high blood pressure and other related ailments. These fatty acids are abundant in sunflower oil and safflower oil. Each gram of lipid is capable of yielding 9.3 calories of energy. It is suggested that 25% to 30% of total calories should come from fat.

Vitamins

Vitamins are complex organic compounds, whose presence in trace amount in the food is essential for growth and other physiological activities.

Vitamins do not have any energy value. However they are essential for controlling energy yielding processes. The identified

vitamins are classified as **A, B, C, D, E** and **K**. Of these, vitamin **B** and **C** are water soluble in nature.

Vegetables and fruits containing these vitamins if washed in water as cut pieces would lose them easily. Vitamin **A, D, E** and **K**, if consumed beyond required level may cause defects, commonly referred to as vitaminosis.

Of the various vitamins, vitamin **D** or calciferol on exposure to sunlight can be synthesised by our body through the lipid compound called ergosterol, found below our skin. Hence it is known as 'sunshine vitamin'.

The most important functions of vitamins include.

1. **Physiological processes:** Vitamin **A** plays a very important role in visual perception. Vitamin **E** might ensure fertility in animals. The clotting of blood is aided by vitamin **K**. Vitamin **C** provides immunity against infections and it may also support processes of growth.

2. **Maintenance of body tissues:** The epithelial tissues of the body are maintained by vitamin **A** and **B2**. The growth of bones is ensured by vitamin **D**. Vitamin **E** plays a role in the rejuvenation of tissues.

Nourishment to nerve cells is provided by vitamin **B1**. The process of maturation of erythrocytes is due to vitamin **B12**.

3. **Metabolic processes:** The process of calcium and phosphorus metabolism happens due to the presence of vitamin **D**. Vitamin **E** remains an antioxidant. Vitamin **B1** remains as a co-enzyme in tissue metabolism and it is found useful in the process of oxidation of glucose in CNS. Vitamin **B2** is essential for carbohydrate metabolism.

Niacin (vitamin **B**) plays a role as a co-enzyme and is essential for oxidation-reduction reactions. Normal metabolism of amino acids and fat are due to vitamin **B6**. Biotin (vitamin **B**) serves as a co-enzyme and co-factor in oxidative metabolism. Vitamin **C** activates certain intracellular enzymes.

Vitamin Deficiency Ailments.

Vitamin A

- ❖ Atrophy of lacrymal glands of the eye and reduction in tear secretion.
- ❖ Corneal epithelium becomes red and dry (**xerosis**). It may also become wrinkled and keratinised (**xerophthalmia**). Appearance of Bitot's spot in the cornea might happen.
- ❖ Cornea may get necrosed and get infected (**keratomalacia**).
- ❖ May cause night blindness (**nyctalopia**).

Vitamin D:-

Defective calcification of bone, deficiency of vitamin-D, causes **rickets** in growing children and **osteomalacia** in adults.

Vitamin E: - Rare in human, **sterility** in experimental animals.

Vitamin K:-

- ❖ Lack of vitamin K leads to **defect in blood coagulation**.
- ❖ In humans, vitamin K deficiency leads to **haemorrhagic** manifestations.

Vitamin B1:-

Gross deficiency of vitamins B1, leads to a condition known as **beri**

beri. Beriberi affects nervous and cardiovascular systems. In children and infants the onset is acute.

Vitamin B2 :

Loss of appetite and other gastro-intestinal symptoms, soreness and burning of lips, mouth and tongue. Fissures appear at edges of the mouth.

Vitamin Niacin:

Its deficiency leads to **pellagra**. The principal symptoms of pellagra include mental changes, (dementia) dermatitis and stomatitis. The tongue becomes smooth, red and painful.

Vitamin B6: (Pyridoxine)

In human pyridoxine deficiency causes dermatitis around eyes, nose and behind the ears. Fissures appear above the lips and angles of the mouth.

Vitamin B12:- Its deficiency causes **pernicious anaemia**, typical sore tongue and several neurological problems related to the spinal cord.

Vitamin C:- Its deficiency in the body leads to **scurvy**, a disease characterised by bleeding gums, loosening and falling out of teeth and intra muscular haemorrhages. In the absence of this vitamin the collagen and connective tissue proteins are not synthesised properly.

Minerals

Along with complex organic substances, such as carbohydrates, proteins and lipids, our body needs substances such as minerals, vitamins and water as accessory food factors.

Of the minerals certain elements are found in greater concentration. They are sodium, calcium, potassium, magnesium, phosphorus, sulphur and chlorine.

Certain other minerals are required in slightly lower concentration for performing useful functions. These include, iron, copper, zinc, cobalt, manganese, iodine and fluorine (trace elements). Of these minerals, larger portion of certain minerals are concerned with **body building activities** such as formation of bones and teeth (Calcium, Magnesium and Phosphorus).

Trace elements and other minerals are useful in **physiological activities** such as oxygen transport (Iron), hormone synthesis (Iodine) and intermediary metabolism (Manganese, Copper, Zinc). Some of the elements remain as **constituents** of the body fluids (Chlorine, Sodium and Potassium). Presence of certain minerals is essential for **neuromuscular irritability** (Magnesium, Sodium and Potassium), blood clotting (Calcium), and **cardiac functions** (Potassium and Calcium).

Water

Water is a major constituent in the body of all **mammals**. The proportion of water in the lean body mass (mass of the body - fat content) is constant at around 71 to 78 % in animals including human beings.

The total body water content varies with age, sex and body weight. In a new born child it is 85 to 90 % of body weight. In young adults it ranges from 55 - 60 %.

Of the total body water, about 2/3 is found as intra-cellular fluid (ICF) and 1/3 as extra-cellular fluid (ECF). About 25% of ECF is the plasma of blood.

The body water content is kept constant by maintaining a proper balance between water intake and loss. Intake of water happens through drinking of water and beverages, water in the food consumed and water generated during metabolism. The average water intake is around 2500 ml/ day (as water 1400 ml).

Water loss happens through four routes. They are

1. Urine (about 1400ml), 2. Expiration (400ml), 3. Through skin (600ml), 4. Loss in faeces (100ml)

Role of water

1. It is an essential constituent of all the cells of the body.
2. It serves as a transport medium for nutrients and excretory products.
3. It serves as a site for chemical reactions.

4. It is a valuable solvent for electrolytes, enzymes, hormones and vitamins.
5. It plays a vital role in the maintenance of body temperature.
6. It helps to maintain form and texture of tissues.

Balanced diet

A balanced diet must have all food supplements in needed proportion. It should be preferred in such a way that normal growth.

Working capability, nitrogen balance and full calorie requirement can be maintained. While planning a balanced diet, the total calorie requirement of the individual is calculated and then the different components of the food are selected. Normally the calorie content of the food is fixed with an understanding that 10 -15 % of calories are to be obtained from proteins, 25 - 30% from fats and the rest from carbohydrates.

Calorie values

In nutrition and dietetics a calorie means the amount of heat required to raise 1 Kg water by 10C. As per the Nutrition Expert Committee of ICMR (1968) the calorie requirements are prescribed for Indian Reference Man (IRM) and Woman (IRW). The IRM and IRW have following characteristics.

IRM: - 25 years of age, 1.62 sq.mt of body surface, 55 kg body weight and remains healthy.

IRW: - 25 years of age, 1.4 sq.mt of body surface, 45 kg body weight and remains healthy.

The calorie requirement for IRM and IRW depending on their nature of work is prescribed as follows

IRM

Daily activities	Sedantary work	Moderate work	Heavy work
A. Basal metabolism (BMR) (8 Hrs of Sleep)	460 calories	460 calories	460 calories
B. Non occupational activities (8 Hrs)	1220 calories	1220 calories	1220 calories
C. Occupational activities (8 Hrs)	750 calories	1100 calories	2200 calories
Total	2430 calories	2780 calories	3880 calories

IRW

A. Basal metabolism (8 Hrs of sleep)	354 calories	354calories	354 calories
B. Non occupational activities (8 Hrs)	826 calories	826calories	826 calories
C. Occupational activities (8 Hrs)	610 calories	900calories	1800 calories
Total	1790calories	2080calories	2980calories

While formulating and planning the diet for a person, his/her calorie requirement is assessed. This assessment is based on the requirement of IRM and IRW. It is adjusted according to age, weight, and health and working conditions. Final prescription of food is provided based on the calorie value of each item of food. Due attention is given also for palatability and social food habit. Balanced diet for Indian adult male and female doing moderate work.

Obesity:

Obesity is due to storage of excess of fat in the body. It results in a significant impairment of health from a variety of diseases, notably hypertension, atherosclerosis, heart disease and diabetes. A level of 10% above the standard weight, for subjects of same age and sex is considered as obese

Normal BMI range for adults is 19 – 25

Obesity may be due to genetic reasons, increased appetite leading to excessive intake of food than is needed by the body, endocrine causes and/or metabolic disorders.

Arthritis

Arthritis is the inflammation of all the components and structures of the joints. It involves synovium, articular surfaces and capsule. Several etiological factors are attributed to the origin of arthritis (arthritogenesis). They are diet, psycho-somatic illness, infections, diseases and metabolic abnormalities, etc., Types of arthritis include.

1. **Infective arthritis:-** Infections such as Staphylococcal, Streptococcal, Gonococcal, Rheumatic, Small Pox, Tuberculosis, Syphilitic, Guinea worms, etc., can cause damages at the joints. It produces pain in joints.

2. **Rheumatic arthritis:-** It is a generalized disease affecting the connective tissues, of the whole body. It focalizes the involvement of musculoskeletal system. It is an inflammation of synovial membrane. Rheumatic disease is considered to be of auto immune origin. It is due to immunological disorder against an unknown antigen..

3. **Osteoarthritis (Osteoarthrosis):** - It is a degenerative condition of the joints, without any inflammatory process. Osteoarthritis is a progressive process affecting the articular cartilage of aging joints. It is characterized by focal degeneration of the articular cartilage. In the later stage, the cartilage gets eroded and exposing the sclerosed bone.

4. **Metabolic arthritis:-** Metabolic arthritis is due to metabolic disorders. This is a disease due to an inborn error of Purine metabolism. It is commonly called **gout**. This condition is characterized by the deposition of Sodium Urate crystals (uric acid) on the articular cartilage, synovial membrane and in the periarticular tissues. Gout is characterized by onset of pain swelling and reddening of joints.

Rickets and Osteomalacia

Rickets and Osteomalacia are caused due to inadequate mineralisation of the bones. Our skeletal system stores 98% of the calcium in the human body and hence calcium metabolism has a major influence on the structure and growth of bone.

Rickets:- In this case, mineralization of bones is defective. The rickets caused by nutritional deficiency is called **Nutritional rickets**. In India, it is a common problem among the population below the poverty line. It is due to Vitamin D deficiency. It occurs in children below four years. But it can afflict all age groups who have calcium and D deficiency.

Vitamin D is associated with calcium absorption and deposition. Lack of calcium and vitamin D causes softening of bones and pliable deformity. In children the symptoms of rickets are bowed legs, knock knees, pigeon chest, broadening of wrist and ankles, protruberant abdomen, etc.,

The primary prevention of the Rickets, in the child begins by better nutrient of the pregnant mother, followed by supply of Vitamin D. Cod and shark liver oil are very good sources of Vitamin D.

Osteomalacia: - In adults Vitamin D and Calcium deficiency leads to osteomalacia. This is characterized by bone pain and tenderness. It causes brittleness in the bones

Myasthenia Gravis:

This disease affects one in 20000 persons. It causes the person to become paralysed because of inability of neuro-muscular junction to transmit signals from the nerve to muscle fibre. The muscles affected include those used in walking, breathing, chewing and talking. A characteristic sign of the disease is the dropping eyelids. Myasthenia gravis often affects women in the ages of 20 to 30, but it can strike anyone after adolescence. About 10% of the victims die. It is believed that myasthenia gravis is an **autoimmune disease** in which the patients have developed antibodies against their own acetylcholine activated ion channels. These antibodies are produced by the Thymus

gland. If the disease gets intense enough, the patient does of paralysis of respiratory muscles. This disease can be cured by removal of the Thymus and by a blood- cleaning process, called **plasmaphoresis**, that removes the destroying antibodies.

Pneumonia :

Inflammation of the lungs due to infection is called pneumonia. Pneumonia is caused by viruses or bacteria. *Viral pneumonia* is due to adenovirus, respiratory syncytial virus or a coxsackie virus. The most common bacterial pneumonia is *Pneumococcal pneumonia*.

Pneumonia may also be caused by a mycoplasma (an organism that is intermediate between a bacterium and a virus)

Symptoms and Signs: Symptoms and signs include fever, chills, shortness of breath and a cough that produces yellow - green sputum and occasionally blood.

Treatment: The drugs prescribed depend on the causative microorganism. They may include antibiotic drugs or antifungal drugs. Aspirin or paracetamol may be given to reduce fever. Oxygen therapy and artificial ventilation may be required.

Tuberculosis (TB)

It is an infectious disease, caused in humans by the bacterium **Mycobacterium tuberculae**. It was once common worldwide and was a

killer disease. People infected with HIV are highly susceptible to tuberculosis and the disease is becoming more common again in communities with high rates of HIV infection.

Causes:- Infection is caused by airborne droplets (produced by coughing or sneezing). The bacteria breathed into the lungs multiply to form an infected "focus". In a high proportion of cases, the body's immune system then halts the infection and healing occurs. The infection can also occur in intestines, bones and kidneys.

Symptoms: The main symptom includes coughing (sometimes bringing up blood) chest pain, shortness of breath, fever and sweating (at night) poor appetite and weight loss. The main complications of tuberculosis of the lungs are pleural effusion. (Collection of fluid between the lung and the chest wall).

Bronchitis

Bronchitis is the inflammation of the bronchi, the air ways that connect the trachea (wind pipe) to the lungs, resulting in cough that may produce considerable quantities of sputum (Phlegm). Two forms, of the disease are recognized as acute bronchitis (sudden onset and short duration) and chronic bronchitis (Persistent over a long period and recurring over several years). Both are more common in smokers and in areas with high atmospheric pollution.

Acute bronchitis: It is caused by viral infection or by the effect of air pollutants. Bacterial infection may cause acute bronchitis. Attacks occur more often in winter. Smokers, babies, the elderly and people with lung diseases are particularly susceptible.

Chronic Bronchitis:

It is a form of bronchitis in which sputum is coughed up on most days for atleast three consecutive months. The disease results in narrowing and obstruction of the air - ways in the lungs. It often coexists with another form of lung disease, emphysema (widening of alveoli). Chronic bronchitis and emphysema together are called chronic obstructive lung disease (COLD) or chronic obstructive airways disease.

Causes: Pollution and smoking are the causes of chronic bronchitis. It stimulates the production of mucus in the lining of the bronchi.

Stroke

“Stroke is a rapidly developed clinical sign of focal disturbances of cerebral function lasting more than 24 hours or leading to death”. (WHO) In spite of the presence of factors inhibiting the coagulation of

blood within vessels, clotting may occur at times. Such clots frequently are formed in veins than in arteries.

The blood clot or thrombus formed in the streaming blood is called **thrombosis**. A clot in the cerebral vessel is called stroke or cerebral thrombosis. Stroke may be caused due to vascular occlusion, which is a blockage in the cerebral artery. The occlusion and stroke lead to infarction. The infarction leads to abnormal symptoms in the brain. Vascular occlusion is of two types viz., Thrombotic and embolic. An embolus is a portion of the thrombus clot that becomes detached and enters into circulating blood. An embolus may block the circulation to vital parts leading to serious consequences.

Brain haemorrhage: Haemorrhage or bleeding of brain vessels may be caused by hypertension which results in bursting of blood vessels or due to **aneurysm** wherein the arterial wall bulges and forms a sac like structure and ruptures later. The stroke and the haemorrhage are also due to vascular malformations.

Stroke causes both **physical**; and **mental** crippling. It is a worldwide health problem. It can occur at any age. Several risk factors may lead to stroke and brain haemorrhage. They are cardiac abnormalities, diabetes, elevated blood lipids, hypertension, obesity, smoking and stenosis (narrowing of valvular orifice), etc. One can control stroke by controlling the above risk factors.

Alzheimer's Disease

Alzheimer's disease is otherwise called **Chronic brain syndrome**. It is characterized by progressive loss of memory followed by general loss of cognitive functions and death. This disease becomes more and more prevalent among aged persons. Occasionally people develop the disease before 50 or even before the age of 40. It affects less than 5 per cent of the population between 65 - 74. In the aged people beyond 80 almost 50 per cent are affected invariably.

Alzheimer's disease is associated with the atrophy of cerebral cortex. Neurons undergo degeneration. In the damaged regions, plaques formed by the degeneration of axons and dendrites, appear.

Alzheimer's disease is commonly attributed to **genetic mutation**. People with Down syndrome are invariably affected with this disease. It is presumed that at least two or three genes in chromosome 21 are linked to this disease. However genetics is not the only **etiological factor**, for this disease.

Meningitis (Brain fever)

The term Meningitis refers to the inflammatory condition of the brain membranes and the sub-arachnoid space. Meningitis may be caused by bacterial infection, or viral infection or fungal infection. The clinical symptoms of meningitis include headache, photophobia, irritability, stiffness of the neck, fever and other neurological symptoms.

Diabetes mellitus

Diabetes mellitus is the metabolic disorder of carbohydrate metabolism caused by insufficient or nil production of the hormone *insulin* by the *pancreas*. Insulin is responsible for the absorption of glucose into cells for their energy needs and into the liver and fat cells for storage as glycogen reserve. Insulin deficiency may be due to (1) pancreatic disorders (2) defects in the synthesis of insulin from Beta cells of Langerhans (in pancreas) (3) destruction of Beta cells and (4) genetic defects etc.

Symptoms

1. The blood sugar level is more than 120mg. in diabetic patients.
2. Untreated diabetes exhibits the following symptoms.
 - a. **Polyurea** - excretion of increased quantity of urine.
 - b. **Polydipsia** - excessive thirst leading to increased consumption of water.
 - c. **Polyphagia** - excessive appetite leads to increase intake of food. In spite of over eating, diabetic patient loses weight.
3. Weakness and body pain are the common symptoms.
4. The body's inability to store or use glucose causes weight loss, insatiable hunger and fatigue.
5. Diabetes mellitus also results in abnormal (fat) metabolism.

6. Accelerated degeneration of small blood vessels.

Types of diabetes mellitus

(1) Insulin -dependent type.

(2) Non-insulin dependent.

Insulin-dependent type: This type develops due to heavy viral infection which reduces the production of insulin.

Non-insulin dependent: This is due to inadequate amount of insulin production. Obesity (over weight) is the major reason. This type usually of gradual onset and develops mainly in people over 40. Recently insulin resistant diabetes is commonly noticed and reported in younger persons too.

Causes for Diabetes

1. Diabetes tends to run in families so it occurs in people who inherit the genes responsible for the insulin dependent form.
2. Viral infection that damages the pancreas causing the deficiency of insulin.
3. Obesity is the major cause leading to development of non-insulin dependent diabetes.
4. Severe illness such as pancreatitis and thyrotoxicosis causes diabetes.
5. Over eating along with lack of physical exercise.

11TH STD

Cancer biology

2.3.1 Cancer is a proliferation of cells which grow in an uncontrolled manner, invading local tissues and spreading widely through the blood or lymphatics to produce secondary deposits, or metastases in distant parts of the body.

The word 'cancer' comes from Latin, meaning a crab. A tumour was called a cancer because of swollen veins around the area resembling a crab's limbs. The study of cancer is called Oncology. Oncology is a word derived from the Greek, onchos, a lump, or tumour. The abnormal tissue

growth is called neoplasm. If a neoplasm can cause harm by spreading, it is said to be malignant.

Cancer was known to ancient civilizations. However the disease as it would be defined today was established as an entity by German pathologists of 19th century. They described cellular nature of cancer and classified cancer. At the beginning of the 20th century, most major forms of cancer had been described.

Further, attention was focused on finding the cause and introducing treatment. In 1775 Pott recognised cancer in chimney sweeps. He associated soot with cancer. From this time onwards environmental and occupational hazards were recognised as follows:

shale oil	skin cancer in workers
radioactive ores	lung cancer in miners
beta-naphthylamine	bladder cancer in rubber industry workers
cigarettes	lung cancer

Later it was discovered that certain viruses can also cause cancer. One of the earliest virus, causing cancer, described was Rous sarcoma virus. Recently, human T-cell leukaemia has been found to be due to the virus HTLV-1.

Some forms of cancer can also be inherited. A rare eye tumour, retinoblastoma is inherited. It is a dominant character showing Mendelian inheritance.

Cancer biology

The knowledge of cancer biology is growing rapidly. Researches are being conducted to fully understand the development of cancer at the cellular or molecular level. The available information is not sufficient for satisfactory treatment of cancer.

During normal development and growth the cells in our body divide mitotically and get differentiated to specialized cells of the tissues. The processes of cell mitosis, growth and differentiation are controlled by

cellular genes. Cancer is caused due to mutation or abnormal activation of such genes. such a mutation can happen in a single cell.

Thus it may be monoclonal in origin. With further growth of cancer, additional mutations may occur in the daughter cells giving rise to subclones. The mutated cells may remain as heterogeneous cancer cells. Among these subclones some may have greater capacity and metastasize to distant tissues. They may also remain more resistant to damage from various anticancer treatments.

The cancer cells have characteristic properties. They can be differentiated from normal cells under microscopic observation. These cells have large nuclei. In each cancer cell, the ratio of nucleus to cytoplasm is high. They have prominent nucleoli.

The cells can grow indefinitely in culture medium. As component cell of a tissue they remain less differentiated. Even after getting organised into tissues unlike other cells they do not lose their replicative capacity. Cancer cells have the ability to invade surrounding tissues.

The sequence of events that convert a normal cell into a cancer cell is called carcinogenesis. The process of carcinogenesis includes, initiation, growth, promotion, conversion, propagation and progression. Progression includes the processes of invasion and metastasis.

Mature cancers have relatively uncontrolled growth, behaviour. As other normal cells they do not show any of the normal intracellular and extracellular growth control mechanisms. Initially the cancer cells have an exponential growth. Gradually their growth surpasses blood vascular supply. This results in slowing down of growth.

Molecular biology of cancer

Techniques in molecular biology have helped in understanding the most intimate structure of the cancer cell. It has been found that at molecular level two mechanisms operate.

1. The parts of genome involved in cell growth become activated. These are called the 'proto-oncogenes'. These strands of DNA induce malignant growth transformation in the cells.

The conversion of proto-oncogenes into oncogenes can happen due to 'point mutations' on DNA. Further such cancer cells display chromosomal abnormalities such as duplication, deletions and translocations. Thus such alterations in gene arrangement can lead to generation of oncogenes.

Oncogenes of human tumours

Oncogene	Type of cancer	Activation mechanism
hox11	Acute T-cell leukemia	Translocation
erbB-2	Breast and ovarian carcinomas	Amplification
L-myc	Lung carcinoma	Amplification
ret	Thyroid carcinoma DNA	Rearrangement.

A distinct mechanism by which oncogenes are activated in human tumors is amplification. It results in elevated gene expression. Gene amplification is very common in cancer cells. It occurs a thousand times more frequently than in normal cells. Molecular biologists are now working on the products of oncogenes.

2. The growth of normal cells is controlled by suppressor genes. In cancer, parts of the genome functioning as the suppressor gene are either lost or inactivated. Hence, negative regulators of cell proliferation are removed. It contributes to the abnormal proliferation of cells.

Gene	Type of cancer
APC	Colon / rectum carcinoma
BRCA 1	Breast and ovarian carcinoma
1 NK 4	Melanoma, lung carcinoma, brain tumors, leukemia's, lymphoma
Rb	Retinoblastoma
PTEN	Brain tumors, kidney and lung carcinomas.

The protein products of the tumor suppressor genes normally inhibit cell proliferation. Inactivation of such genes therefore leads to tumor development.

The complete sequence of events required for the development of any human cancer is not yet known. But it is clear that both the activation of oncogenes and the inactivation of tumor suppressor genes are critical steps in tumor initiation and progression.

Simultaneous effect on both the genes will result in multiple genetic defects. It results in the increased proliferation, invasiveness and metastatic potential of cancer cells.

Types of cancer

Cancers are named according to the tissues from which they arise.

1. Sarcoma - Malignancy in structural tissues

Ex: Osteosarcoma (bones), liposarcoma (fat).

2. Carcinoma - Epithelial cancers.

Ex: Lung carcinoma, breast carcinoma.

3. Lymphoma - Lymphatic tissues

4. Leukemia - White blood cells.

Causes for Cancer (Etiology)

Majority of the cancers are caused by living habits and environmental factors.

1. Tobacco: - Nearly 35% of all cancer deaths are due to usage of tobacco in some form. At least 90% of lung cancer deaths are due to smoking. Smoking can also affect gastro-intestinal tract, pancreas, genito-urinary tract and upper respiratory passage. Snuff and chewing tobacco can affect mouth and respiratory tracts.

Smoke inhaled by non-smokers (passive smoke) can also cause lung cancer and blood cancer.

2. Exposure to ionizing radiations such as x-rays, gamma rays, uv rays can produce cancer. These radiations rupture DNA strands, causing mutations. Solar radiations can cause skin cancers.

3. Physical irritants, such as continued abrasion of the linings of the intestinal tract by some types of food can also lead to cancer. Dietary substances such as fat, high calorie intake of animal proteins, salted or smoked food can cause cancer in Breast, Colon, Stomach and Oesophagus.

4. Certain drugs if taken without medical advice can cause cancer.

5. Viruses and parasitic organisms like schistosoma, liverfluke can also affect.

Cancer and death

A severe onset of cancer ends in the death of a person. It is because of the unique characteristics of the cancer cells. The growth of normal cells is controlled by certain factors.

However the cancer cells do not require the growth factors. Hence these cells do not respect usual cellular growth limits.

Normal cells have a nature of remaining together in tissues. But the cancer cells are less adhesive to each other. Hence they wander through the tissues and enter the blood. They can be transported to all parts of the body and cause new cancer growths.

The cancer cells rapidly multiply. Some cancers also produce angiogenic factors that cause many new blood vessels to grow into the cancer. Thus these cells will drain all the nutrients and normal cells get deprived of food. Ultimately the normal cells and tissues suffer nutritive death.

Management of cancer

The treatment or management of cancer depends on an accurate diagnosis. Diagnosis is made through microscopic observations (tissue biopsy), study of markers on the surface of cells, cytochemical methods, cytogenetics and various scanning and 'x' ray diagnostic methods.

In order to compare results and for communicating treatment programme among medical personnel staging systems are essential

(Ex: stage1, stage2) staging defines tumours as either confined to the tissue of origin or having spread to local tissues and organs and finally as having metastasized.

After diagnosis, treatment of cancer involves surgery, chemotherapy, radiotherapy and hormonal treatments.

Till last century, surgery was the only effective method of treatment. Even to-day through surgery biopsy can be affected for diagnosis. If the tumour is restricted to the primary site, through surgery it can be removed. In latest treatment procedures surgery is restricted to affected region, rather than amputation or removal of the entire organ.

Radiotherapy:- Discovery of x-rays by Roentgen(1895) and of radioactivity by Curies in 1899 opened new ways of treating cancer. In Radiotherapy high energy ionising radiations are used.

The radiations used are x-rays and gamma rays or subatomic particles such as beta particles, high energy electrons and neutrons or charged particles like helium ions. Ionising radiations can penetrate tissues. They can damage DNA leading to cell death and mutagenesis.

The basis of radiation therapy depends on the differential sensitivity of the tumour tissue and the normal tissue. Hence the aim of radiotherapy is to prescribe sufficient radiation dose to the tumour, sparing as much of the normal tissue as possible.

Chemotherapy:- The purpose of chemotherapy is to prevent cancer cells from multiplying, invading and metastasizing. The chemicals used in treatment affect cell multiplication and tumour growth. Several drugs are now available for usage. They can used singly or in combination. Some cancers like breast cancer are hormone dependent. Hence hormones are used in their management.

Inspite of all advances in diagnostics and treatment, the death rate due to cancer is greater. Primary prevention of cancer will be a better alternative to diagnosis and treatment. 70% to 80% of cancers result from environmental causes.

Hence public awareness towards environmental issues is a need. 33% of cancers in India are tobacco related. Hence smoking cessation and other measures to reduce tobacco usage are to be insisted upon. Consumption of

fibrous food and avoidance of fatty food will avoid tumours related to alimentary canal.

Thus it is apparent that fight against cancer will be successful with early detection and appropriate education for avoidance.

10TH STD

Health and its significance

“Health is a state of physical, mental and social wellbeing of an individual and not merely absence of a disease or infirmity”. When a person is in good health, the different organ systems, not only function well discharging their duties, but the body as a whole is also able to adjust itself and strike a balance with the physical, mental and social environments.

The varying environmental factors such as temperature, humidity, wind, pressure, sun, rain, pollution caused by man, atomic radiation, malnutrition, the millions of microbes that surround our bodies, the inter-personal conflicts are all other factors affect our lives and are challenges to our health.

Dimensions of Health

1. Physical dimension:

A person, who is free from disease, is bright with his skin shining enjoying normal metabolism, has a good lustrous hair and has no black rings around his eyes.

2. Mental dimension:

A mentally healthy person who knows his capacities, does not overestimate or underestimate himself and can judge his shortcomings and weaknesses.

3. Social dimension:

A person adjusting himself in society, does not find fault with others. He maintains interpersonal relationships with his family members and

colleagues at work spot and is free from interpersonal conflicts and will not quarrel.

Diseases and causes

The word disease means, "Without ease or not at ease" and it is opposite to health. The condition of malfunctioning of the organ system or systems is called disease. There are numerous diseases that damage our health.

Causes of the diseases

Diseases are caused due to various factors such as pathogens, environmental factors, nutritional factors, genetic factors, metabolic factors, etc.

Based on the causative agent, diseases are classified into:

- ❖ Diseases not caused by organisms
- ❖ Diseases caused by organisms

Diseases not caused by organisms - Non communicable diseases

1. Organic diseases or metabolic disorders:

Healthy body maintains a constant blood sugar level which is normally 80- 120 mg / 100 ml of blood under, fasting conditions. When large quantities of glucose enter the blood stream, as it happens after a meal, the excess glucose is converted into insoluble glycogen and stored in liver and muscles for future use. Later when required, glycogen is reconverted into glucose and reintroduced into blood stream.

All these processes are controlled by the hormone, Insulin, secreted by beta cells of Islets of Langerhans of Pancreas. If Insulin is not produced in sufficient quantity, excess of sugar cannot be stored and utilized. As a result, sugar continues to get accumulated in the blood, till it is lost through urine. This leads to other complications and results in diabetes mellitus.

Diabetes mellitus is a state of expulsion of excess unused glucose in the urine due to less production of insulin. Similarly, Diabetes Insipidus, Coronary heart diseases, Renal failure, Hypertension, Obesity, Alzheimer's

disease, Stroke affecting the functions of the brain, etc, are all caused due to metabolic disorders.

2. Hereditary diseases or Genetically disorders:

The genetically disorders are caused due to defective or mutated genes. Albinism is an inherited disorder of melanin metabolism, characterized by the absence of melanin in the skin, hairs and eyes. The recessive mutant genes cause this disorder. The clinical symptoms of Albinism are milky white coloured skin and marked photophobia (high sensitivity to light). Haemophilia, sickle cell anaemia, Thalassaemia, Down's syndrome, Bubble boy syndrome, etc,. Are a few other genetically disorders.

3. Nutritional Deficiency Diseases:

A diet which contains all essential nutrients in correct proportion is indispensable for maintaining good health. Deficiency in certain food constituents causes various kinds of diseases. Protein deficiency causes Marasmus and Kwashiorkor. In Marasmus, the child loses weight and suffers severe diarrhoea and it will appear as though bones are covered by the skin. In Kwashiorkor the child develops an enlarged belly with swelling in the face and feet.

Vitamin	Deficiency disease	Symptoms
Vitamin A	Nyctalopia	Night blindness
Vitamin B ₁	Beri-Beri	Nervous disorder
Vitamin B ₅	Pellagra	Dementia, dermatitis, diarrhoea
Vitamin B ₁₂	Pernicious anaemia	Destruction of RBC
Vitamin C	Scurvy	Bleeding gums and loosening of teeth
Vitamin D	Rickets	Defective calcification of bones
Vitamin E	Sterility	Inability to reproduce
Vitamin K	Haemorrhage	Profuse loss of blood

8TH STD

Cancer and its prevention

Normally body cells grow and reproduce in an orderly way. In contrast cancerous cells multiply rapidly. This is due to damaged genetic material of the cell. This stage is known as initiation. It can be influenced by external factors like radiation, viral infections and certain chemicals. These cancerous cells create lots of problem in our metabolism and invade to the other areas through blood streams, where they cause secondary tumours. This stage is called **metastasis**.

What causes cancer?

Cancer is ultimately the result of cells that uncontrollably grow and do not die. Normal cells in the body follow an orderly path of growth, division, and death. Programmed cell death is called apoptosis, and when this process breaks down, cancer begins to form. Unlike regular cells, cancer cells do not experience programmatic death and instead continue to grow and divide. This leads to a mass of abnormal cells that grows out of control.

What are the symptoms of cancer?

Cancer symptoms are quite varied and depend on where the cancer is located, where it has spread, and how big the tumour is. Some cancers can be felt or seen through the skin – a lump on the breast or testicle can be an indicator of cancer in those locations. Skin cancer (melanoma) is often noted by a change in a wart or mole on the skin. Some oral cancers present white patches inside the mouth or white spots on the tongue.

Other cancers have symptoms that are less physically apparent. Some brain tumours tend to present symptoms early in the disease as they affect important cognitive functions.

Pancreas cancers are usually too small to cause symptoms until they cause pain by pushing against nearby nerves or interfere with liver function to cause a yellowing of the skin and eyes called jaundice. Symptoms also can be created as a tumour grows and pushes against organs and blood vessels. For example, colon cancers lead to symptoms such as constipation, diarrhoea, and changes in stool size. Bladder or prostate cancers cause changes in bladder function such as more frequent or infrequent urination.

How is cancer classified?

There are five broad groups that are used to classify cancer.

1. Carcinomas are characterized by cells that cover internal and external parts of the body such as lung, breast, and colon cancer.
2. Sarcomas are characterized by cells that are located in bone, cartilage, fat, connective tissue, muscle, and other supportive tissues.
3. Lymphomas are cancers that begin in the lymph nodes and immune system tissues.
4. Leukaemia are cancers that begin in the bone marrow and often accumulate in the bloodstream.
5. Adenomas are cancers that arise in the thyroid, the pituitary gland, the adrenal gland, and other glandular tissues.

Prevention

The following are some of the ways to prevent diseases like heart attack, cancer, diabetes, hypertension Smoking cause lung cancer. It is related to mouth, throat, oesophagus, pharynx, larynx and liver. Smoking should be avoided.

High intake of fruits and vegetables are protective against many forms of diseases like heart attack, cancer, diabetes and hypertension. A vegetarian diet is typically high in fibre, low in saturated fat compared to meat eaters. High intake of beta carotene, vitamin C and other vitamin containing food should be taken.

Apart from citrus variety of fruits, bean sprouts is also an excellent source of vitamin C. Try to reduce your weight, if you are obese. Avoid pickles and salty foods. Treatment involves surgery, chemotherapy radiotherapy and hormonal therapy.

6th STD

Food items obtained from plants and animals:

The root, stem, leaf, flower, vegetable, fruit and seed of the plants are used as food for us. Different food items like milk, egg and meat are obtained from animals.

Nutrients

The constituents of the food which are essential for the body are called nutrients.

Types of Nutrient

- ❖ Carbohydrates - Provide energy
- ❖ Proteins - Help in growth
- ❖ Fats - Provide energy
- ❖ Vitamins - Help in physiological activities
- ❖ Minerals - Act as regulators in physiological activities

- ❖ Water - Transports food regulates body temperature.

Water content in vegetables, fruits and food items:

Name of the food	Water content	Name of the food	Water content
Cucumber	95%	Bread slice	25%
Potato	75%	Egg	73%
Mushroom	92%	Milk	87%

Balanced diet:

A food that contains all the nutrients in the right proportion is a balanced diet. Go through the following table.

S.No	Food category	Nutrients present
1.	Cereals: Rice, Wheat, Ragi (Finger millet) Bajra (Pearl millet), Sorghum, Corn, Barley, Rye	Carbohydrate, protein, a small amount of lipid, vitamin B ₁ & B ₂ , folic acid, iron, fibre.
2.	Pulses: Red gram, Black gram, Green gram, Horse gram, Bengal gram, Chick pea, Pea, Soya beans, Country beans etc.,	More proteins, a small amount of lipid, vitamin B ₁ & B ₂ , folic acid, iron, fibre

3.	Milk and meat products: Milk, Ghee, Curd, Yogurt, Skimmed milk,	Protein, lipid, vitamin B ₂ , calcium
	Chicken, Liver, Fish, Egg, Mutton.	Protein, lipid, vitamin B ₂
4.	Fruits & Vegetables: Mango, Guava, Tomato	Carotenoid, vitamin C
	Papaya, Orange, Water melon, Sweet lime, Grapes	Iron, calcium
	Gooseberry, Greens, Drumstick leaves Coriander, Lettuce, Spring onion.	A small amount of lipid, carotenoid, vitamin B ₂ , folic acid, calcium, iron, fibre
	Carrot, Brinjal, Lady's finger, Capsicum, Country bean, Onion, Drumstick, Cauliflower.	Carotenoid, folic acid, calcium, Iron fibre.
5.	Ghee, Oils: Butter, Ghee, Vanaspathi, Cooking oils like Groundnut oil, Coconut oil, Gingely oil.	Lipid, Essential fatty acids
6.	Sugar, Jaggery	Carbohydrate, iron.

Jaggery provides more benefits to the body than the sugar.

Note:

- ❖ Vitamins are lost when vegetables are washed after chopping.
- ❖ Vitamins and mineral salts are found in abundance in the peels of vegetables and fruits.
- ❖ We lose vitamins and mineral salts from grains and pulses by repeated washing.

Deficiency diseases:

Diseases caused due to the deficiency of nutrients in the food that we eat are called deficiency diseases.

Deficiency diseases and their symptoms:

Nutrient	Deficiency disease	Symptoms
Protein	1. Kwashiorkar (children from 1-5 age)	Weak appearance, retarded growth, oedema in abdomen and legs, weak limbs.
	2. Marasmus	Enlarged head, loss of weight, retarded growth of body and brain.
Vitamin A	Night blindness	Defective vision, blindness in dim light.
Vitamin B,	Beri-beri	Weak muscle, fatigue
Vitamin C	Scurvy	Bleeding gums
Vitamin D	Rickets	Weak and bow bones
Calcium	Disintegration of bones and teeth	Weak bone and teeth, inflammation in neck.
Iodine	Goitre	Body fatigue
Iron	Anaemia	Giddiness

Nutrition:

Ingestion, digestion, absorption and assimilation are the various stages of nutrition. Organisms consume both solid and liquid food substances by various methods.

Types of nutrition

1. Autotrophic nutrition

Mode of nutrition in which an organism prepares its own food is called autotrophic nutrition. E.g.: **Green plants, Euglena**. They prepare their own food by photosynthesis.

2. Heterotrophic nutrition

The mode of nutrition in which an organism depends on other organisms for food as they cannot prepare their own food is called heterotrophic nutrition.

Types of parasites

1. Ectoparasites

2. Endoparasites

- ❖ The plant *Cuscuta* depends on other plants for food. This is an example for parasitic mode of nutrition. Organisms like head louse, leech etc., are found attached to the outer surface of the body and get nourishment from the host. So, these are called ectoparasites.
- ❖ Round worm lives inside the body (gut) and derives food from the intestine. So it is an endoparasite.

Saprophytes.

- ❖ In saprophytic nutrition, the organism decomposes the dead plant and animal substances and converts them into simple molecules and absorbs them through their body wall.
- ❖ Discuss in the class about the mode of nutrition in animals and plants devoid of chlorophyll.

3. Special type of nutrition

Plants like *Nepenthes*, *Drosera*, and *Utricularia* are green in colour and are autotrophic. Since they are found in nitrogen deficient soil, they trap insects and kill them to get nitrogen from them. So they are called insectivorous plants.

Animals based on nutrition

Animals which feed only on plants are called herbivorous e.g. goat, cattle. Animals which feed on other animals are called carnivorous e.g. tiger. Animals which feed on both plants and animals are called omnivorous e.g. crow

II GENETIC DISERDERS

12th std

Genetic Diseases

1. Sickle cell anaemia:

Sickle cell anaemia is a genetic syndrome caused by an autosomal mutant allele Hbs. In homozygous condition (Hbs Hbs), it causes the production of an abnormal haemoglobin called haemoglobin S. The normal haemolobin is designated as HbA (HbAHbA).

Sickle cell persons with the genotype HbsHbs suffer from a fatal haemolytic anaemia. The patient dies due to damaged heart, kidney, spleen and brain as a result of clogged blood vessels or vascular obstruction. Persons with heterozygous genotype HbA Hbs are said to be carriers and they survive.

2. Thalassemia:

Thalassemia is an erythroblastic anaemia due to homozygous recessive gene expression in children. Two types of this disease viz., thalassemia major and thalassemia minor exist. The former is the severe form while the latter is its milder form. The homozygotes suffer from severe thalassemia while all heterozygotes suffer from milder thalassemia.

The clinical manifestations of thalassemia include i) decrease in the bone marrow activity, ii) peripheral haemolysis, iii) splenomegaly (enlarged spleen) and hepatomegaly, (enlarged liver) etc. The thalassemic children die at the age of seventeen.

3. Agammaglobulinemia :

Agammaglobulinaemia is a recessive gene disease, wherein γ -globulin synthesis fails to occur. In this disease, the patient shows a great deficiency or total absence of plasma cells and unusual lymph nodes with fewer lymphocytes than normal. The failure of antibody synthesis in this disease, makes the subjects more prone to viral and bacterial infections especially of the chest. This disease mostly affects boys.

4. Albinism:

It is an inherited disorder of melanin metabolism characterized by the absence of melanin in the skin, hairs and eyes. The clinical characteristics of this disease are the milk-white coloured skin and marked photophobia. Albinism is an inborn error metabolic disease, In this, the genes by undergoing mutation do not produce particular enzymes, which take part in the metabolic pathways. The metabolism of one amino acid phenylalanine proceeds in chains of enzyme-mediated reactions.

The change or absence of enzyme due to defective genes, results in physiological abnormalities. In albinism, complete lack of melanin pigment (a dark brown pigment) causes the albino to suffer. The incidence of albinism in human has been reported to be from 1:5000 to 1:25000.

The albinism may be generalized albinism, localized albinism of the eye (ocular albinism) or partial albinism (skin and hair). The recessive genes 'aa' do not produce the tyrosinase enzyme, which converts DOPA (3,4 - dihydroxy phenyl alanine) into melanin in the melanocytes.

5. Huntington's chorea:

This is a fatal disease caused by an autosomal dominant gene in human. The onset of the disease is between 35 and 40 years of age. It is characterized by uncontrolled jerking of the body due to involuntary twitching of voluntary muscles. It leads to progressive degeneration of the central nervous system accompanied by gradual mental and physical deterioration.

Huntington's disease was the first completely dominant human genetic disease to come to light. The affected gene is located on chromosome 4. Other characteristics of this disease are deterioration of intellectual faculty, depression, occasional hallucination and delusions and other psychological problems. This disease is incurable.

6. Severe Combined Immunodeficiency (SCID):

This is an extremely rare inherited disease affecting children. The gene for the disease called ADA (Adenine deaminase) is located on chromosome 20. The children suffering from the syndrome completely lack the immune defense mechanism against infection due to rapid death of all white blood cells. SCID is also called Bubble Boy Syndrome. The child is kept in a sterile bubble. Unless given bone marrow transplant, the child's life span is short lived.

11TH STD

Sex determination in Human beings

The human sex determination mechanism to a larger extent resembles XX - XY type of *Drosophila*. However, the Y chromosome contains male determining genes and it is the determiner of fertility and sex of male individual.

Thus in human beings, the presence of Y chromosome determines maleness and its absence determines femaleness. Evidences to establish this viewpoint had been provided by certain abnormal conditions called syndromes.

Sex anomalies in Human beings

1. Turner's syndrome (XO Females): In this abnormality the females are sterile and have short stature. They have webbed neck, broad shield-shaped chest, low intelligence, under developed breasts and poorly developed ovaries. These conditions result due to the presence of 44 autosomes and only one X chromosome in her body cells. This abnormality is known as Turner's syndrome.

2. Klinefelter's syndrome: - This syndrome is caused due to the presence of an extra X chromosome in males. This happens when an abnormal egg with XX chromosome is fertilized by a sperm carrying Y

chromosome. The zygote will have three sex chromosomes (XXY). The resulting young one is an abnormal sterile male. The symptoms of this syndrome are the presence of small testicles, mental retardation, longer arms and high pitched voice.

3. Super females: - These females are also known as Poly X females. They possess an extra X-chromosome (44 autosomes +3 x chromosomes). The poly X females are mentally retarded and sterile.

4. XYY males: - Such males will have an extra Y chromosome (XYY). This condition results in mental retardation and criminal attitudes.

5. Hermaphroditism: - A hermaphroditic person will have one extra X and Y chromosome. The person will have both ovarian and testicular tissues. The external genitalia will not be well defined.

Sex linked inheritance in Humans

Most of the sex linked characters in humans are X - linked. There are 150 confirmed X- linked traits known. Most of them are recessives.

Colour blindness:

The human vision is basically due to cells called rods and cones found on the retina of the eye. The cone cells are sensitive to red, green and violet light. The formation of colour sensitive cones is controlled by a dominant X-linked gene.

The recessive form of this gene is incapable of producing colour sensitive cones. Hence homozygous recessive females (XCXC) and Homozygous recessive males (XCY) are unable to differentiate between red and green colour. The frequency of colour blind women is less than colour blind men.

Colour - blind man x normal vision woman

When a colour-blind man marries a normal woman in their F1 progeny all children would be normal. However the female will be a carrier for the recessive gene. If that female gets married to a normal male in the F2 generation normal and colour-blind nature will occur in 3 : 1 ratio.

Pleiotropic

It is an established fact that a specific gene controls a specific phenotypic trait. This finding is not always true. Studies on 'gene expression' have revealed that a gene often influences more than one phenotypic trait. This phenomenon of multiple effects of a single gene is called pleiotropism.

In such a genic influence more conspicuous expression of a phenotypic trait by a gene is called its major effect. If the gene causes other less conspicuous phenotypic changes, it is known as secondary effect. Such genes responsible for multiple effects are called pleiotropic genes.

Vestigeal wings in *Drosophila* are caused by a recessive gene in homozygous condition. A keen observation has shown that this gene affects other traits as well. They are (i) the small halteres or balancers behind the wing (ii) structure of reproductive organs (iii) egg production (iv) life duration and (v) bristles on the body.

III. VECTOR BORNE

12th std

Introduction:

The world of microorganisms includes various species of bacteria, viruses, fungi and protozoan parasites. The discovery of microscope and the ingenious techniques of isolation and identification of these microbial organisms opened up a new field of study named **Microbiology**.

This study deals with the form, structure, reproduction, physiology, metabolism and classification of micro-organisms. The area of microbiological studies include various aspects of their distribution in nature, their relationship to each other and to other organisms, their effects on plants, animals and human beings, their roles in the sustainability of environmental habitats such as soil, air and water and also their beneficial aspects to biotechnology.

History of Medical microbiology:

The medical microbiology had its origin in the year 1888 when the Pasteur Institute in Paris (France) was established. Robert Koch became the Director of the Institute For Infective Diseases. Both Louis Pasteur and Robert Koch infused the spirit and interest to gain knowledge in medical microbiology to the countrymen of America and Europe.

The medical microbiology deals with the aspects of infection, the causative agents of infection and the diseases due to infection. Following the establishment of Germ Theory of Diseases by Pasteur, innumerable infectious diseases that haunt the human population were discovered. For most of these infectious diseases, the drugs and vaccines have been found.

Pasteur, Koch, Lister:

Medical Microbiology involves the study of micro-organisms that colonize or infect human beings; the mechanism by which they cause diseases; the body's response to infection and specific antimicrobial prevention and treatment.

The contribution of **Louis Pasteur** (1822 - 1895) in France in the field of microbiology leads to a greater understanding of human ailments and animal diseases. Much of Pasteur's work involved the growth of bacteria and yeasts in liquid cultures.

He developed methods of sterilization and of pasteurization. Pasteur (1857) observed different kind of microbes associated with different kinds of fermentation.

e.g. Spheres of variable size (yeast cells) within alcohol fermentation and smaller rods (Lactobacilli) with lactic fermentation. This finding led Pasteur to state that specific microbe may cause specific disease in man.

His crowning achievements were Pasteurisation of milk, the development of techniques to reduce the virulence of infectious organism, without eliminating their capacity to produce immunity. In this way he developed vaccines, for the control of "cholera" "anthrax" and "rabies" in man.

Robert Koch - (1843 - 1910)

Robert Koch, a younger contemporary of Pasteur, made his contributions on new procedures for staining, visualizing and growing bacteria. He solidified liquid culture media with agar. He also isolated and characterized the bacilli of anthrax, and tuberculosis and demonstrated their causative role by a series of experiments.

After identifying the tubercle bacillus, Koch has advocated his postulate, in order to distinguish a pathogenic microbe from adventitious microbes. The impact of his work towards the end of 19th century lead to the discovery of “specific toxins” made by the causative bacteria for diphtheria and tetanus and “antibodies” produced in host animals against the toxins to neutralise their effect. His finding also lead to immunization therapy. He was awarded the Nobel Prize in the year 1905 for his work on tuberculosis.

Contributions of Joseph Lister:

(1827 - 1912) to microbiology is the technique of “pure culture” of bacteria. The growth of a mass of cells of the same species in a laboratory vessel / test tube using serial dilutions in the liquid media is called pure culture. Lister obtained a pure culture of the organism *Bacterium lactis* and also found the importance of pure culture which form the suitable media for the growth of microorganisms, responsible for infections, fermentation, nitrogen fixation in soil, etc.

The pure culture techniques lead to developments in modern microbiology. On the basis on Pasteur’s evidence, in 1860 Joseph Lister, discovered a system for “antiseptic” surgery. This system prevents the surgical wound infection and other lethal complications.

I. Virus: Structure, Genetics, Culture and Diseases:

Viruses are infectious agents. They are much smaller than the bacteria. Their approximate size ranges from 20 to 300 nm. Viruses are incapable of independent growth in artificial media. They can grow only in animal or plant cells or in microorganisms. Hence they are

referred to as obligate intracellular parasites. They reproduce in these cells by replication.

Replication is a process in which many copies or replicas of the viral component are assembled and made to represent the progeny. They lack metabolic machinery of their own to generate energy or to synthesize proteins. They depend on the host cells to carry out these vital functions. The bacterial viruses are called **bacteriophages**. These viruses infect the bacteria and multiply inside the bacterial body and cause the lysis of bacteria (lytic cycle) or integrate themselves with the bacterial genome (lysogeny).

Structure of Viruses:

Animal and plant viruses are composed of a central core of nucleic acids surrounded by a protein covering called capsid. The capsid is made up of units called capsomeres. Viruses exhibit a characteristic symmetry,

1. Spherical viruses are isohedral, 2. Rod shaped viruses are helical in symmetry. Certain group of viruses are complex in symmetry.

Some animal viruses, in addition to the nucleocapsid structure contain an outer membrane like structure called the envelope. The envelope is made up of lipoproteins. The envelope conceals the symmetry of viruses.

Virions with envelopes are sensitive to lipid solvents such as ether and chloroform. On the other hand, the naked virions are not affected by the lipid solvents.

Isohedral viruses such as adeno viruses, SV15, polio viruses and blue tongued viruses are spherical in shape and their surface is a lattice with identical triangular units.

Helical surface symmetry and structure are characteristic of tobacco mosaic virus(TMV) and animal viruses that cause diseases such as measles, mumps, influenza and rabies. In these, the nucleocapsid is a flexible structure packed within a fringed lipoprotein

envelope. The fringes are made of glycoproteins. In TMV the nucleic acid core is covered by a capsid consisting of closely packed capsomeres arranged in a helix.

Complex or uncertain symmetry is seen in Pox viruses, T-bacteriophages,. These have different proteins and lipoproteins.

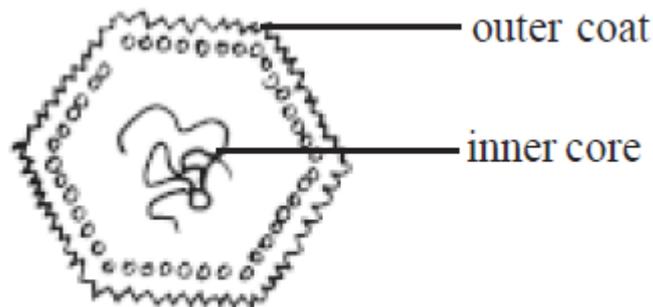


Fig. 2.2. Morphology of viruses



Fig. 2.2(a). T₂-bacteriophage

Viral genetics:

The viral genome contains all the genetic information either as DNA or RNA. but never both. The proportion of nucleic acid in a virion varies from 1 % as in influenza virus to about 50%, as in certain phages. Smaller viruses like paraviruses may have 3 to 4 genes while larger viruses like herpes and pox may have several hundred genes. Virions contain only a single copy of the nucleic acid. Hence they are called haploid viruses.

The only exception is the retroviruses, which are said to be diploid as they contain two identical single-stranded RNA genomes. The virions are called the infectious particles.

The structure of nucleic acid in the virion may be either linear or circular. The DNA of most animal viruses is a linear molecule. In some plant viruses the genome is a circular RNA. But the RNA in animal viruses exists only as linear double stranded or single stranded molecule.

Cultivation (culture) of Animal viruses:

Viruses can grow only in living cells. However the culture of viruses is possible nowadays. The most economical and convenient method of cultivating a wide variety of animal viruses is the 'chicken embryo technique'.

In this technique, fertile chicken eggs incubated for 5 to 12 days are inoculated with the virus particles through the shell, aseptically. The opening may be sealed with paraffin wax. The eggs incubated at 36°C are ideal sources for the growth of viruses.

Chick embryos contain several different types of cells in which various viruses will undergo replication. The yolk sac is a general ideal

medium for the growth of viruses. Viral cultures are of three types viz., Primary cell cultures, diploid cell strains and continuous cell lines.

1. Primary culture:

Primary cell culture are derived from normal tissue of an animal such as mouse, hamster, chicken and monkey or a human being. When cells from these tissues are processed and cultured the first monolayer is referred to as the primary culture. A monolayer is a confluent layer of cells covering the surface of a culture vessel.

2. Diploid cell strain:

Diploid cell strains are derived by primary cell cultures from a specific tissues like lung or kidney which is of embryonic origin.

These diploid cells are the most employed host of choice for the production of human vaccine virus.

3. Continuous cell lines:

Continuous cell lines are capable of an infinite number of doublings. Such cell lines may arise with the mutation of a cell strain or more commonly from the established cell cultures from malignant tissue. Many viruses, which are difficult or impossible to grow have been cultured in continuous cell lines.

Viral Diseases:

A. Cancer and Viruses:

Viruses have been identified as one of the causative agents for cancer or tumour. Such tumour inducing viruses are called oncogenic viruses. Adenoviruses, polioma virus, simian virus 40 (SV 40), Epstein-Barr virus (EBV) (a herpes virus) are oncogenic DNA viruses. The RNA sarcoma viruses are oncogenic RNA viruses (eg., Rous sarcoma).

B. Rabies Virus and Rabies disease:

Rabies virus belongs to the rhabdovirus family. It is a parasite of domestic and wild mammals. The transmission to humans occurs through the bite of an infected animal. Dogs, cats, bats, are the mammalian animal sources for the rabies virus.

In humans, the symptoms of rabies are severe headache, high fever, alternating excitement and depression, muscular spasms in throat and chest, hydrophobia etc. The incubation time in humans is usually about 3 to 8 weeks but it may also vary. If untreated the mortality rate from rabies is 100 percent.

The new rabies vaccine was discovered in 1980. It is an inactivated vaccine prepared from the virus propagated in cultures of diploid human cells. This vaccine is both safe and highly immunogenic.

C. Pox virus:

Pox viruses are the largest of all viruses and are brick shaped. They contain double stranded DNA, protein and lipid. They have a dumb bell shaped nucleoid surrounded by two membrane layers.

Variola virus is called the small pox virus. It is transmitted by droplet infection either directly from the infected person or by handling articles infected by the patient. Small pox is completely eradicated. The small pox vaccine consists of vaccinia, closely related to variola. It gives protection both by humoral and cell mediated immunity. Other pox viruses are chicken pox and measles viruses.

D. Hepatitis-B:

Hepatitis B virus (HBV) is an enveloped virus with a double stranded DNA. This causes jaundice and hepatic carcinoma. This disease is deadly and more infective than AIDS. HBV vaccine consists of purified HBV Ag (Australian antigen) obtained from the blood serum of apparently healthy carriers.

II. Bacteria - structure

The structure, size and arrangement of bacterial cells constitute their morphology.

The various morphological features are

1. They are spherical or rod like or spiral shaped.
2. The arrangement of cells in pairs, clusters, chains, trichomes and filaments etc.
3. The appendages are visible by special staining techniques or by electron microscopy.

The above three features represent the gross morphological characteristics, which are of taxonomic importance in bacterial species identification. In addition, the bacterial cells possess elaborate internal structures, which constitute microbial cytology and bacterial anatomy.

Bacterial Culture

All bacteria need nutrients for their growth. They need a nutrient medium for their growth and culture. A bacteriological medium is composed of known chemical compounds. It is called a chemically defined medium or synthetic medium, The compounds are carbohydrates, proteins, nucleic acids, lipids, vitamins and other complex organic substances.

Certain complex materials include peptones, meat extract, yeast extract etc. The medium with the above raw materials can support the growth of a wide variety of heterotrophic bacteria. Agar is included as a non-nutritive solidifying agent. Nutrient agar and nutrient broth are the simple solid and liquid media for the growth of heterotrophs respectively.

The preparation of bacteriological media involves the following steps.

1. Each ingredient or the complete dehydrated medium is dissolved in the appropriate volume of distilled water.
2. The pH of medium is determined.
3. Agar is added and the medium (solid medium) is boiled to dissolve agar.
4. The medium is dispersed in flasks or tubes.
5. The medium is sterilized by autoclaving.

The growth of bacteria also require in addition to nutrients, physical conditions such as temperature, gaseous conditions and pH (acidity and alkalinity) and other miscellaneous requirements such as illumination, hydrostatic pressure, etc.

Bacterial Genetics :

In bacteria the cells have a single circular strand of DNA. It is not associated with proteins as are eukaryotic chromosomes. The bacterial genes, like the eukaryotic genes possess the features of replication, phenotype expression, mutation and genetic recombination etc. In

bacteria the genetic recombination results from three types of gene transfer viz., conjugation, transduction and transformation.

Conjugation involves the transfer of some DNA from one bacterial cell to another followed by the separation of the mating pair of cells. In this, large segments of the chromosomes and in special cases the entire chromosome may be transferred.

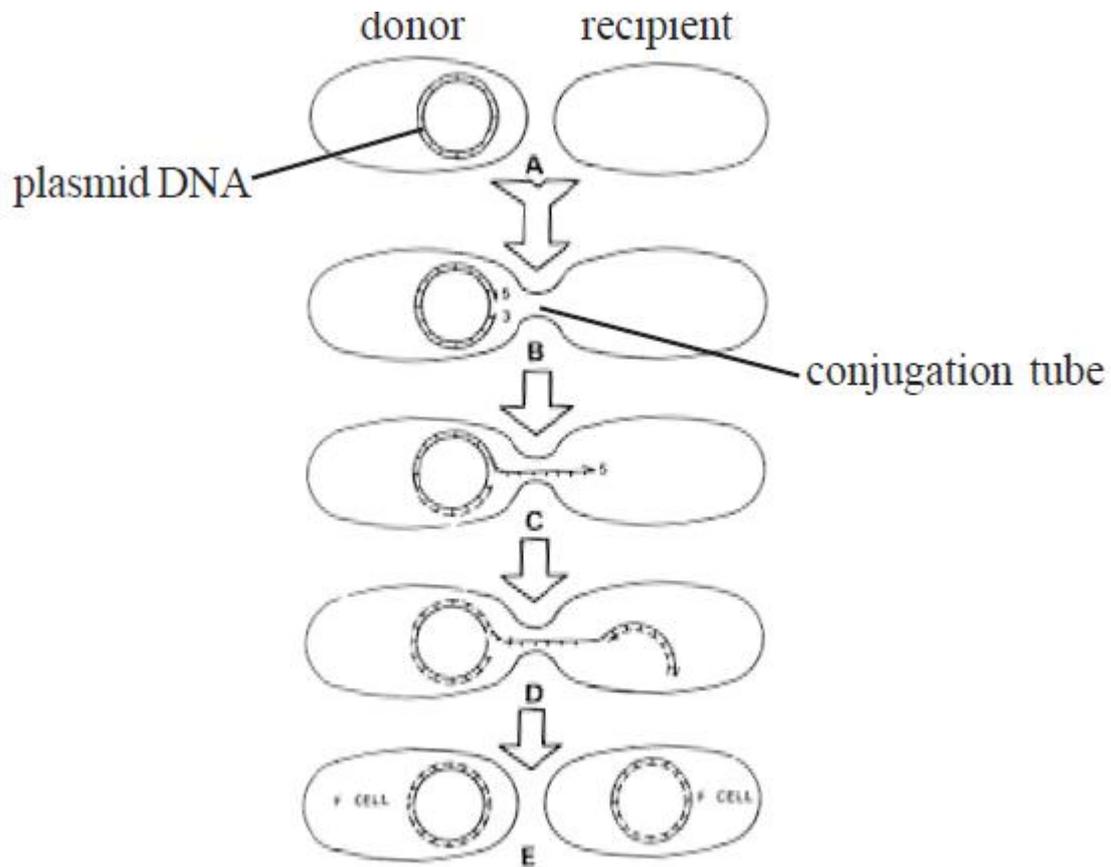


Fig. 2.4. Bacterial conjugation

Bacterial transformation is a process in which cell free or naked DNA containing the genetic information is transferred from one bacterial cell to another. It was discovered by an English health officer, Griffith in 1928. The transforming principle was identified as DNA by Avery Macleod and Mc Carthy in 1944.

In transduction, a bacteriophages acts as a vector, transferring a portion of DNA from one bacterium (donor) to another (receptient). If all fragments of bacterial DNA have a chance to enter a transducing phage, the process is called **Generalized transduction**. On the contrary if a few restricted genes of the bacterial chromosomes are transduced by bacteriophage, it is called **specialized transduction**.

Bacterial Diseases

A. Salmonella and Human Diseases:

Salmonella are pathogenic bacilli which cause three kinds of infection to humans viz., enteric fever (Typhoid or Paratyphoid), Gastroenteritis and Septicemia.

Typhoid fever is caused by *S.typhi*. It is transmitted via Pathogen contained food and water. The disease is characterized by a continued fever, inflammation of the intestine, formation of intestinal ulcers and enlargement of the spleen.

Gastroenteritis is caused by Salmonella, but most commonly by *S. choleraesuis*. The bacteria reach the blood stream from the intestinal tract, where it multiplies. It causes recurring high fever, chills, loss of appetite and weight loss. When the bacteria infect the organs from blood they can cause meningitis, pneumonia, abscesses, nephritis, osteomyelitis, or endocarditis, etc.

B. Cholera :

Cholera is caused by *Vibrio cholere*. It is a disease of antiquity and has been the cause of untold sufferings and death. Cholera is transmitted in water and food contaminated with this bacteria. In the small intestine, the bacteria adhere to epithelium, multiply and produce the enterotoxin. The symptoms of cholera are vomiting, profuse diarrhoeal stool (rice water stool) Which results in severe dehydration, loss of minerals, increased blood acidity and haemoconcentration.

C. Plague :

Plague is caused by the bacterial species *Yersinia pestis*, a non motile gram negative bacilli. There are two types of plagues. They are **bubonic plague** and **pneumonic plague**. Bubonic plague is characterized by enlarged and inflamed lymph glands (Bubos). The symptoms are shivering, fever, nausea, vomiting and general weakness. In untreated cases the bubonic plague can cause 58% mortality. Pneumonic plague is a pneumonia characterized by a thin

watery sputum with bright red streaks of blood. The mortality is 100% in untreated cases.

D. Syphilis :

The disease syphilis is a well known and dreadful sexually transmitted disease (STD). It is caused by *Treponema pallidum*. Syphilis occurs only in humans and is transmitted by direct sexual contact (Venereal syphilis) or through placenta from an infected mother to the foetus (Congenital syphilis).

Venereal syphilis progresses in three stages viz., primary, secondary and tertiary stage. The symptoms are very prominent in the tertiary stage. It will lead to blindness, loss of hearing, brain damage, insomnia, headache and delusions and spinal cord damage.

E. Gonorrhoea :

Gonorrhoea is another sexually transmitted disease caused by *Neisseria gonorrhoea*. In the males the primary site of infection is the urethra. In the female it is the cervix. It causes pain during urination and a yellowish discharge from the urethra of males. In females also it causes painful urination and vaginal discharge. Other symptoms are fever, abdominal pain, arthritis, meningitis etc.

III. Protozoan microbiology

Protozoans are eukaryotic, single celled organisms, which are predominantly microscopic in size. The majority are between 5 to 250 microns in diameter. Protozoan microbiology is mostly concerned with the disease aspects in humans. Some well known protozoan diseases in human beings are the intestinal amoebiasis, African sleeping sickness, and malaria. Several flagellate protozoans are responsible for diseases in both children and adults. *Giardia intestinalis* is associated with diarrhoea in children. Trichomonads are found in the mouth and cause gingivitis.

A. Plasmodium and Malaria:

Malaria is a mosquito borne disease caused by the protozoan, *Plasmodium*. The life cycle of malarial parasite comprises two phases namely the asexual phase in man and the sexual phase in the female *Anopheles* mosquito (Definitive host).

Four different types of Malaria are recognized on the basis of period of recurrence of fever. They are 1. Tertian, Benign Tertian or Vivax malaria, caused by *Plasmodium vivax*. 2. Quartan Malaria caused by *Plasmodium malariae* 3. Mild Tertian or Ovale Malaria caused by *Plasmodium ovale* 4. Malignant Tertian or Pernicious Malaria caused by *Plasmodium falciparum* Of the four, the malignant type is fatal.

In malarial fever, the patient suffers from shaking chills, and sweating. As the chills subside, the body temperature may rise to 106 o F. The high fever is induced by the toxic haemozoin granules, which are liberated in plasma when the parasite schizonts burst out from the RBCS.

The patient also suffers from severe anaemia due to destruction of erythrocytes. Other symptoms are enlargement of spleen, due to massive increase in the number of phagocytic cells of the lymphoid macrophage system.

In the case of falciparum infection thrombosis of visceral capillaries occurs. Death takes place when the capillaries of brain are plugged with both the parasites and the malarial pigment. Another very serious outcome of the falciparum infection is black water fever. It is characterized by the wholesome destruction of patient's erythrocytes and the excretion of liberated haemoglobin in the urine.

B. Amoebiasis

Amoebiasis in man is due to the infection by the protozoan endoparasite (Sarcodina) *Entamoeba histolytica*. It is worldwide in distribution but, its prevalence is greater in tropics and sub tropics than in temperate zones.

The vegetative trophozoite form is pathogenic. The trophozoites make their way deep into the sub mucosa of the large intestinal wall by eating through the intestinal mucosa. The blood and the ulcer

contents pour into the lumen of the intestine and pass out as bloody stool. This characterizes the amoebic dysentery or amoebiasis.

C. Other pathogenic protozoans

1. *Trypanosoma gambiens* - causes African sleeping sickness
2. *Leishmania donovani* - causes kala azar
3. *Leishmania tropica* - skin leishmaniasis

IV. Larval microbiology

Larval microbiology deals with human diseases caused by parasitic larvae. Parasitic infections which man acquires from animals are known as zoonotic infections or **zoonoses**. In the zoonoses, human infections are only accidental events and the parasite is not benefited since the chain of transmission is usually broken with human infection.

The term **anthroponoses** means infections with parasites species that are maintained in man alone. Malaria and filaria are examples. The term **Zooanthroponoses** refers to infections in which man is not merely an incidental host but an essential link in the life cycle of the parasite (eg., Beef and pork tapeworm).

Schistosomes or blood flukes

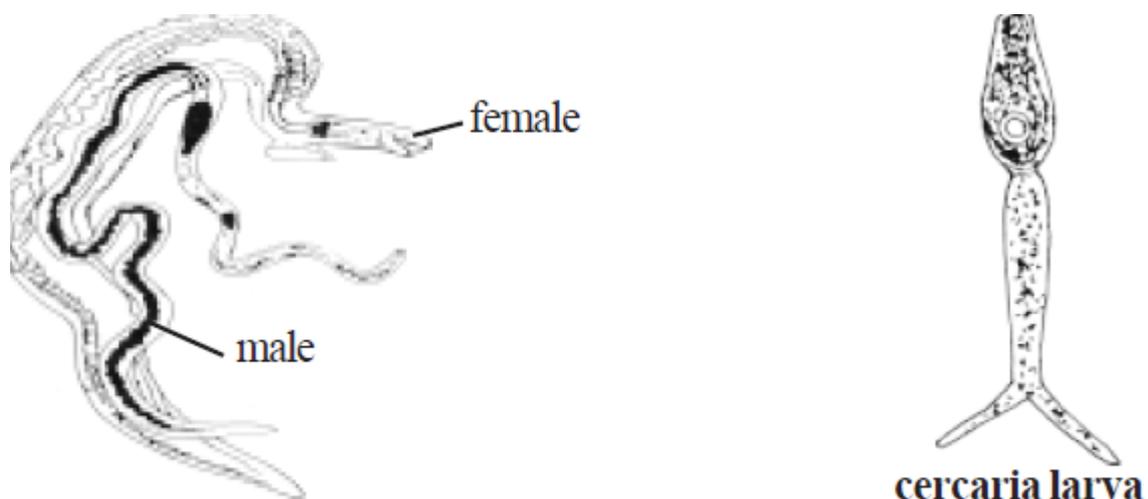


Fig. 2.5. Blood flukes

Pathogenecity of Microorganisms:

Pathogenicity refers to the ability of microorganism to cause the disease in animals and humans. Infectious diseases more often result due to the interactions between the disease producing pathogenic microorganisms and host organisms.

The Pathogenic adaptations

The Pathogenicity of the microbes is due to several phenomena or adaptations.

1. Pathogens are able to selectively attach to the external surfaces such as the skin and conjunctiva or the internal surfaces such as the mucus membranes of the respiratory, gastrointestinal or urinogenital tracts.

2. They also penetrate the above body surfaces and gain access to the internal tissues.

3. In some infections, the pathogen may remain localized, growing near its point of entry into the body.

4. Some pathogens become widely distributed in different tissues or organs. This is called generalized infections.

5. Some other pathogens can grow within the cells of host, causing severe disturbances to normal physiological processes.

6. Yet another group, may grow extracellularly and bring damage to the body tissues by elaborating substances called toxins.

The pathogenicity differs in different strains of pathogenic species. Some strains are highly virulent. In the case of **virulent strains**, only a few bacterial cells may suffice to cause disease in a host.

On the contrary, other strains may be less virulent, and large numbers of cells may be needed to cause the disease. Some strains may be **avirulent**, and are incapable of causing the disease even when

large numbers of cells are inoculated into the host. Such avirulent strains are called attenuated strains. These are widely used as vaccines to elicit the immunity.

Antimicrobial Resistance:

Pathogenic microbes are provided with their own mechanisms to establish infection in the host animals and humans. Similarly the hosts body has a number of defense mechanisms to mount resistance against the invasion and to prevent infection of pathogens. The antimicrobial response of hosts may be natural, non-specific and specific. Natural resistance includes species resistance, racial resistance and individual resistance.

Chemotherapy

The control and treatment of infectious diseases with a chemical compound or drug is called **chemotherapy**. The chemical compounds and drugs are called chemotherapeutic agents.

A good chemotherapeutic agent possess the following characteristics:

1. It destroys or prevents the activity of a disease causing pathogen, without injuring the host tissues
2. It is able to penetrate the cells and tissues of the host and can encounter the pathogens in effective but safe concentrations or dosage.
3. It leaves the hosts natural defence or immune mechanisms such as phagocytosis or antibody production, unaffected.
4. It exhibits selective toxicity, that is it kills or inhibits the pathogenic microbes without having harmful effect or having least harm to the host.

Antibiotics and Chemotherapy:

Antibiotics are special and unique type of chemotherapeutics agents obtained from living organisms such as bacteria or fungi. The

word antibiotic refers to a metabolic product of one microorganism that in very small amounts is detrimental or inhibitory to other microorganisms. The first antibiotic that was discovered was Penicillin from the fungus, *Pencillium sp.* by Alexander Fleming in 1929. Since then hundreds of antibiotic substances have been isolated.

Antibiotics are of two types. 1. Broad spectrum antibiotics can destroy or inhibit many different species of pathogens.

2. Narrow spectrum antibiotics can destroy specifically some or few species of pathogens.

The mode of action of antibiotics may be either bactericidal or bacteriostatic. The former destroys the microbial cells while the latter inhibits the growth of them. Moreover, the antibiotics may inhibit cell wall synthesis or disrupt the cell wall or damage the cytoplasmic membrane or inhibit the protein synthesis and nucleic acid synthesis (purine and pyrimidines); inhibit the specific enzyme systems and also inhibit the metabolic pathway of pathogens through competitive inhibition of key enzymes.

Some notable antibiotics are Ampicillin, Streptomycin, Tetracyclin and Erythromycin etc. Some antifungal antibiotics are Griseofulvin and Imidazole etc. Some antiviral antibiotics are Amantidine and Cycloguanosine.

The more promising chemotherapeutic agent for treating viral diseases is the Interferon. Interferons are glycoprotein molecules secreted by the leucocytes and fibroblasts. Some of the antitumour antibiotics are of the anthromycin group.

AIDS (HIV) and its control

The disease Acquired Immuno Deficiency Syndrome (AIDS) was identified in the year 1981 (December). Early epidemiological studies have established that it is a communicable disease transmitted through sexual contact or through blood and blood products.

In 1983 **Luc Montagnier** at Pasteur Institute, Paris and **Gallo** at National Institute of Health (NIH) USA isolated the virus that caused

AIDS. In 1986, the committee on taxonomy of virus coined the term HIV or Human Immunodeficiency Virus to avoid confusion due to different names being given by different researchers.

HIV is new member of the Lentivirinae subfamily of human retroviruses. Retroviruses are RNA viruses, which have the capacity to convert their RNA into DNA with the help of an enzyme called reverse transcriptase.

Structure of HIV:

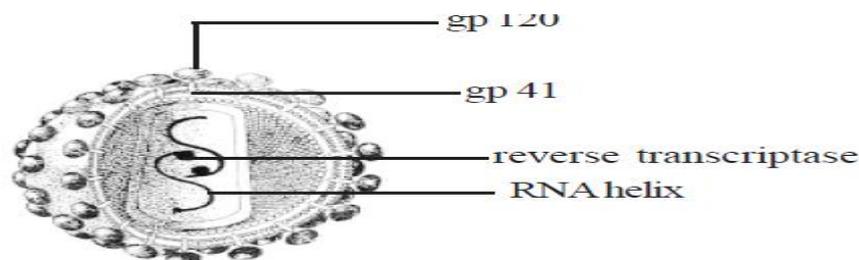


Fig. 2.6. Structure of HIV

HIV is spherical in shape. Its size is about 100-140 nm. Like any other virus, it is made up of a central icosahedral capsid core containing the genetic material surrounded by a protein envelope. The protein envelope is attached several spicules of glycoprotein, Like other retroviruses the glycoprotein sticks out on both sides (inside and outside) of its protein coat.

The outer position of glycoprotein called gp120 is attached to the gp 41 situated on the inner side of the viral coat. gp 41 is an unusually long protein with over 100 amino acids. gp 120 appears like a knob.

Electron microscopic studies have revealed that the distribution of proteins of the viral surface is very much like a soccer ball made of 12 pentagons and 20 hexagons, stitched together to make a sphere.

The envelope of HIV also contains other proteins including some HLA antigens (Human Leucocyte Antigen). The genome of HIV contains two helix of RNA molecules in folded form. The enzyme reverse transcriptase is attached to RNA.

Pathogenesis:

HIV causes profound immunodepression in humans. It is due to the depletion of one type of WBC, which is involved in the formation of

antibodies called CD4 plus T-helper cells (lymphocytes). In addition other cells such as B-lymphocytes and macrophages are destroyed by HIV infection.

The infected macrophages serve as the reservoir of viruses and disseminate to all tissues in the body. HIV is found besides blood, in all body fluids such as semen, vaginal secretion, cervical secretion, breast milk, CSF, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid and amniotic fluid. HIV can even destroy the brain cells.

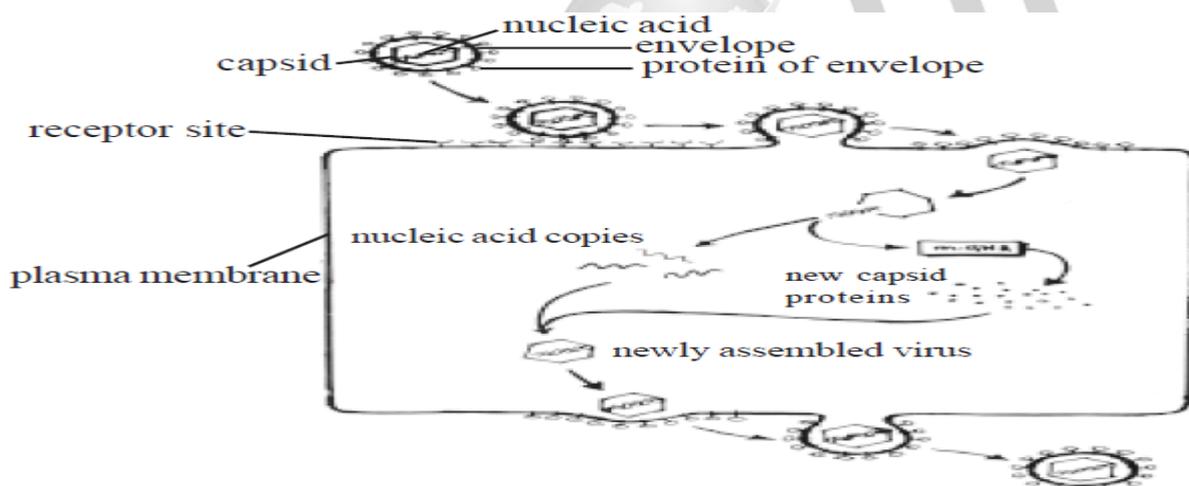


Fig. 2.7. Viral multiplication

Symptoms:

The following symptoms have been defined by WHO.

- ✓ Weight loss at least 10% body weight
- ✓ Chronic diarrhoea for more than a month
- ✓ Prolonged fever for more than one month
- ✓ Night sweats and persistent coughs
- ✓ Opportunistic infections such as tuberculosis, or pharyngeal candidiasis (fungal infection in mouth and throat)
- ✓ recurrent herpes zoster (viral) infection

- ✓ Meningitis and nerve damage
- ✓ Loss of memory and intelligence
- ✓ An unusual cancer, kaposi sarcoma which produces scattered purplish lesions over the chest and abdomen.

Diagnosis:

ELISA test (Enzyme Linked Immuno Sorbent Assay) is a sensitive preliminary blood test used to detect HIV antibodies.

Western Blot is the confirmatory test, which is highly specific and based on specific antibodies to viral core proteins.

Control and Management:

- ✓ Screening of blood and blood products.
- ✓ Education to people about do's and don'ts in AIDS contraction and bringing more awareness among the public.
- ✓ Education about protected sexual behaviour and practices
- ✓ Participation of voluntary agencies, teachers, NGOs, paramedical workers, several other voluntary health organizations, in AIDS awareness programmes
- ✓ Making the antiretroviral drugs such as AZTs (Azidothymidine/Zidovudin) and saquinovir etc., available to patients.
- ✓ The management of HIV infection involves the above general measures, treatment of opportunistic infections and cancer, antiretroviral drugs, immunomodulators and supportive treatment and counselling.

11TH STD

Type study - 1. Plasmodium

Phylum - Protozoa

Class - Sporozoa

Order - Haemosporidia

Members of the genus *Plasmodium* are collectively known as malarial parasites. They cause a febrile disease called malaria. Malaria as a chill and

fever disease is known to mankind for a long time. Eradication of malaria is an important problem in public health. For a long time it was believed that malaria was caused by harmful vapours produced in marshy land (Gr. *Malo*-bad+air).

Charles Laveran, a french military surgeon, for the first time, noticed *Plasmodium* in the blood of a malarial patient, in 1880. Its connection with the intermediate host and the modes of transmission were experimentally worked out in Calcutta by Sir Ronald Ross in 1889. For this discovery he was awarded the nobel prize for medicine in 1902.

Grassi (1890) provided absolute scientific proof for the specific relationship between *Anopheles* mosquito and the human malarial parasite.

Plasmodium: The *plasmodium* is an intracellular sporozoan blood parasite. For the completion of life cycle it requires two hosts, a vertebrate and a blood sucking invertebrate. Transference of the parasite is effected by the invertebrate host.

In man, the infection takes place by the inoculation of the slender, sickle shaped nucleated sporozoite in the blood by the bite of an infected female mosquito belonging to the genus *Anopheles*. At least four species of Plasmodium, *P. vivax*, *P. falciparum*, *P. malariae* and *P. ovale*, are known to attack man causing different kinds of malaria.

The life cycle of the malarial parasite involves two hosts, the man and the mosquito. The modes of development in these two hosts are different. In man the mode of reproduction is asexual and in mosquito it is sexual. Man is the intermediate host and the mosquito is the definitive host.

Life cycle in Man - Schizogony

There are two phases in the life cycle of malarial parasite in man. They are (1) Pre erythrocytic cycle or Exoerythrocytic cycle (in liver cells) and (2). Erythrocytic cycle or Endo-erythrocytic cycle (inside the red blood corpuscles)

Pre-erythrocytic cycle:

The pre-erythrocytic cycle comprises the asexual reproduction of the parasite in the liver. When an infected female *Anopheles* mosquito bites a person, thousands of slender, sickle shaped nucleated sporozoites are injected in the blood.

The sporozoites first enter the capillary vessels of the skin and then enter the general circulation. These parasites circulate in the blood for about 30 minutes and enter into the pre-erythrocytic cycle in the reticuloendothelial cells of the liver.

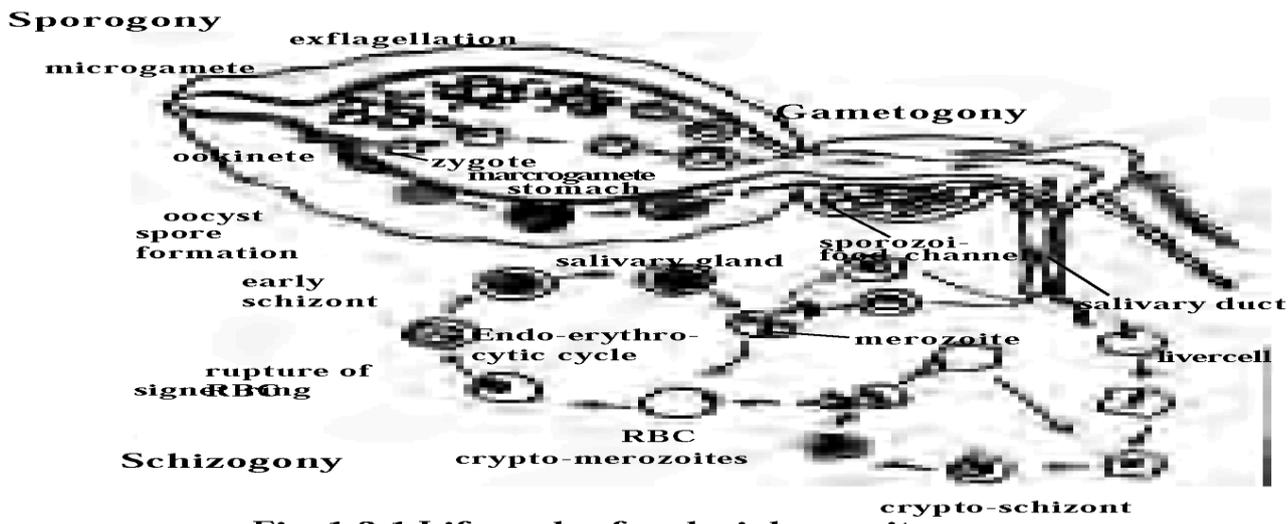
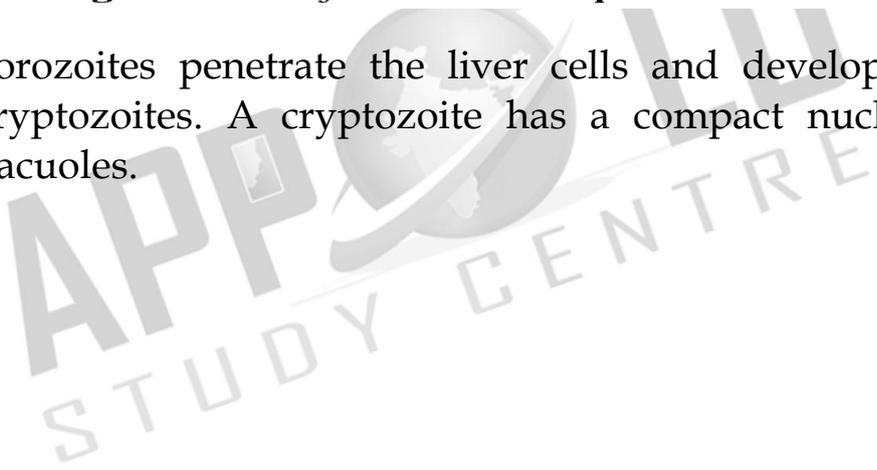


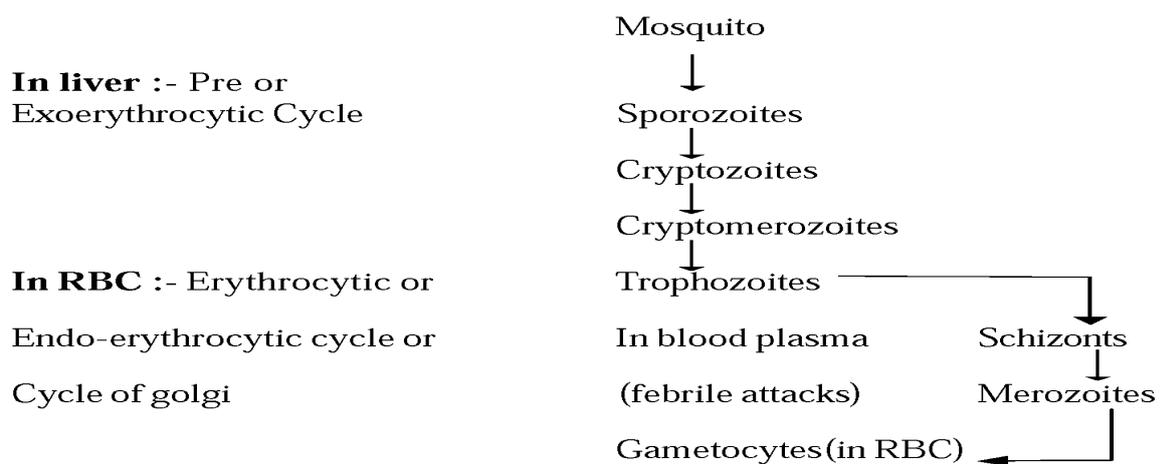
Fig. 1.3.1 Life cycle of malarial parasite

The sporozoites penetrate the liver cells and develop into forms known as cryptozoites. A cryptozoite has a compact nucleus and no pigment or vacuoles.

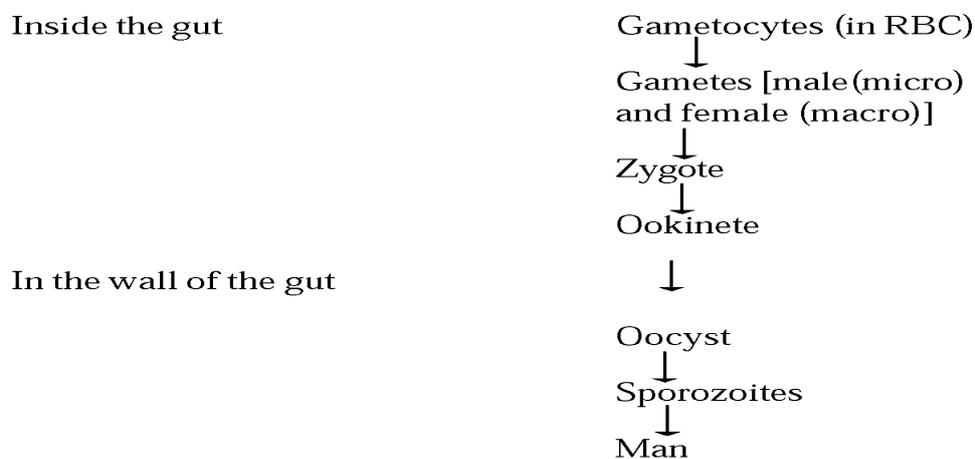


Life history of Plasmodium (the malarial parasite)

Life cycle in Man (Schizogony)



Life cycle in Female anopheles mosquito (Sporogony) or Cycle of Ross



Cryptozoites rapidly grow feeding on the liver cells. When a cryptozoite has reached its full growth it fills the entire cell. In this stage it is known as the crypto-schizont.

It undergoes schizogony and the resulting cells known as cryptomerozoites are set free in the blood by the rupture of the liver cells. The released crypto-merozoites invade fresh liver cells or red blood corpuscles. This cycle is considered as a period of incubation before the parasites could start the erythrocytic cycle. During this period of 7 - 17 days, the parasites are not seen in the blood stream.

Erythrocyte or Endo - erythrocyte cycle.

Each cryptomerozoite makes its way into a red blood corpuscle and feeds on its contents. After some time, the parasite gets an amoeboid shape. This growing stage is known as the trophozoite stage. Soon it develops a vacuole which gradually increases in size.

Thus the nucleus is pushed to one side. This stage is called the signet ring stage. With further growth the vacuole disappears and the amoebula occupies the entire interior of the corpuscle. This stage is known as the schizont stage.

In the schizont, the nucleus breaks up into bits (6-24) and each becomes surrounded by a small amount of cytoplasm. These cells are known as merozoites. By the rupture of the wall of the red blood corpuscles the merozoites along with wastes (haemozoin) are released into the blood. This causes the malarial fever.

The liberated merozoites attack another set of corpuscles and start the life cycle anew. This method of infection is known as autoinfection. The life cycle in the blood of man is called the cycle of Golgi or schizogony or endoerythrocytic cycle.

Schizogony keeps up the multiplication of the parasites and their maintenance in the blood.

After schizogony has taken place for several generations some of the merozoites which invade the red corpuscles, instead of developing into trophozoites and schizonts, develop into gametocytes. The gametocytes are of two types - macro-gametocytes and micro-gametocytes.

The macro-gametocyte has a small nucleus and a dense food laden cytoplasm. The micro-gametocyte has a relatively large nucleus and clear cytoplasm. Their further development depends on their entry into the stomach of a female *anopheles*. If it does not take place they disintegrate.

Life cycle in the mosquito - sporogony

When a female *anopheles* mosquito bites an infected person, it sucks blood along with all the stages of parasite. But in the gut of the mosquito, only the mature gametocytes survive and the rest of the stages are destroyed. From the gametocytes develop gametes. The process of development of gametes from gametocytes is known as gametogony.

Gametogony:

The nucleus of the micro-gametocyte divides into many fragments and the cytoplasm is thrown into flagellated structures. There may be as

many cytoplasmic structures as there are nuclei. This process is known as exflag - ellation.

The resultant cells are called the microgametes. The nucleus of the macro-gametocyte divides equally into two. The cytoplasm divides unequally. So among the resulting cells one is bigger and the other is smaller. The small cell is thrown out. This process is known as maturation. The resulting bigger cell is known as female gamete or macrogamete.

Syngamy and sporogony:

Inside the stomach of the mosquito the microgamete and the macrogametes come into union and nuclear fusion takes place. This kind of union is called syngamy and the resultant form is known as zygote.

The zygote assumes an elongated form and is capable of movement. It is known as ookinete. It pierces the wall of the stomach and comes to lie under the outer layer of stomach wall. There, it ceases to move, becomes round and forms a membranous cyst-wall. This stationary zygote enclosed in a cyst-wall is known as oocyst. It grows in size absorbing the nourishment from the host.

The nucleus of the oocyst divides repeatedly, each being surrounded by a fragment of cytoplasm. Thus inside the oocyst, a large number of cells develop into minute, slender, sickle shaped bodies called sporozoites.

The cyst wall breaks, liberating the sporozoites into the body cavity (haemocoel) of the host. They wriggle forward and enter the salivary gland.

When such an infected female anopheles mosquito bites a healthy person, it injects into his blood a stream of sporozoites. This kind of transmission is called inoculation.

Types of Malaria:

The disease caused by *Plasmodium* is known as malarial fever. It is characterised by recurring bouts of fever, each lasting several hours.

Different species of Plasmodium		
S.No	Species of Plasmodium	Type of fever

1.	<i>Plasmodium vivax</i>	benign tertian fever
2.	<i>P. falciparum</i>	malignant tertian fever
3.	<i>P. malariae</i>	quartan fever
4.	<i>P. ovale</i>	Ovale or mild tertian fever

Stages in the Life History of Plasmodium

S.No	Stage	Occurrence
1.	Sporozoites	In the blood stream of man
2.	Cryptozoite	Liver (man)
3.	Trophozoite	Blood (man)
4.	Amoebula stage	RBCs (man)
5.	Signet ring stage	RBCs (man)
6.	Merozoite	RBCs (man)
7.	Macrogamete	Stomach of female anopheles mosquito
8.	Microgamete	Stomach of female anopheles mosquito
9.	Ookinete	Stomach of female anopheles mosquito

The febrile condition in man is due to toxins liberated into the blood along with the merozoites when the corpuscle is ruptured at the end of schizogony.

There are four species of *Plasmodium* known to cause malaria in man. The commonest and most widely distributed species is *P. vivax*. It causes benign tertian malaria in which the fever recurs every third day (every 48 hours). *P. falciparum* is largely limited to the tropics and subtropics and causes the malignant tertian or subtertian malaria. This type of malaria has a high death rate.

Blood corpuscle parasitised by this species tend to clump together and block up small blood vessels and damage the essential organs. It is a dangerous species and the disease often appears in an epidemic scale. *P. malariae* causes quartan malaria with feverish fits every fourth day (every 72 hours). The fourth species is *P. ovale*. It is principally found in west Africa but occasionally in S. America, Russia and Palestine. It causes benign tertian malaria in which the fever recurs every third day (every 48 hours).

These four species differ from each other in the details of structure, time needed to complete the schizogony, the incubation period, number of merozoites released and duration of sexual cycle.

Control of Malaria

The control measures fall under the following three categories.

Treatment of infected patient

(1) Plasmodium does not produce antitoxins or antibodies in human blood. Therefore malaria cannot be treated by inoculation or vaccination with immune sera. It can only be treated with drugs that may kill all stages of the parasite without poisoning the patient.

Quinine, which is extracted from the bark of cinchona trees, had been used effectively for the past 300 years to cure malaria. The various synthetic drugs, such as Paludrine, Atabrin, Camoquin, Chloroquine, Resochin, Pamaquin etc are used as suppressants of various stages of the parasites.

(2) Prevention of infection:

It can be effected in two ways.

(i) using protective measures such as mosquito nets, anti-mosquito creams (repellants) and coils.

(ii) use of the prophylactic drugs; small daily dose of anti-malarial drugs will kill the parasite either in the sporozoite or merozoite stage.

(3) Control of vector

It is perfectly clear that if the vector is completely exterminated the infection cannot be transmitted from one person to another. It is the most

effective and surest way of controlling malaria. It is achieved by using effective insecticides and by draining swamps. It destroys the breeding places of mosquitoes.

Adult mosquito can be most effectively controlled by spraying DDT, malathion or any other insecticide in the houses; fumigating pyrethrum cresol and other compounds of naphtha; sterilization of male mosquitoes. The young stages of mosquito can be controlled by introducing larvivorous fishes like Gambusia and Lebistes in ponds, lakes, canals and tanks.

10TH STD

Diseases caused by Microbes and prevention

A disease caused by a parasitic organism and transmitted from one person to another by the transfer of the parasite is known as *infectious disease*. We shall study the cause, spread and prevention of a few selected infectious diseases prevalent in our country so that we will know how to guard ourselves against them and other similar diseases.

I. Viral diseases

A. Common Cold

More than hundred strains of viruses are responsible, for causing common cold in man. Children are more susceptible to common cold than adults.

Symptoms

1. Inflammation of upper respiratory passage – nasal epithelium.
2. Flow of mucous.
3. Headache, slight rise in temperature, etc,.

It lowers the resistance of the body, leading to a number of secondary infections like pneumonia, bronchitis, etc.,

Transmission

i) It spreads mostly through the droplets discharged from the nose and the mouth of the patient in the process of talking, laughing, sneezing, etc.,

ii) It may also spread through close inanimate objects like handkerchief, bedding, clothes, utensils, toilet articles, etc., (called *fomites*)

Control and prevention: There are no effective measures to control common cold. However, a good nourishing food, avoiding contact with patients and wearing suitable clothing are suggested, to keep away from common cold.

B. Influenza

It was a dreadful disease once and worldwide in distribution (pandemic) in 1970s.

Causative agent: A(H1N1) Virus , is spherical in shape and highly contagious, causing influenza.

Symptoms

Sudden onset of fever accompanied by aches and pains in the back and limbs.

Transmission

It spreads through nasal and mouth droplets of patients and enters into the respiratory tract of normal man. It also spreads through fomites.

Prevention

- i. Avoid contact with the patients.
- ii. Avoid crowding.

II. Bacterial diseases

Bacteria are prokaryotic organisms. Some of the bacteria are parasitic in man, causing diseases like TB, Cholera, Typhoid, dysentery etc.,

A. Tuberculosis

It is an airborne disease affecting the lungs and also parts of our body such as bones, joints, lymph glands, alimentary tract, liver, kidney, etc.,

Causative agent: *Mycobacterium tuberculosis*, a rod shaped bacterium causes tuberculosis (TB).

Symptoms

- i) The affected parts develop lesions in the form of small nodules called tubercles from which the disease gets its name.
- ii) Persistent cough
- iii) Loss of body weight

Transmission

Tuberculosis is transmitted through air. Large number of bacteria leave the patients through the droplets of sputum expelled by the patients while eating, sneezing, talking, laughing and so on by the patients. The droplets may remain suspended in the air for a long time. The dust arising from the sputum may also contain viable germs. The waxy cell wall of the tuberculosis bacillus prevents it from drying up and so it can remain viable outside the body for a long period. The germs **Fig. 2.10 Tuberculosis bacteria** Making a culture of live bacteria Boil a few grams of chopped meat, carrot and potatoes in water for 15 minutes, then filter off the solid matter to obtain a fairly clear broth.

Leave the broth in open test tubes for a few hours. Plug the tubes with cotton wool and leave them in a warm place (approximately 25°C) until the broth has "gone bad" owing to the growth of bacteria. What you have produced, is a bacteria culture. suspended in the air may be inhaled by a healthy person.

Prevention

- i) Keeping oneself healthy and avoiding insanitary conditions, overcrowding and poor ventilation.

- ii) Sunlight and fresh air are important agents, as they act as natural disinfectants readily destroying the germs.
- iii) Isolation of the patients and frequent sterilization of articles used by them are also important.
- iv) Incineration (burning) of the droplets, the sputum from the patients to prevent its occurrence in the air.
- v) Immunization with BCG vaccine is an effective measure to prevent this disease.
- vi) The patient should cover his mouth and nose while coughing.

B. Typhoid

Causative agent: A short rod shaped bacterium with numerous flagella - *Salmonella typhi* causes typhoid.

Symptoms

- i) Continuous fever.
- ii) Inflammation and ulceration of intestine.
- iii) Enlargement of spleen and a characteristic red spot eruption on the abdomen.

Transmission

Transmission of typhoid is through food and water contaminated with the germ, the personal contact with patients and carriers. Flies are also important transmitting agents of this disease.

Prevention and control: Isolation of the patient, control of flies, hygienic food habits, proper public sanitary measures are effective means of prevention of this disease. Artificial immunization with typhoid vaccine is advised. A recovery from typhoid usually confers a permanent immunity.

III. Protozoan diseases:

Some of the unicellular protozoans are parasitic pathogens and cause diseases in man.

A. Malaria

Causative agent: A tiny protozoan - Plasmodium is responsible for causing malaria. Four different species of Plasmodium namely, P.vivax, P.malariae, P.falciparum and P.ovale occur in India causing malaria. Of these, the malignant and fatal malaria, caused by Plasmodium falciparum is the most serious one.

Transmission

Through the vector - the female *Anopheles* mosquito.

Symptoms

- i) Malaria is characterized by chillness and rise in temperature. This is followed by perspiration and lowered body temperature. The person feels normal for some time but the fever recurs at regular intervals.
- ii) Successive attacks of malaria result in the distension of spleen and destruction of liver tissues.

Prevention and control:

- i) Sanitary measures include ground fogging with disinfectants.
- ii) Closure of stagnant pools of water and covering ditches is suggested.

Life cycle of malarial parasite - Plasmodium: The sexual stage of Plasmodium takes place in female Anopheles mosquito whereas the vegetative stage occurs in man. When a female Anopheles mosquito bites an infected person, these parasites enter the mosquito and undergo further development in the mosquito body.

The parasites multiply within the body of the mosquito to form sporozoites that are stored in the salivary glands of mosquito. When these mosquitoes bite a person, the sporozoites (the infectious stage) are introduced into his body; they multiply within the liver cells first and enter the RBC of man, resulting in the rupture of RBC. This results in the release of toxic substance called haemozoin which is responsible for the chill and high fever, recurring three to four days.

iii) Using mosquito nets and repellants also, will grossly lower the chance for infection.

B. Amoebic dysentery (Amoebiasis)

Causative agent: *Entamoeba histolytica* - a protozoan parasite in the large intestine of man causes **Amoebiasis**.

Symptoms

- i) Fever.
- ii) Constipation and abdominal pain and cramps.
- iii) Stools with excess mucous and blood clot.

Transmission

It is a water and food borne disease. House flies act as mechanical carrier and serve to transmit the parasite from the faeces of infected persons to the food - thereby contaminating the food and water.

Prevention and control: Precaution may be taken by providing germ free clean water; clean food habits. Good sanitary facilities will control the flies.

IV. Fungal diseases in man

Some of the fungi are parasitic on man and cause diseases

Ringworm

Three different genera of fungi namely, Epidermophyton, Microsporum and Trichophyton cause ringworm.

Symptoms

The above fungi live on the dead cells of outer layer of skin in man and cause superficial infections in skin, hair, nail, etc; and form patches and Itching

Transmission

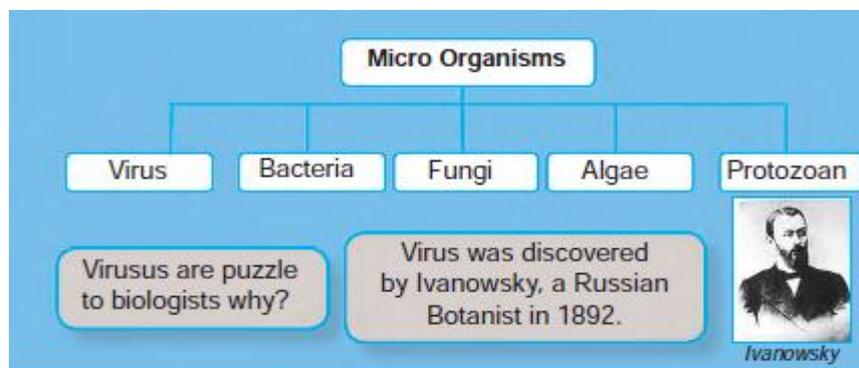
By direct contact or through fomites such as towels, combs, etc,.

Control and prevention: Avoid contact with infected person and articles used by them.

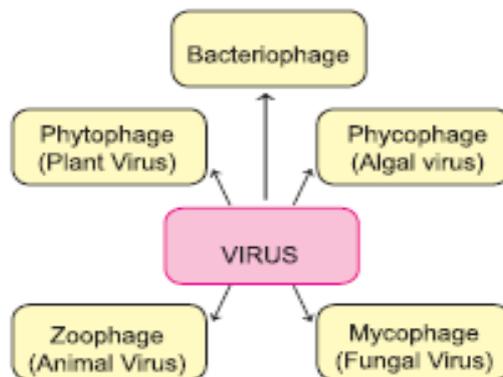
8TH STD

VIRUS

Virus is a Latin word which means poison. Viruses are the smallest and simplest of all living organisms. The study of viruses is called Virology. Viruses show both living and non-living characteristics. They are considered as being on the border line between living and non-living organisms. The living cell inside which the virus grows and multiplies is known as host cell. Outside the host cell, viruses do not show any of the characteristics of living organisms.



Based on their host, viruses are classified in to five types.



BACTERIA

The curd contains *Lacto bacillus* bacteria which helps to change the milk into curd. Let us now study about bacteria. Bacteria are unicellular and microscopic, belonging to the world of microbes. The study of bacteria is called Bacteriology. Bacteria were first observed under a microscope by the Dutch Scientist Anton Von Leeuwenhoek in 1675. Later, Louis Pasteur, Roberts Koch and Lord Lister carried out detailed studies on bacteria.

The structure of bacteria can be studied with the help of an electron microscope. The bacterial cell is a prokaryotic cell. It has a rigid cell wall protecting the cell and giving a definite shape to it. The living material inner the cell wall is called protoplasm. It is differentiated into cell membrane, nuclear material and cytoplasm. Membrane bound organelles like golgi bodies, mitochondria, endoplasmic reticulum, lysosomes are absent.

It contains bacteriochlorophyll pigments. The nuclear material of a bacterial cell is made of a circular, DNA molecule. It is not bound by nuclear membrane. There are thread like appendages which are called flagella, the organs of motility. Pili are minute, straight, hair like appendages and are considered to be organs of attachment.

Bacteria are measured in microns.

1 micron = 1/1000 millimetre.

Four types of bacteria are recognised based on shape. They are

1. Cocci (Spherical shaped)
2. Bacilli (Rod shaped)
3. Spirillum (Spiral or cork screw)
4. Vibrio (Comma Shaped) On the basis of the number and arrangement of the flagella, bacteria are classified as
 1. Monotrichous (Single flagellum at one end)
 2. Amphitrichous (Tuft of flagella arising at both ends).
 3. Atrichous (Without any flagella).
 4. Lophotrichous (Tuft of flagella at one ends).
 5. Peritrichous (Flagella all around).

ALGAE

Chlamydomonas is a unicellular green algae. It is spherical or oval in shape. The protoplasm is surrounded by a cellulose cell wall. The cell wall

may have a pectic sheath around it. There is a single large cup-shaped chloroplast. Inside the chloroplast a pyrenoid which contains starch may be present. There are two flagellae at the narrow end of the cell which helps in locomotion. There may be a vacuole at the base of the flagella.

An eye spot is located at the anterior end. Based on the presence of other pigments, algae are classified into four classes. The study of algae is called Phycology which you have studied in the previous chapter.

FUNGI

The conversion of sugar solution into alcohol and liberation of carbon di - oxide is known as fermentation. Here the sugar solution is fermented and gives a smell. Wine, alcohols are prepared from the molasses by the fermentation activity of the yeast. etc. Yeast is a unicellular, saprophytic fungus. The cell is oval shaped.

The nucleus is seen at one end of the vacuole. The cytoplasm shows the presence of organelles like endoplasmic reticulum, ribosome, mitochondria, etc., Fungi do not possess chlorophyll. Hence they are incapable of photosynthesis. The study of fungi is called Mycology.

They lead a parasitic or saprophytic mode of life. A black powdery spot with a network of thread like filaments, called hyphae is called mycelium (bread mould) which changes the colour of the bread.

PROTOZOA

Protozoans are unicellular organisms. Metabolic activities are done by organelles. Protozoans show mainly two modes of life, free living and parasitic. Free living organisms inhabit fresh and salt water. Parasitic forms live as ectoparasites or endoparasites. They cause diseases.

Uses of Microorganisms IN Medicine, agriculture, industry and daily living.

Micro-organisms are used in the manufacture of antibiotics, linen, bread, wine, beer and the other industries. Microorganisms are used to enrich the soil fertility.

What is antibiotic?

Antimicrobial agents which are useful medicines or drugs and are extracted from the micro-organisms. are called antibiotics.

Name of the Species		Antibiotic
Bacteria	<i>Streptomyces griseus</i>	Streptomycin
	<i>Bacillus subtilis</i>	Bacitracin
Fungi	<i>Penicillium notatum</i>	Penicillin
	<i>Penicillium chrysogenum</i>	

Bacteria, Fungi are used to make antibiotics, vaccines, etc.

AGRICULTURE

It may be defined as the science or practice of farming. Agriculture depends on soil fertility. Microorganisms like bacteria, fungi, few algae enrich the soil fertility. Nitrogen is essential for all life. Bacteria convert complex proteins in the dead bodies of plants and animals into ammonia, nitrites and nitrates.

Bacteria play a major role in the cycling of elements like carbon, oxygen, nitrogen and sulphur as biological scavengers. They oxidize the organic compounds and set free the locked up carbon as carbon di-oxide due to which we smell the foul odour.

The following bacteria are involved to enrich the soil fertility:

Ammonifying bacteria:- e.g., *Bacillus ramosus*

Nitrifying bacteria:- e.g., *Nitrobacter Nitrosomonas*.

Nitrogen-fixing bacteria:- e.g., *Azatobactor, Clostridium, Rhizobium* (Root nodules bacteria).

Various blue green algae like *Oscillatoria, Anabaena* and *Nostoc* increase the soil fertility by fixing atmospheric nitrogen.

Role of micro-organisms in industry and daily living.

The leaves of tea, tobacco, the beans of coffee and cocoa are fermented by the activity of *Bacillus megaterium* to impart the characteristic

flavour. This is called curing. In the world today many industries totally depend upon the microbial activities of micro-organisms such as Lactic acid bacteria. *Streptococcus lactis* (lactic acid bacteria) converts milk protein into curd.

Vinegar is manufactured from sugar solution employing *Acetobacter aceti*. Butyl alcohol, methyl alcohols are prepared from molasses by the fermentation activity of *Clostridium acetobutylicum*. Alginic acid is obtained from brown algae. Oxalic acid is the fermentation product of fungi *Aspergillus niger*.

Yeast is the best source of vitamin B complex and vitamin Riboflavin. Mushroom is also an edible (e.g.) *Agaricus*, *Morchella* are edible and are cultivated. *Chlorella* and *Spirulina* are used as protein sources. Hence they are known as single cell protein.

Harmful micro organisms

Micro-organisms cause damage to the plants and food materials. They contaminate food, which leads to food poisoning. Influence of micro-organism on plants and animals reduce the market value of their product. The various harmful activities of bacteria, fungi and virus are given in the table.

S. No	Micro-organisms	Name of the Species	Diseases
1	BACTERIA	<i>Xanthomonas citri</i> <i>Pseudomonas solanacearum</i> <i>Xanthomonas oryzae</i>	Citrus Canker Wilt of Potato Bacterial blight in Rice
2	FUNGI	<i>Cercospora personata</i> <i>Cercospora arachidicola</i> <i>Pyricularia oryzae</i>	Tikka disease of groundnut Blast disease of rice
3	VIRUS	Bunchy Top Virus Tobacco Mosaic Virus Cucumber Mosaic Virus	Bunchy top of Banana Tobacco Mosaic disease Cucumber Mosaic disease.

Viruses, bacteria, fungi, protozoa and certain worms are the main organisms causing diseases. To cause disease, they must first gain entry into the body. Such entry must be either through the skin or through the nose into the respiratory system or through the mouth to the alimentary canal.

The method of carrying these disease organisms to the body is varied. The carriers of disease organisms are called vectors. They are said to transmit diseases. Some organisms pass directly through the surface of the skin. Such is the case with the spores of the fungus which causes ring worm. Bacteria frequently enter the skin through a wound, causing inflammation of the wound.

Many micro-organisms enter through the nose or mouth and penetrate the delicate membranes of the respiratory system. Virus causing colds and influenza enter this way. Parasitic bacteria, protozoans, viruses, etc., cause various communicable diseases in man.

Communicable diseases are pathogenic diseases which spread from, person to person, either directly or indirectly. The following table shows some of the common communicable diseases in man.

PATHOGEN	DISEASES	MODE OF TRANSMISSION
<i>VIRUS</i>	Common cold, Polio. Hepatitis, Influenza, Jaundice.	Air water, direct contact
	AIDS	Sexual Contact
<i>BACTERIA</i>	Cholera, typhoid	Contaminated water.
	Tetanus	Cuts and wounds
	Leptospirosis	Contact of animal's urine. (Rat and Squirrel)
	Leprosy	Contact (vector)
<i>FUNGI</i>	Athlete's feet	Spores in water and in ground.
<i>PROTOZOAN</i>	Malaria	Vector example mosquito

Harmful micro-organisms in food and drink can be taken in through the alimentary canal unless high standards of hygiene are followed. The food may be contaminated in a variety of ways. Bacteria may enter the food causing it to go bad, if food is not properly stored.

The bacteria causing cholera and typhoid and the protozoan causing amoebic dysentery are easily picked up from the infected food and water.

Disease causing microbes

Due to chemical reaction, butter milk gets spoilt if kept in a brass vessel. The starchy foods get spoilt due to change of starch into sugars by the enzymes present in the food articles.

6TH STD

Do you know which book was sold in large number and paved way for the maximum criticism? It was the book titled 'Origin of Species' which was published in the year 1859. It was written by a Naturalist named Charles Darwin. Why did it raise criticism?

Darwin sailed to several important islands of the world in the ship, H.M.S. Beagle, for more than 10 years and collected information. He said that living organisms on the earth have evolved gradually from one form to another over a million years. He was the first person to explain the similarities between ape and man, cat and tiger.

Mushroom grows in our garden when it rains. Frogs croak when water stagnates. Dragonflies fly, fire flies illuminate during night time. Are you not interested to know more about the various characteristic features of organisms living on this earth?

Darwin too was interested. He collected and preserved one hundred and seventeen types of beetle, when he was young. We too keep peacock feather in our book for it to grow. Can we rear golden beetle? How many life forms like this are there on the earth?

When did life originate on this earth? How did the first formed organism appear? How did they procure food? How did they grow? How do we resemble our parents? How can the body be healthy? How can food be produced? **Biology**, a branch of science, answers these questions.

Organisms differ in their character, size, nutrition, habit and habitat. This is called Bio-diversity. Electron microscope was discovered by Ernst Ruska and Max Knoll in 1931.

Virus

Virus cannot be seen with naked eye. It can be seen only through Electron microscope. Viruses cause a variety of diseases in plants and animals. These infect us when we are not aware of them. The branch of science that deals with viruses is called Virology.

HIV In 1984, Robert Gailo discovered HIV which causes AIDS

The branch of science that deals with bacteria is Bacteriology

Beneficial activities of bacteria

- ❖ Curdling of milk.
- ❖ Decomposition of organic wastes into manure.
- ❖ Fermentation of idly and dosai flour.

- ❖ Some bacteria act as bio-fertilizer increasing the yield.

Bacterial diseases

- ❖ Plants - Citrus canker, Tomato blight
- ❖ Animals - Anthrax, Tuberculosis
- ❖ Human beings - Pneumonia, Tetanus, Tuberculosis. Let us discuss.

Let us divide into groups and debate on advantages and disadvantages of bacteria. *Chlamydomonas* is a motile, unicellular plant. It is an alga.

Worms like tape worm, hook worm, *Ascaris* live in the human intestine. They cause indigestion, frequent stomach ache, dysentery and stomatitis.

It is good to intake properly cooked food and drink boiled water. Mosquito, housefly and honey bee are insects. They can live in any part of the world. They have compound eyes. Among the animals, insects are found in large numbers. They are both beneficial and harmful to us.

Stagnant sewage water welcomes me, Human body is my vehicle, their blood is my food, I am simple in my appearance and pierce like a needle. Disease is my partner. Who am I?

Some animals are marine, e.g., Star fish and Sea cucumber. Their skin is entirely covered with calcareous spicules. Using this they attack their enemies. What a surprise! These organisms regenerate the broken or lost parts.

