CHAPTER ONE
INTRODUCTION TO BIOLOGY

Now a days we find contributions of Aristotle, Socrates, Theophrastus and many other scholars of the past age in different fields of knowledge. This is not possible for the scholars of the present time. A question may arise in your mind as to why it is not possible today. The reason is that in ages long past the extent of knowledge was limited. People engaged in achieving knowledge were also small in number. Today the dimension of knowledge has been increased many times. To contribute in more than one field is quite difficult at the present time. For convenience to know and understand things we have divided our world of knowledge in many branches. In this way Science, Literature, Arts, Social Science and many other branches have been created. As a whole, knowledge of human beings is undivided. But it has been divided into various branches for easy learning and understanding.

You may have known that the knowledge of science is increasing rapidly. It is becoming possible because of the research of a large number of scientists in different fields of science. Many people think that knowledge of science is becoming double in every eight years. New subjects of science are being created. It is not possible to realize and understand this huge store of knowledge for an individual alone. As a result, scientists are engaged in research in particular subject or topic. At different times many scholars have divided the knowledge of science in various ways. The division and different branches of science are constantly spreading with the increase of knowledge in science. The two main branches of science are Physical science and **Biological Science.**

Physical Science is otherwise called the Science of non-living things. In Physical science characteristics, actions-reactions, multiformaity and many similar other properties of non-living objects are examined and discussed.

Observation, examination and discussion of livings beings are included in Biology. Biology is the science of living beings. The term Biology comes from two Greek words (bios means life and logos means knowledge). Aristotle is regarded as the father of Biology.

We find two types of life in nature. One is plant while the other is animal. Accordingly Biology has been divided into two branches: Botany and Zoology. Botany deals with theoretical discussion and research about characters and other features of plants, while Zoology is limited in subjects relating to animals.

PRINCIPAL BRANCHES OF BIOLOGY

Biology has been divided into Botany and Zoology on the basis of nature of living beings. Inspite of this, now-a-days extensive research has been done on Microorganism. They influence human life in various ways. So for discussion about them a new branch is made. This is known as **Microbiology.** Considering the subjects of living bodies on which discussion is made the whole range of Biology is divided into the following main branches.

1. Morphology: This branch deals with both the external and internal structures of organism. The subject concerning internal . structures is also known as Anatomy.

2. Cytology: Each living organism consists of one or more cells. Structures and functions of cells are treated in this branch of Biology.

3. Histology: In this branch discussion is made on structure, location and function of different tissues.

4. Physiology: This branch includes all the activities of living things e.g growth respiration, excretion, photosynthesis and other biological activities.

5. Taxonomy: In this branch discussion is made on identification nomenclature, and classification of plants and animals into groups and subgroups.

6. Genetics: How different characters are inherited from parents to offsprings, and how the processes can be controlled and improved etc. are brought under study and research in this branch.
7. Ecology: This branch considers the effects of environment on living organisms or living communities and also interaction between them.
8. Evolution: This branch deals with the origin and successive transformations of living organisms.

The groups discussed above are the basic branches of Biology. Scientists gradually started to utilize the knowledge of these branches for human welfare, and as a result applied branches of Biology were created. **Agriculture, Medical science, Breeding etc.** are some of the important applied branches of Biology. Applied Biology also includes **Forestry** and **Horticulture, Fishery, Pest Control. Animal Husbandry** etc.

There are numerous varieties of plants and animals on earth. Generally similar plants or animals are arranged in particular groups. Some special branches of Biology have been created on the basis of different types of living things are under discussion and research: for example. **Phycology** includes only members of algae; fungi are treated in **Mycology; Virology** deals with viruses only; bacteria are considered in **Bacteriology; Helminthology** is based on study of worms only; insects are discussed in **Entomology.**

Each of the above mentioned divisions has been divided into subdivisions or branches. It has been mentioned earlier that research in Biological fields has greatly extended now-a-days.

Biology, as it appears today, was not the same the past 50 years ago. It was believed that sweat-soaked warm clothing of men and some wheat, if kept together in a box for few days, rats would be produced. This wrong concept about the origin of life prevailed for a long time. Subsequently ideas about origin of life have changed by the research works of various scientists. Modern

Biology is the result of research and thinking of some great scientists. This chapter introduces you with some of these scientists.

Aristotle (384-322 B.C): The great Greek scientist, Aristotle is regarded as the father of Zoology. He first established Zoology as a branch of Science. Aristotle was simultaneously a scientist, poet, thinker and philosopher. It is he who first mentioned about the basic similarities in the structure of plants and animals. He stayed in an island named Lesbos for five years continuously and made research on animals. He wrote a book on animals and named it "Historia animalium" which is full of information and knowledge.

Theophrastus (370-285 B.C.): Little amount of works of the Greek philosopher Theophrastus is known to us. Of those available, nine volumes of "On the History of Plants" and six volumes of "On the causes of plants" are important. Theophrastus was the pupil of great philosopher Aristotle. He divided the plant community into four groups. For example: Trees shrubs, Undershrubs and Herbs. He is regarded as the Father of Botany.

Al Biruni (973-1048): Known as an world famous scientist and educationist. Al Biruni was an Arabian citizen. His real name is Abu Raihan Mohammad Ibne Ahmed Al Biruni. He made contributions in different branches of science. He visited India during the reign of Sultan Mahmud of Ghazni and described the conditions prevailing in India in an attractive way.

Ibne Sina (980-1037): He was a renowned Muslim philosopher and scientist. He had excellent skill in Chemistry, Medicine, Mathematics, Astronomy and Literature. His full name is Abu Ali Hussain Ibne Abdullah Ibne Sina. He composed more than hundred books on different subjects. Sixteen of which were written on Medicine. He had a fourteen volume compositions named Al-**Kanun**' on Medicine.

A1 Nafis: He was an Arabian scientist. He first (300 years before William Harvey) described correctly the system of blood circulation in human body. He was also a successful physician. His actual name was Abu Al Hasan Ali Ibne Al Nafis, He dedicated himself in the field of science for a long time, and died in Damascus at the age of eighty.

William Harvey (1578-1657): William Harvey was a British scientist. He rediscovered the system of blood circulation in 1628 and as a result some of the previous ideas about it came to an end. In 1651 he pointed out that life starts from the egg cell. He is considered to be the father of Animal Physiology. He clearly described the systems of blood circulation and excretion in animals, and explained the relationship between the two processes. He published a book "On the motion of the heart and blood in animals".

Anthony Von leenwenhoek (1632-1723): Dutch scientist leeuwenhoek first built the microscope. But his microscope was not like that of today. Descriptions of bacteria, nerve cell, Hydra, Volvax, etc. were written by him on observations through his microscope. They have been found to be precisely correct.

Carolus Linnaeus (1707-1778): Swedish scientist Linnaeus introduced the system of Binomial Nomenclature for plants and animals. A physician by profession, he was the professor of physiology in Uppsala University, Sweden. Collecting numerous plants and animals he classified them and made their nomenclature. His "Systema Naturae" composed on classification of living beings is a famous research work. Besides this his other two famous Botanical books titled "Species Plantarum" and "Genera Plantarum" are based on research work. He is considered to be the father of modern Taxonomy.

Charles Robert Darwin (1809-1882): English naturalist Darwin introduced the Theory of Natural Selection. He expressed his findings and ideas in his famous research publication, "Origin of Species by Means of Natural

Selection" in the year 1859, after observing the living communities of Galapagos Islands.

Alfred Russel Wallace (1823-1913): English naturalist Wallace made observation and research works in the Amazon plateau for four years. His renowned book `Travels on the Amazon and Rio Negro" was written on this experience. He wrote "The Malay Archipelago" on his eight years research experience in Malay Peninsula. The huge collection of insects he made has been kept preserved in the Hope collection centre of Oxford University. He is famous for the introduction of Natural Selection Theory along with Charles Darwin.

Gregor Johann Mendel (1822-1884): Austrian Priest Mendel performed research work with pea plants in his church garden for a long time. Based on this research he established two laws concerning genetics, which are followed till today. He is regarded as the father of Genetics.

George Bentham (1800-1884): The most notable work of this English Botanist is the composition of three volumes of "Genera Plantarum" along with Joseph Dalton Hooker.Other books written by him are `Handbook of the British Flora'. `Flora Hongkongensis', Flora `Australiensis' etc.

Thomas Henly Huxley (1825-1895): Renowned British Zoologist T.H. Huxley did a lot of works on birds. He termed birds as `glorified reptiles' and proved that birds have been evolved from the reptilian ancestors. Besides, he made extensive research on Zoology. He was a notable supporter of Charles Darwin's theory of Natural Selection. Huxley described protoplasm as the physical basis of life.

Aristotle

Theophrastus

Anthony Von Leewenhoek

Carolus Linnaeus

Charles Darwin

Gregor johann Mendel

Alexander Fleming

Selim Ali

Watson

Alexander Fleming (1881-1955): Alexander Fleming was a Microbiologists He observed in 1918 that some bacterial growth stops in a culture media where Penicaillium is grown. He tried to find out the reason behind it. From his quest and research he subsequently discovered the drug penicillin that has saved millions of lives. He won Nobel Prize along with two other winners in the year 1945.

David Prain: David Prain was an English physician. He obtained degree in medicine from Aberdin and Edinburgh. Joining Indian Medical Service he came to India in 1883. His first Place of Posting was Luxmipur in Noakhali. Later he started research with the plants of this region. He was the Director of

Calcutta Botanical Garden from 1887 to 1897. His famous book, "Bengal Plants", Published in two volumes, widely treats plants of Bangladesh and adjoining areas. "Flora of Sundribuns" is another notable book written by him.

Salim Ali (1896-1987): Known as the Birdman of India, Salim Ali was a renowned ornithologist. He scientifically observed all birds of India and wrote an informative book. The title of the book is "The Indian Birds" In addition to this he composed many other books on birds. His autobiography is also a famous publication. In 1983 the Indian Government awarded him "Padmabhushan" title in recognition of his research work.

Sir Hans Krebs (1900-1981): English scientist Krebs won Nobel Prize in 1953 along with F.A. Lipmann in medicine and physiology for his research work on metabolism of cells. He was appointed as the departmental head of Biochemistry in the Oxford University in 1954. Krebs cycle of respiration in living beings is his discovery.

James Watson and Francis Crick: The two British scientists, Watson and Crick are famous for making the model of the molecular structure of DNA which bears the hereditary factors of human beings. While carrying out the research for PhD Degree in Cambridge University they discovered the molecular structure of DNA in 1953. They won Nobel Prize in the year 1963 for this work. Watson and Crick first noticed that DNA molecule is structurally a double helix and spiral.

Melvin Calvin (Born in 1911): Calvin, a professor of California University U.S.A. is famous for his research concerning the pathway of carbon assimilation in green plants. In co-operation with other scientist Bassham, discovered the biochemical steps of Carbon assimilation known as Calvin Bassham pathway of photosynthesis. He obtained Nobel Prize in 1961.

CHARACTERISTICS OF PLANTS AND ANIMALS

Taking a few main characteristics from many we shall now compare plants with animals.

1. **Size and shape:** Plants have no definite size and shape while animals have definite size and shape.
2. **Life Time:** Life time is not limited for plants and under suitable conditions they live for a long period. But animals live up to a certain length of time under suitable conditions.
3. **Growth:** In suitable environment growth of many plants continue for a long period. Growth in animals takes place up to a certain stage of life and growth ceases after that.
4. **Movement:** Most land plants remain fixed in soil with the help of roots as a result they cannot move. But some organs of plants may show some movement. A few animals (Such as Sponge) are not capable of movement. Most of the animals can move freely.
5. **Nature of Food:** Plants cannot take solid food Animals can take solid and liquid type of food.
6. **Nutrition:** Plants are autotrophic, it can prepare food through photosynthesis. Animals cannot prepare their own food. For foods they are to depend on plants and other animals.
7. **Structure of Cell:** A Plant cell has dead cell wall. Most of the mature cells have a large vacuole and plastids. The animal cell has no cell wall and it contains small vacuoles and centrioles.

8. Reproduction: Plants reproduce by vegetative, asexual and sexual methods. Reproduction in animals mainly takes place by sexual method.Vegetative and asexual reproduction may be found in some animals.

9. There are different systems in animal body. But plants have no body system.

ROLE OF BIOLOGY IN SOCIAL, ECONOMIC AND ENVIRONMENTAL DEVELOPMENT

The two main branches of Biology are Botany and Zoology. In addition to these, there are other branches and sub-branches of Biology. You have come across some of those in the preceding parts of this chapter. Now let us discuss the importance of Biology on the basis of knowledge you have already attained.

Agricultural science has many branches of which Agronomy, Horticulture, Plant breeding, plant pathology, Fishery, Animal husbandry, Poultry, Honeybee culture (Apiculture), Sericulture etc. are important. With the application of knowledge of these branches economic development is possible.

Both plants and animals are the essential components of natural environment. It is known to you that plants and animals are interdependent in many ways. Ecology makes us alert about the importance of plants and animals and also the necessity of their presence in nature, Educated and conscious citizens can play important role in conservation and development of environment. Economic development sometimes produces adverse effects on natural environment. Environmental degradation and hazards can be encountered through proper application of our knowledge in ecology, Economic solvency and good environment help social development.

NATURE AND ORIGIN OF LIFE

You know what nature is. We live in nature. We have soil, water, air different plants, animals, insects and worms etc. all around us. All these together constitute nature. Millions of years ago nature was not as we see it today. Nor will it remain the same after millions of years. This indicates that nature is always changing. Nature undergoes changes due to various natural forces such as river-currents, earthquakes, volcanic eruptions etc. Different human

activities, such as destruction of forests, construction of dams etc. also bring about changes in nature.

Scientists have been thinking about the origin of nature. There are different theories about the origin of the Earth. Among these the commonly acceptable theory explains that a part of the Sun or a similar star got detached as a result of the attraction of another star. The planets including the Earth and then satellites have been created from the detached part of the sun.

According to this theory at the beginning the Earth was in a hot, gaseous state Subsequently the Earth gradually cooled and condensed to form the Earth as it is now. The core of the Earth is still in an extremely hot liquid and gaseous state. Nature of the Earth at the primary stage was not at all suitable for inhabitation of life. Gradually it became favourable for the existence of living forms. Now a question may arise in your mind as to how life originates in nature. Did plants and animals exist in nature from the very beginning?

There are different theories regarding the origin of life on the Earth. In the beginning of this chapter we have described an old concept of the origin of life But the theory presented by Oparin, a Russian scientist, about the origin of life is still accepted.

According to the theory of Oparin nature was quite hot when life was created Different gases such as ammonia (NH_3), hydrogen (H_2), methane (CH_4) hydrogen cyanine (HCN) etc. were present in the atmosphere. During that period there was heavy rainfall and thunderstorm. Under such environmental condition amino acids were formed by the interaction of various gases and these amino acids are considered by scientists to be the first molecule of life The first cell or life came into being through incorporation of amino acids. It is also believed that life was created first in the primitive aquatic environment.

3. According to the Oparin's theory and established scientific reasons which one of the following is correct if arranged chronologically from origin of life to the recent?

a. Amino acid ⟶ Unicellular Algae ⟶ Bacteria ⟶ Unicellular Amoeba.
b. Amino acid ⟶ Unicellular Amoeba ⟶ Bacteria ⟶ Unicellular Algae.
c. Amino acid ⟶ Bacteria ⟶ Unicellular Algae ⟶ Unicellular Amoeba.
d. Amino acid ⟶ Bacteria ⟶ Unicellular Amoeba ⟶ Unicellular Algae

4. According to the Oparin's theory and established scientific reasons which one of the following animals came into being at the last in the terrestrial environment?

a. Bird
b. Man
c. Buffalo
d. Banyan tree

Creative questions

1. Kalidas became curious about plants and animals when he was studying at Shingua High School. Seeing his curiosity the teachers of that school advised him to study biology when he will be grown up. According to that advise Kalidash studied on Botany in the University. The subjects he studied included both pure and applied branches of Biology. But afterwards he started working on applied branch and invented many high yielding fruits & crops. He is still engaged in this works.

a) What is Biology?

b) Why is physiology called the pure branch of Biology?

c) Explain that why is the works of Kalidash included in the applied branch of Biology.

d) Analyse the importance of pure branch in the success of Kalidash.

The first cell had protoplasm, amino acid and later on DNA molecules are formed by union of amino acid molecules, But the cells did not have any nucleus. This non-nucleated cell successively gave rise to nucleated cell and multicultural organism.

Exercise

Multiple choice questions

1) Why is Gregor Johann Mendel famous for?

a. For Natural Selection theory.
b. For the invention of blood circulation mechanism.
c. For the invention of penicillin.
d. For the law of heredity.

2) Which scientist contributed much for detail description of plants in Bangladesh?

i. Aristotle
ii. Theophrastus
iii. David Prain

Which of the following is correct?

a. i. b. ii.
c. iii. d. ii & iii

Give answer to the question no. 4 and 5 according to the following paragraph.

The theory presented by Oparin about the origin of life in nature is more accepted. According to the theory at the beginning of life amino acids, the first molecule of life were formed by the interaction of various gases. Then the first cell or life came into being through incorporation of amino acids in the aquatic environment. The first cell did not have any nucleus. This non-nucleated cell gave rise to a nucleated cell and successively multicellular organisms.

CHAPTER-TWO
Structure and Nature of Living Cell

Those who have life are living beings. Microorganisms, Plants and Animals have life, so they all are living beings. Living world is composed of microorganisms plants and animals. One or more cells make every living being. Cell is the structural and functional unit of living body. All sorts of reaction and anti- reaction in living body are cell centered. So to know about any living beings one should know about the living cell at first.

All living cells are not alike. As they are, different in structure, they are different in size, shape and functions. Different types of cell are described below in brief.

All the cells of Plants and Animals are eukaryotic but they have differences as well. Difference between Plant cell and Animal cell are shown in a tabular form at the end of this chapter. However the main difference between them is the Plant cells have a non-living cell wall, which is absent in the Animal cells.

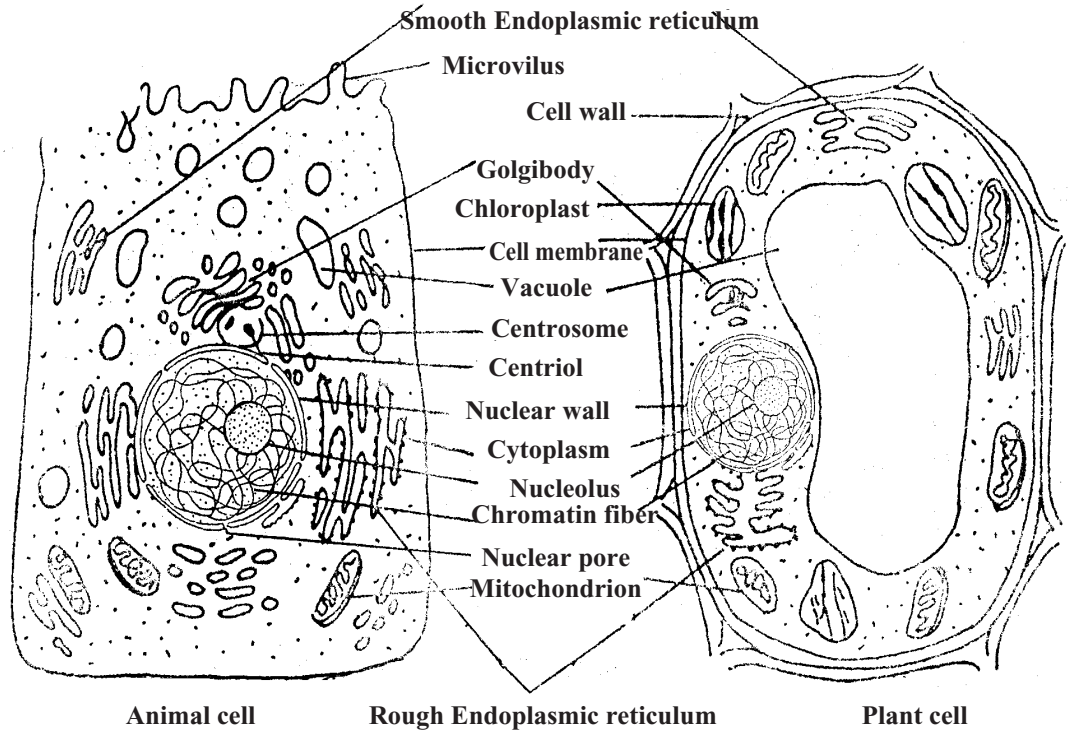


Fig : 2.1 :- Generalised Plant and Animal Cells (Seen under Electron Microscope)

A. On the basis of Nuclear Structure

Prokaryotie cell or Proto cell : Nucleus is not well organized in these cells; nuclear membrane and nucleolus are absent here. In these cells Chromosome contains only DNA. Generally no other organelles are present except Ribosome. Cell division happens here through Amitosis process.

Eukaryotic cell or Eucell : There are well-organised nucleus in these cells with membrane and nucleolus. Chromosome contains DNA, proteins Chloroplasts, Mitochondria and other organelles. Cell division happens through mitosis process.

B. On the basis of Function

Somatic cell : These cells construct the living body but do not take part in reproduction. In the lower group of living objects they are haploid i.e. only one set of chromosomes are present, but in higher groups they are diploid i.e. there are two sets of chromosome in the nucleus.

Reproductive cell: These cells take part in sexual reproduction but do not construct the main body. These cells are also haploid. Sperm and ovum are examples of reproductive cell.

Size, shape and Structure of Living cell :

It is normal to have some diversity in size, shape and structure of cells. The size, shape and structure of a eukaryotic cell (eucell) are described below in brief.

Size : A cell may be 0.1 μ (micron) to 55cm (centimeter) or even more.

[1 Millimeter = 1000 Micron]

Shape: Cells are of different shapes. Mainly they are spherical, oval, rectangular, barrel shaped or polygonal.

Structure of typical cell :

Structurally cells are of various types. For that in a certain cell all the organelles or structural ingredients may not be present. For that reason, considering the presence of all the organelles in a certain cell, it may be termed as a Generalized Cell. A generalized cell has mainly two parts- Cell wall and protoplasm.

Cell Wall:

Cell wall is the unique characteristics of a plant cell. The non-living and hard wall, which constructs the plant cell, is called the cell wall. At first Robert Hook observed it in 1665 AD. There is no cell wall in Animal cells.

Chemical composition of cell wall:

The cell wall is mainly composed of cellulose, hemicellulose, pectose, lignin, suberine etc. Those are made by different carbohydrate compound. The cell wall of fungi is made of a carbohydrate called chitin. The cell wall of bacteria made of protein, lipid and polymer.

Function of cell wall:

The functions of cell wall are to give a definite shape to the cell. It protects the Cell from external injury and gives necessary rigidity and to regulate the flow fluid between external and internal side of the cell.

Protoplasm:

Protoplasm is made by the mixture of different complex compounds. It is jelly like, translucent, viscous, colourless semi solid-living substance. All the pro perties of life are present in it. Protoplasm is divided into three parts: Plasma membrane, Cytoplasm and Nucleus.

1. Plasma membrane or Cell membrane:

Just beneath the cell wall there is a soft living membrane surrounding the whole protoplasm. This is called cytoplasmic membrane or cell membrane.

Stucture:

Plasma membrane is bi-layered. Under electron microscope there revealed a light layer between two dark layers. In the cell membrane of some epithelial cell there found some finger like out growth-these are called **Microvilli (Singular : Microvillus).** They increase the absorption surface of the cell. The membrane between two adjacent cells modified in various forms to make the

Connection between two cells rigid. They also make the movement of different substances between the cells easier. In many cells spaces in the cell membrane may be broader.

Functions of Cell membrane :

(a) Transportaion of different materials inside and outside the cell, (b) Absorption of different substances (mainly nutrients) from outside the cell, (c) protection of the cell body and giving the cell a definite shape.

2. Cytoplasm :

Outside the nucleus, the part of protoplasm, which is surrounded by the cell membrane, is known as cytoplasm. It is composed of different organic and inorganic compounds like water. different nucleic acid and enzymes. The outer area of cytoplasm is more concentrate. less granular and hard, which is called Ectoplasm, and the central area, Which is less concentrated, called Endoplasm.

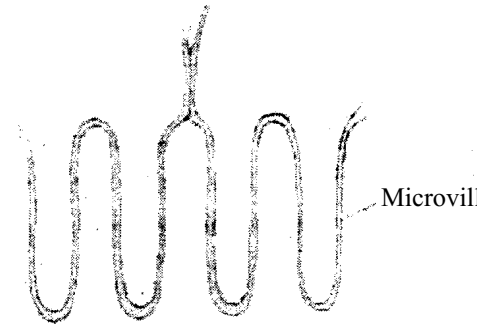


Fig.2.2: - Bi-Layered Cell Membrane

Different organelles like plastids, mitochondria, endoplasmic reticulum, ribosome, golgi bodies, lysosome, centrosome and different nonliving substances are present in the cytoplasm.

Function of Cytoplasm : (a) to hold different organelles and (b) to perform some organic functions.

Description of organelles present in cytoplasm is given below :

Plastid :

Plastids are largest in size among the organelles present in cytoplasm. They can be seen clearly under microscope. Plastids are not present in Fungi, Bacteria and Animal cells.

Plastids are mainly of two types: Leucoplastid or Leucoplast and Chromoplastid or Chromoplast. Leucoplastids are colourless and Chromoplastids are coloured. Chromoplastid again is of two types Chromoplast and Chloroplast.

Leucoplast: They are colourless, as they have no pigment. Leucoplast may be converted into Chromoplast or mainly chloroplast in contact with sunlight. In absence of light the case may be reversed.

Position: Leucoplasts are present in the cells of organs like root. underground stem etc. which do not come in contact with sunlight.

Shape: Leucoplast may be semicircular or tubular in shape

Function: Their function is to store food.

Chromatoplast: Chromatoplasts are green or other colour; when green, it is called **chloroplas**t and when they are other colour it is called **Chromoplast.**

Chromoplast: They are variously coloured, other than green, mostly yellow and red in colour. They are also variable in shape. Chromoplast occurred in coloured part of plants. e.g. petals, coloured fruit and seeds, roots of carrot etc.

Function: Flowers are coloured and beautiful due to their presence.

Chloroplast: They possesses green pigments named chlorophyll in excess as a result they are green. Other pigments are also present to some extent. Every cell may contain one or more chloroplast.

In higher plants the shapes of chloroplast is lenceolate. In Algal cells their shapes are of various types, e.g. cup shaped, spiral, reticulate, star shaped. semicircular etc.

Structure of chloroplast: The following parts make Chloroplast :

1. A bi-layered semipermiable membrane surrounds the whole chloroplast. It is composed of protein and lipid. This is called lipoprotein.
2. A hygroscopic matrix surrounded by a membrane is there. This matrix is called **stroma.**
3. In the stroma, 40-80 well-arranged barrel shaped grana (sing: granum) are present. In one granum there are 5-25 granum disc. Inside

the granum disc, there are spaces. Probably chlorophyll and other photosynthetic materials are present in this chamber.

4. Some granum discs of two adjacent grana are connected by minute tubular bodies, which are called **stroma lamelli.**

5. Many crystalline bodies are arranged in the membrane of grana disc. These are called **quantosome**. In the dark phase of photosynthesis, carbon-di-oxide is assimilated mainly in the quantosome.

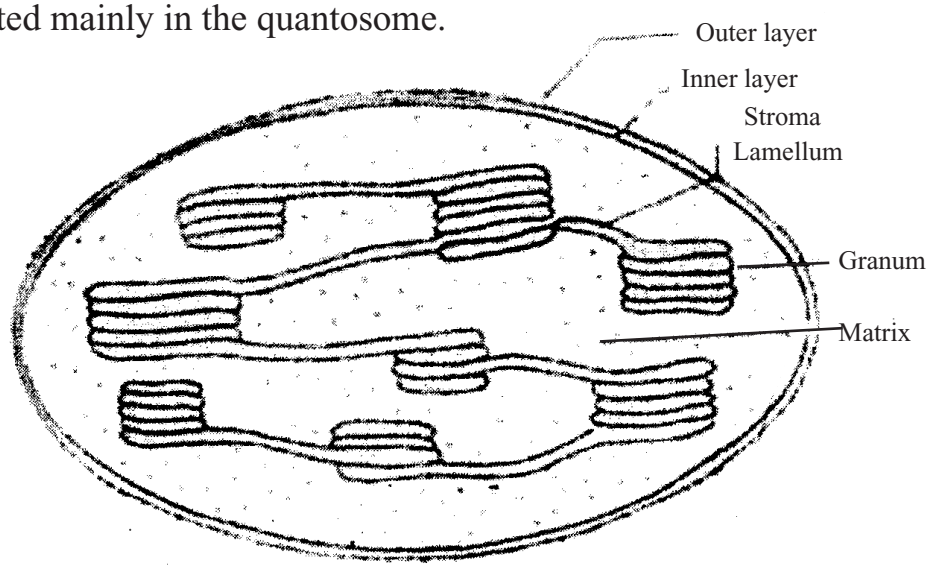


Fig : 2.3 :- Different Parts of Chloroplast (Seen under Electron Microscope and then simplified)

Function: Its function is to prepare carbohydrate food by the process photosynthesis.

Mitochondria: Krebs cycle, fatty acid cycle, electron transport system etc. take place in mitochondria (sing: mitochondrion). All energy producing process occurs in mitochondria for which mitochondria are compared to the powerhouse of the cell. Number of mitochondria may vary according to the species. Normally each cell contains average 300-400 mitochondria. Their shape may be globular, rod, thread, star-shaped or ring-shaped. The outside of mitochondria is surrounded by a bi-layered membrane. The membrane is made by lipoprotein, which is enriched with lipid and protein. The outer membrane is smooth but the inner one has a series of enfolding into the inner cavity of mitochondria. These enfolding are called cristae. Small stalked granular bodies are arranged on the cristae and they are called auxisome. Various enzymes.

Endoplasmic reticulum: ER

In a mature cell a network is found in the cytoplasm. This is called endoplasmic reticulum. Endoplasmic reticulum is of two types - smooth and rough. ER having ribosome on its body is called rough endoplasmic reticulum.

Structure: They are bounded by double-layered semipermiable membrane. Normally they are branched but may occur in parallel. They are continuous with the nuclear membrane and the cell membrane. Chemically the membrane is made by lipoprotein. Small granular bodies may be present on it.

Function: They form the skeleton of protoplasm. Protein synthesis occurs in rough endoplasmic reticulum. Lipid, in alternative opinion, different hormones, glycogens etc. are synthesized in the smooth endoplasmic reticulum. They play the role of internal carrier of lipid and protein.

Ribosome:

Ribosomes are small spherical /granular organelle. They may occur freely in the cytoplasm
and may be attached on the outer wall of endoplasmic reticulum.

Structure: These are spherical and bounded by double layered membrane. Mostly they are made by protein.

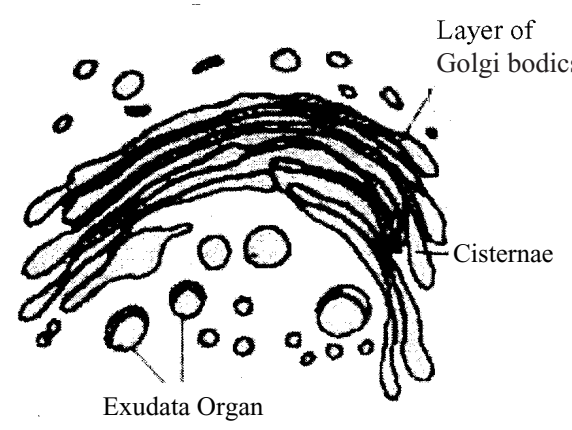


Fig. 2.6 Structure of Golgi bodies

Function: In ribosome various amino acids are combined to synthesize protein.

Golgi bodies/Golgi apparatus:

Golgi bodies may be flat, spherical or elongated. Normally they are present near the nucleus. It was first observed by a scientist named Golgi in 1898 AD in the nerve cells of owl and cat. This organelle is afterward named Golgi apparatus after his name. In plant cells their number is small for which it is not always visible under microscope.

Structure: Golgi apparatus is tubular, small vesicle, vacuolar, elongated vessel like or lamillar bodies. They are vacuolar space bounded by double-layered membrane.

necessary for respiration are well arranged in auxisome. About 70 types of enzymes and 14 types of co-enzymes are present in it. Matrix is also present inside the free space of mitochondria. The main function of mitochondria is to produce energy, like- respiration, oxidative phosphorilation, electron transport system etc.

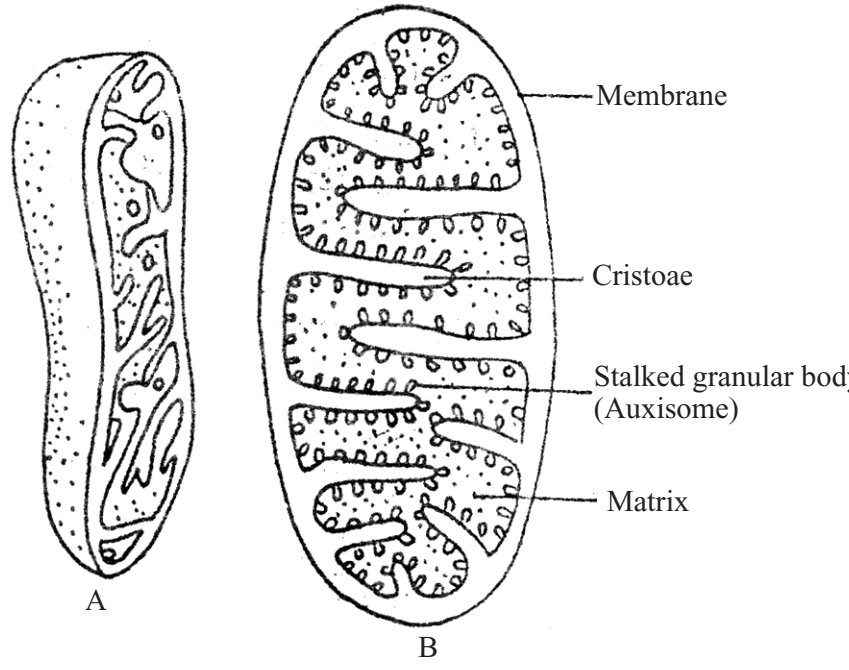


Fig: 2.4 A and B L.S. of a Mitochondrion as seen under electron microscope. (A) Three-dimensional (B) Thin L.S.

Rough Endoplasmic Reticulum **Smooth Endoplasmic Reticulum**

Fig. 2.5 Endoplasmic Reticulum (Simplified)

Function: Function of Golgi bodies are- synthesis of lysosome and non-protein substances, releasing some enzymes, expelling cell water and attaching substances to its membrane produced by endoplasmic reticulum.

Lysosome:

Lysosome is formed by various enzyme bounded by a membrane. Normally they are spherical. Their membrane is bi-layered.

Function: Their functions are phagocytosis i.e. to eat the invading enemy in the cell, to protect different organelles in the cell by dissolving enzymes and to help in digestion.

Centrosome:

In animal cell there is a spherical body outside the nucleus, which is called centrosome. The fluid by which it is composed is called centrosphere. At the center of centrosphere there are two cylindrical objects called centriole. At the time of cell division the pair of centriole is separated and moves to two opposite pole (of the cell).

Function: At the time of cell division centrosome directs the poles of spindle apparatus and help in cell division.

Vacuole:

The open spaces that found in the cytoplasm is the vacuole. In immature cell their number are many and small in size. But in a mature cell all the vacuoles combined together to form a large vacuole. The thin membrane that covers the vacuole is called tonoplast. The internal fluid of the vacuole is called cell sap. Different kind of inorganic salts, organic acid, carbohydrate, protein, fat, various complex substances and various colour are present in the cell sap.

Nucleus:

Denser and clearer organ found in the protoplasm is Nucleus. Robert Brown discovered and named nucleus in 1831 AD in the cell of orchid leaf. Normally each cell contains one nucleus. Some eukaryotic cell like sieve tube, mature red blood cells of mammal do not have nucleus. Usually nucleus is spherical and present at the centre of the cell. They may be present by the side of a large vacuole. Nucleus may smaller or larger in size and shape.

Function : Nucleus controls the total activity of the cell.

Structure: Chemically they are made of nucleic acid and protein. It contains some protein, trace of DNA (Deoxi-ribo nucleic acid) and RNA (Ribo Nucleic Acid), little amount of Co-enzyme and other materials. Physically they are made by the following parts: - Nuclear membrane, Nucleoplasm, Nucleolus and Chromosome

Nuclear membrane: The double layered transparent membrane, which make the outer covering of the nucleus is the nuclear membrane

The outer membrane porous but the inner one is not. Chemically the membrane is made of protein and lipid.

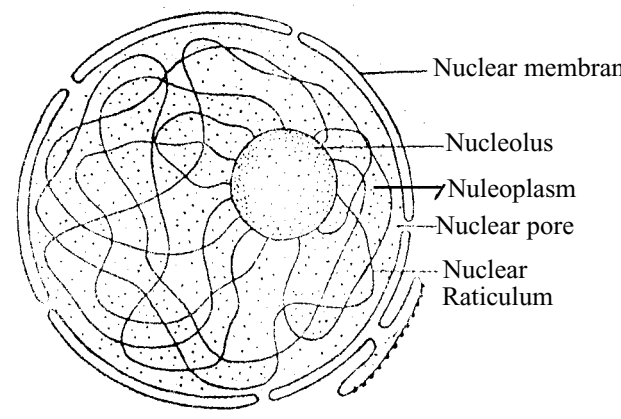


Fig. 2.7 A Nucleus as seen under electron microscope

Function: The main function of this membrane.is to keep the nucleoplasm, chromosome and the nucleus distinct from cytoplasm. Transportation and communication between internal materials and cytoplasm is also done through this membrane.

Nucleoplasm: It is a transparent and dense fluid bounded by nuclear membrane. Nucleolus and chromosomes are present in it.

Function: It holds chromosomes and performs various organic functions.

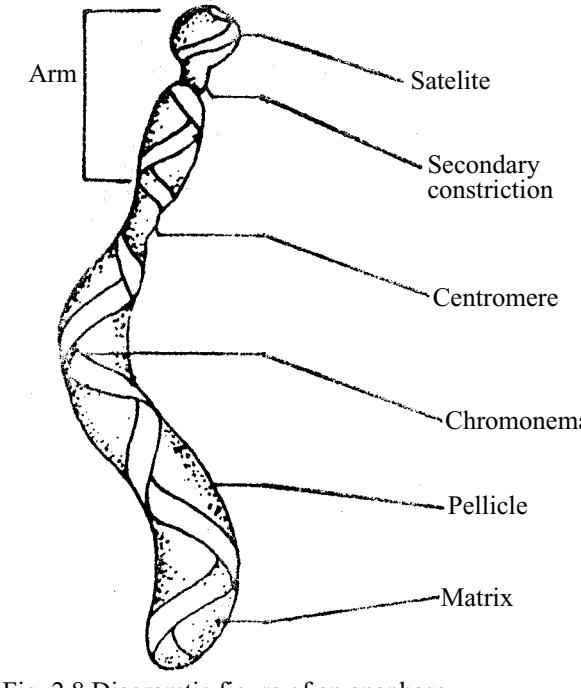


Fig. 2.8 Diagramtic figure of an anaphase chromosome

Nucleolus: The denser, small and round body found in the nucleus is the nucleolus. Every nucleus normally contains a single nucleolus. Nucleolus is usually attached to a certain area of a Particular chromosome. The region of chromosome where it remain attached is called `secondary constriction'.

Chemical composition: The main compositions of the nucleolus are protein, RNA and a trace of DNA.

Physical structure: Nucleolus is usually divided into three parts namely fibrous, granular and matrix.

Function: To synthesise various types of DNA and protein and preserve them.

Chromosome: In every nucleus there is a definite number of chromosomes according to the characteristic of definite species. It can be seen under microscope after proper staining, only in a dividing cell. Every chromosome contains one or more centromere, one chromonema or more chromonemata and some chromosome may have satellite. Chromosome bears a number of gene and genes are responsible for expressing characteristics of different species.

Chemical composition of chromosome: Chemically each chromosome is composed of DNA, RNA, Histon and non-histon protein. Besides, some calcium and magnesium are also present here.

Function: Chromosome is the bearer and carrier of hereditary properties of the organism.

4. Ergastic substances :

In a mature cell, in addition to the above-mentioned substances. there are various types of non-living objects. They are present in the cytoplasm. Non-living objets may be classified into three types, namely reserve food, secretory materials and excretory materials.

Main differences between Plant cell and Animal cell

Plant cell	Animal cell
1. Most plant cells are bounded by a non-living cell wall made of cellulose.	1. No cell wall is present in animal cell.It is surrounded only by plasma membrane.
2. Different types of plastids are present.	2. Plastids are not available here.
3. Usually one or more vacuoles are present.	3. Except some lower group of animals most of the animal cell do not have any vacuole.
4. Normally no centrosome is present in plant cell.	4. Animal cell always bears centrosome
5. Golgi bodies are rarely seen in plant cell under microscope.	5. Golgi bodies are frequently seen here under microscope.
6. In plant cell reserve food is mainly starch.	6. In animal cell reserve food is mainly glycogen.

Exercise

Multiple choice questions

1. In which organ of a plant the Leucoplast is present?

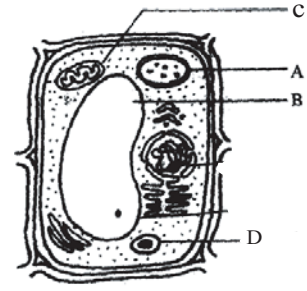
a. Flower b. Stem
c. Root d. Branch

2. The appropriate statement about the nucleus is, itÐ

i. Stays in the middle of the cell
ii. Controls cell devision.
iii. Contains Chromosomes.

Which one of the following is correct?

a. i b. ii
c. i & iii d. ii & iii



Fig

See the above diagram and give answer to the question no. 3 and 4

3. Which one is available in the part labelled C?

a. Centrosome b. Auxisome

c. Quantosome d. Chromosome.

4. In what ways the organ are labelled A help the organism to keep alive?

i. To Produce food

ii. To perform the respiration.

iii. To perform the osmosis

Which one of the following is correct?

a. i b. ii

c. i & ii d. i, ii & iii

Creative questions

1. See the diagram given below & answer the following questions.

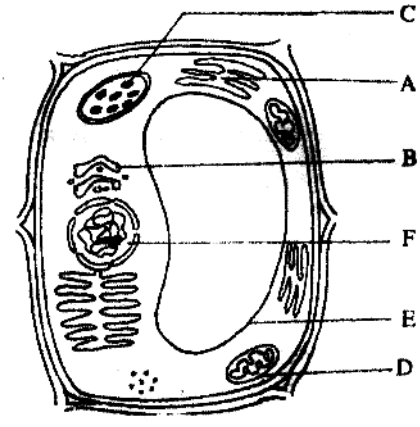


Fig.

a) What is the name of the part labelled D?

b) Write two differences between the labelled A & B.

c) Draw a labelled diagram of the cell showing the position of organelle in absence of organelle labelled E.

d) Analyse the importance of organ labelled C in a living cell.

CHAPTER - THREE

CELL DIVISION

Every living body is composed of cell. Some living bodies are made of only one cell. They are called unicellular organism, e.g. Bacteria, **Amoeba, Plasmodium,** some Fungi and some Algae. Some living bodies are made of more than one cell. These are called multicellular organism. There are many living bodies, which are made of millions of cells. Living bodies like human. beings or mango tree etc. are composed of millions of cells. Unicellular organisms increase their number (multiply) by cell division. In this process one cell divides into two, two to four and so on. In multicellular organisms, a large body consisting of millions of cells develops by cell division from the embryo, which also develops from a single fertilized egg. A young seedling developed to a large tree by cell division. Again new generation is created from male and female gametes formed by cell division. But all these divisions are, not alike. The processes of division are of different types and the results are also different.

Types of cell division:

Cell division is of three types: **(i) Amitosis (ii) Mitosis and (4i) Meiosis.**

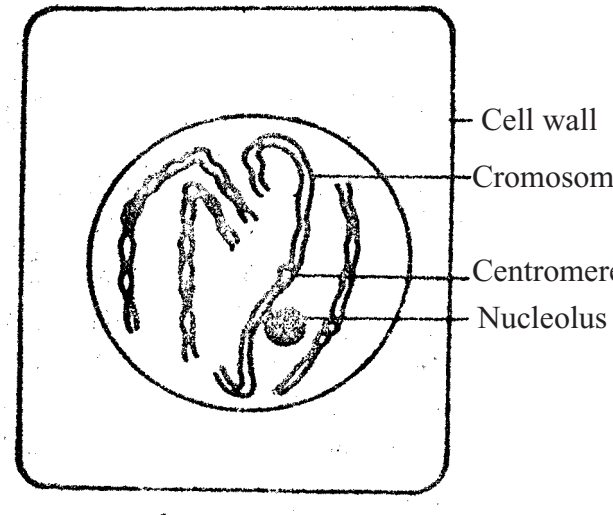
1. **Amitosis:** This type of cell division occurs in unicellular prokaryotic organisms like Bacteria, Yeast etc. In this division, at first the nuclear materials are directly splitted into two portions and then the cell divides into two from the middle region. As a result, from one cell there' develops two.
2. **Mitosis:** Mitosis is a type of cell division by which a eukaryotic cell divides into two by a special method. In this process, the nucleus and chromosome are divided once and the number, structure and properties of chromosome in the newly formed cell remain just alike the mother.

cell. Mitosis is also termed as equational division. Normally this division occurs in somatic cell. As a result of this division, the plant and animal increases in length and breadth. Mitosis occurs in all meristamatic cells of plants.

3 **Meiosis:** Meiosis is a type of cell division by which a Eukaryotic cell divides into four cells by a special method. In this process the nucleus divides twice but the chromosome divides once. The number of chromosome in the newly formed daughter cell reduces to the half the number of mother cell. As the number of chromosome reduces to half this process is also termed as reduction division. In Greek `Meiosis' means `to reduce' and from this the term Meiosis comes in use. This division occurs in reproductive mother cells of diploid organisms. As a result haploid gametes develop. In haploid organisms, this. division occurs in the zygote, as a result of which the organism becomes haploid again.

Stages of Mitosis :

Mitosis is a continuous process. The process is completed by a complex method. According to the sequence and stages, this continuous process is divided into five stages. The stages are: (1)Prophase, (2) Pro-Metaphase, (3) Metaphase, (4) Anaphase and (5) Telophase.



Prophase

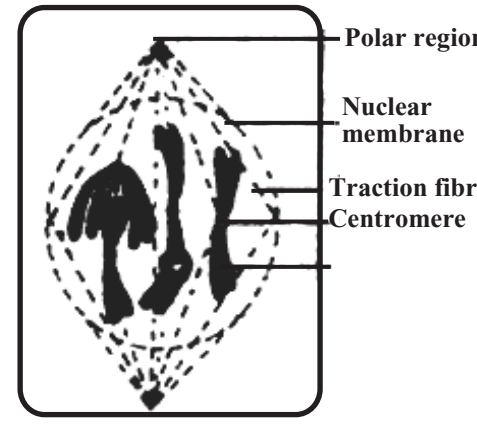
1. Prophase: At this stage, the nucleus swells up. Chromosomes begin to be de-hydrated. As a result, the chromosomes gradually become shorter and thicker.

Then they are visible under microscopes. At the end of this stage nucleolus and nuclear membrane become disappear.

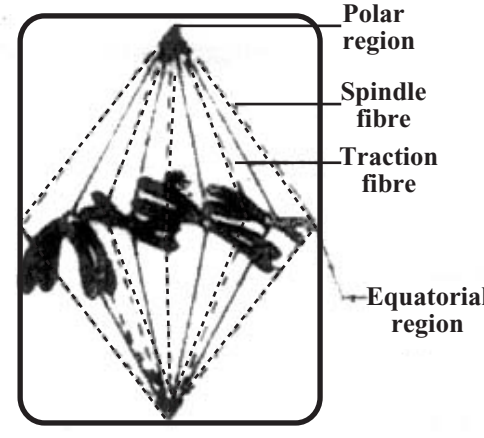
2. Pro-Metaphase : At the beginning of this stage. the fibrous protein converse to form a bi-polar spindle apparatus. Each chromosome is then become attached to a fibre of the spindle apparatus by its centromere. Each fibre of the spindle apparatus is called spindle fibre. The fibre to which the chromosomes are attached is called traction fibre. As they are attached with the chromosomes so they also called chromosomal fibre. In animal cell aster rays are radiated from centrioles present at two poles.

3. Metaphase : Chromosomes are arranged at the equatorial plane of the spindle. The centromere of each chromosome remains at the equatorial plane and the two arms are placed towards two poles. At this stage, the chromosomes become maximum thick and short. Two chromatids of a chromosome become maximum thick and short. Two chromatids of a chromosome become clearly visible and the centromere is divided in to two parts.

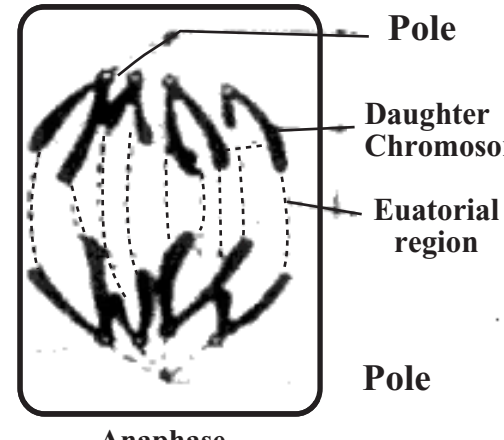
4. Anaphase : Two separate chromatids of a chromosome move towards the opposite pole of the spindle apparatus. Centromere goes ahead at the movement of the chromatids towards the pole and the arms follow them. when the daughter chromosomes reaches near the poles the anaphase stage ends.



Pro-Metaphase

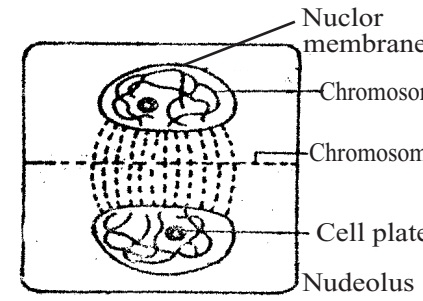


Metaphase



Anaphase

5. Telophase: Daughter chromosomes take position at two opposite poles. Chromosomes gradually take water and become elongated, thin and long. Nuclear membrane develops encircling the chromosomes. Nucleolus reappears at the secondary constriction of the Sat chromosome. Spindle apparatus disappears. At the end of this stage, gradually a cell wall develops at the equatorial region of the cell.



Telophase

As a result, the mother cell divides into two daughter cells. In case of animal cells, instead of formation of cell wall the cell membrane is constricted inwardly and the cell divides into two.

Significance of Mitosis:

The significance of mitosis in the living world is unlimited. Some of them are described here:

1. Growth of the body: Growth of the body of a living being takes place by mitotic division. A unicellular zygote is transformed to a human body consisting of millions of cells. A small zygote forms a large Banyan tree.

2. Maintaining equality of Chromosome number: By this division the number and properties of a chromosome in each cell of a multicellular body remains constant.

3. Keeping the size and shape constant: By this division the definite shape and size of the cell remains constant.

4. Healing of injuries: By producing new cells this process repairs the various types of damage of multicellular organisms.

5. Formation of sex organs: By this process sex organs are formed. As a result, continuity of reproductive sequence is maintained.

6. Qualitative stability: Qualitative stability is maintained by mitosis.

Abnormal cell division :

We are all acquainted with the terms, 'Tumor', 'Cancer', etc. These are the result of abnormal cell division. In mitosis one cell divides into two, two to four and in this way the number of cell increases But there is a regularity in this process. If by any circumstances this regularity is lost, cell divides abnormally. As a result, a tumor is formed.

Cancer cell is also a product of uncontrolled abnormal cell division. It has been found in experiment that various type of Papilloma virus help to produce cancer cell. Two genes named E6 and E7 of this virus (Papilloma) produce some chemicals, which displace two protein molecules responsible for controlling the cell division. As a result, control over cell division is lost and thus a tumor is produced. Sometimes these two genes may be united with-the genes of host cell and stop the action of protein to control the cell division and thus there develop cancer cell or Cancer.

Cancer is a fatal disease. Every year five to six hundred thousand of patients die only because of various forms of cancer. Cancer generates in liver, lunge, brain, breast and skin i.e. almost all the organs of the body. No effective medicine has yet been discovered to prevent this disease.

Male-Female determining chromosome:

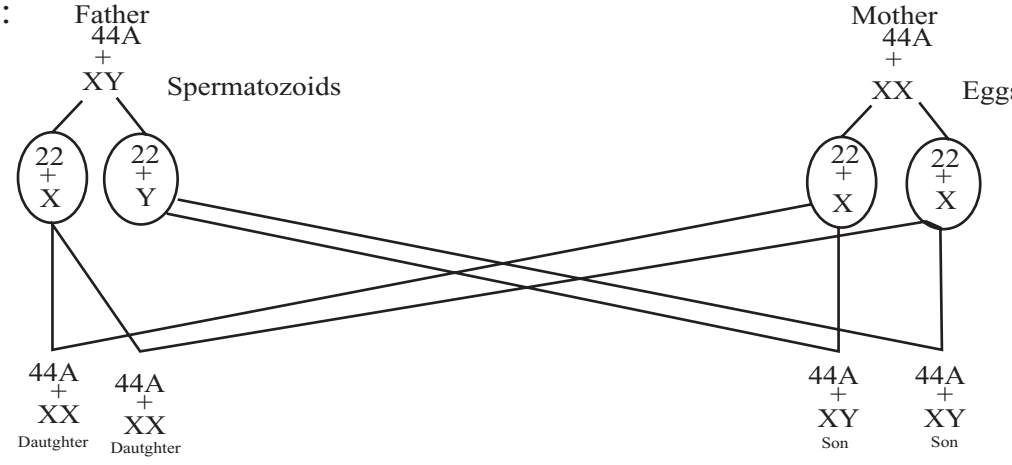
Every living being has a definite number of chromosomes. In human beings there are 23 pairs of chromosome. Among them 22. pairs are similar in both male and female, these are Autosomes, AA. Members of the remaining pair of chromosome are different in male and female. This pair of chromosome determines the sex of human beings. As they determine the sex, so they are called X and y sex chromosome or sex determining chromosome. One of the sex chromosomes is X chromosome and the other is Y chromosome. If the sex chromosome pair is XY, the child will be male (son), and if it is XX, the child will be female (daughter). In Drosophylla (a fly) also XX indicate female and

XY male. So in case of determining the sex, the role of X and Y chromosome is vital.

Whether the child will be a son or daughter:

Now we will discuss whether the father or mother is responsible for the birth of a son or daughter. Both male and female have 44 autosomes, A and a pair of sex chromosome. Sex chromosome of a female is XX and that of the male is XY. The male gamete (sperm) bears X and Y chromosome. But the female gamete (egg) bears X and X. If the X bearing egg of the female is united (fertilize) with Y bearing sperm of the male, the child will have XY. A child having such chromosomes will be a male child. It is seen that if there is no Y chromosome, the child will never be a son. There is no Y chromosome in a female; Y chromosome is present only in male. So if a couple do not have any male child, the husband is responsible not the wife. A figure on this issue

shows:



The role of sex chromosome in determining sex of the child (i.e. whether the child will be a son or a daughter) is known to you. Now work with this grid. Write which child will be a son and which one a daughter.

♀ Mother / ♂ Father	X	Y	X	Y
X	XX Daughter			X Y Son
X				
X				
X				

Exercise

Multiple choic Questions

1. In which stage the nucleus enlarges in size?

a. Prophase b. Metaphase

c. Anaphase d. Telophase

2. By the Process of Mitosis living organisms generally-

i. Ensure the distribution of equal number of chromosomes.

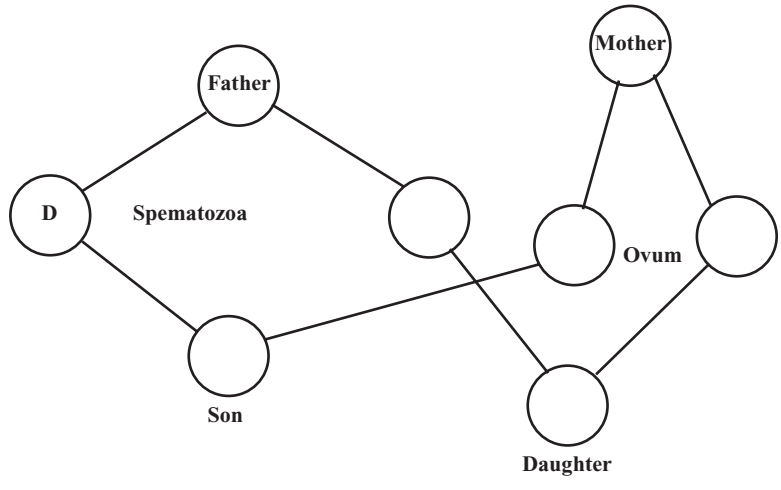
ii. Ensure the equality of properties.

iii. Produced haploid gamete.

Which one of the following is correct?

a. i & ii b. i & iii

c. ii & iii c. i, ii & iii



Answer the question no 3 and 4 on the basis of the above diagram.

3. What is the position of father's or mother's chromosomes in the diagram?

a. Haploid b. Diploid

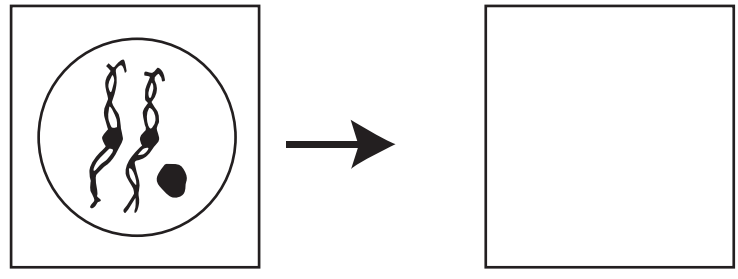
c. Triploid d. Tetraploid

4. What type of sex chromosomes will be in the gamete D & daughter H?

	D	**H**
a.	X	XY
b.	X	XX
c.	Y	XX
d.	Y	XY

Creative questions

Various type of cell division are seen in all cases starting from prokaryotic organism to multicellular organism. Someone of these increases the body shape, some one create germ cells and someone increases the number by the process of binary fission. Diagram of 1st stage of one type of cell division is given below.



a. In which process of cell division prokaryotic organisms generally multiplied

b. Explain the process of cell division of plant root.

c. Draw a labelled diagram of the stage 2 and describe one characteristic.

d. Analyse with example what will be the probable consequence is the process of division of stage no. 2 is not under control in a living organism.

CHAPTER-FOUR
Division Of Labour In Multicellular Plants : Tissue and Tissue System

Tissue :

In unicellular organisms a single cell does all the functions. There is no chance of division of labour on the basis of cell. In contrast, this kind of division is found in multicellular living body. In this case, it is observed that a group of cells performs the duty of manufacturing food; another group stores it, while the other group conducts the transport of food materials. There is further a group of cells that gives mechanical strenght to some organs. In many cases it is observed that a group of cells originating from a single origin remain closely attached in a place and collectively perform a similar type of function. This type of cells in a group is called tissue. In multicellular organisms division of labour is the main cause of formation of tissue.

Types of Tissue :

Cells of all tissues do not have the power of cell division but some of them have. Therefore tissues are of two types in terms of the power of cell division :

1. Meristamatic tissue &
2. Permanent tissue

1. Meristamatic tissue : Meristamatic cells compose the Meristamatic tissue. The cells of this tissue divide repeatedly. These tissues are found in the tress. Due to their presence plants increase in size very rapidly. Other permanent tissues are originated from Meristamatic tissue.

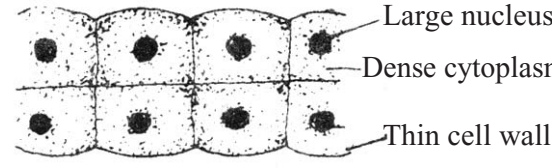


Fig. 4.1 Meristamatic Tissue

Characrteristics of Meristamatic tissues :

Characrteristics of Meristamatic tissues are as follows :

1. Cells possess the power of cell division.
2. Usually the cells are rectangular of oval.
3. Cell wall is made of cellulose and is thin.
4. Nucleus is large and the cytoplasm is denser.
5. Usually no vacuole is seen in the cell.
6. Usually there is no intercellular space in Meristamatic tissue, so the cells are arranged compactly.

Meristamatic tissues are present at the apex of roots and stems. According to their position they are **Apical meristems** and accroding to their origin they are **Primary meristems,** because they are originated from the embryonic stage. Stem and root increase in length by the division of cells of these tissues.

In the roots and stems of gymnosperms and dicotyledonous plants there develops a new Meristamatic tissue, they are called 'Secondary meristems. According to their position they are **Secondary meristems.** Due to the cell division of these tissues the breath of the root and stem increase i.e. the root and stem gradually become broader in breath

2. Permanent tissue:

Cells of permanent tissues are not capable of cell division, for which they are called **Permanent tissue.** They are originated from Meristamatic tissues. All tissues other than the Meristamatic ones are permanent tissues.

Characteristics of Permanent tissue:

1. Cells of these tissues have no power of division.
2. Cells are well developed and properly shaped.
3. Cell wall is comparatively thick.
4. Nucleus of the cells are bigger and cytoplasm is dense.
5. Usually there are vacuoles in the cell.
6. There may have intercellular spaces in between cells.

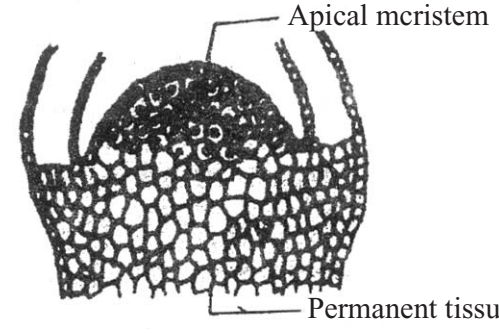


Fig. 4.2 Apical Meristamatic tissue of st

Types of permanent tissue : Permanent tissues are of three types, namely -

(a) Simple tissue, (b) Complex tissue and (c) Secretory tissue .

(a) Simple tissue: Tissues of same kinds compose simple tissue. Simple tissues are of three types, namely

Parenchyma: Characteristics of parenchyma tissue are as follows:

* Cells are almost uniform in length, breath and depth.
* Cells are round, oval or polygonal in shape.
* Cell wallls are evenly thick.
* Cells are living and contain sufficient protoplasm.
* There may have intercellular spaces between adjacent cells.

Permanent - tissues that Thin cell wall contain chlorophyll are called **Chlorenchyma.** The chlorenchyma of leaf IS called **Messophyll.**

Parenchymatous tissues with large air spaces In aquatic plants are **Aerenchyma.**

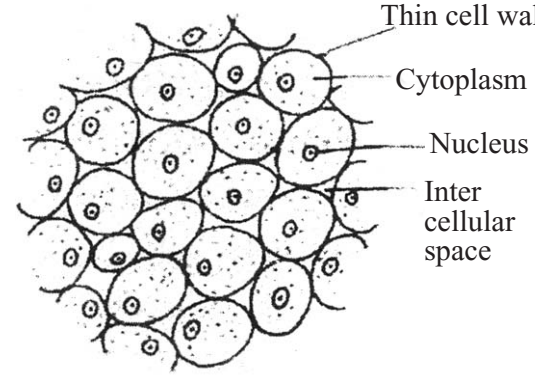


Fig. 4.3 Parenchyma Tissue

Functions:

q Chlorenchyma manufactures food materials.
q They store reserve food.
q They help ,in transporting the food materials.

Parenchyma in the epidermis act as a defensive organ.

Position: Usually pith, pith rays, epidermis and most of the cortex are made of this tissue.

Collenchyma: Characteristics of collenchyma tissues are as follows:

q Cells are to some extent elongated. '
q Cells are living with protoplasm.
q Cell wall is unevenly thick, thickness is greater at eorners of the cells.
q There may have intercellular spaces between adjacent cells

Functions:

q Cells with chlorophyll manufacture food.

q It gives mechanical strength ' to the growmg organ.

Position: It is found under the epidermis, in the petioles and veins of leaves and in the flower stalks.

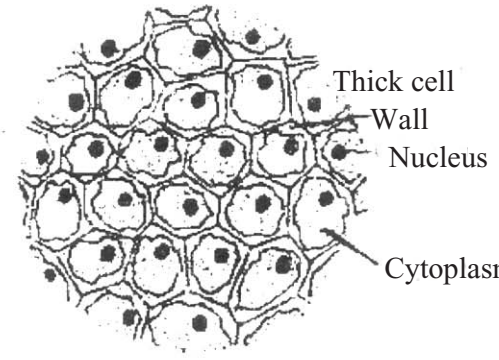


Fig. 4.4 Collenchyma Tissue

Sclerenchyma: Characteristics of Sclerenchyma are as follows:

q Cells elongateq and the ends are pointed.

q Cell walls being lignified become thick and the thickness is uniform. Mature cells are dead and without nucleus and protoplasm.

q In transverse section they are polygonal.

Functions:

q To give mechanical strength to different organs of the plant is the main function.

q Some dead cell may store excretory substances of plants.

q Sometimes it forms hard outer wall to protect the inner soft portion, e.g. seeds of coconut and date-palm

Position : They are present in cortex, phloem and pericycle.

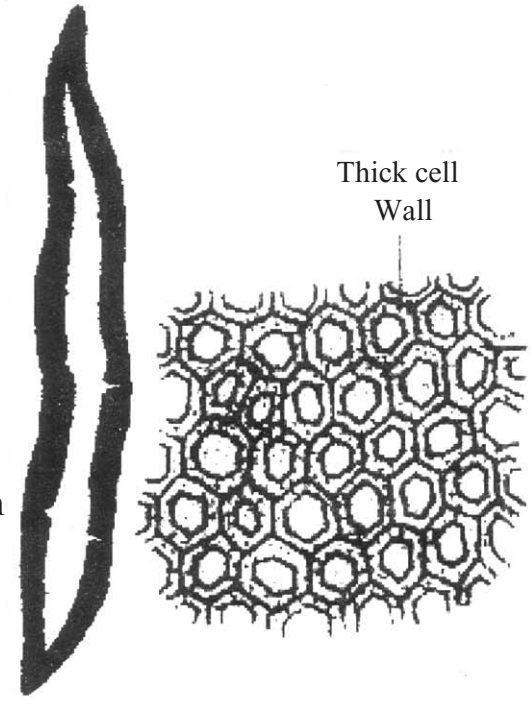


Fig. 4.5 Sclerenchyma Tissue

(b) Complex tissue: Complex tissue is composed of more than one kind of cells. They are two types, namely **Xylem** tissue and **Phloem** tissue.

Xylem tissue: Xylem tissue consists of four types of cells, namely: Tracheids, Vessels or Trachaea, Xylem fibre and Xylem Parenchyma.

q **Tracheids:** Cells are dead, long with transverse ends, containing large vacuole. Cell walls are hard, strong. and lignified. Their main functions are to gIve mechanical strength and to supply water and dissolved minerals from root to the leaves.

q **Vessels or Trachaea:** Cells are broad and short, placed end to end to form a continuous hollow tube. Water and waterdissolved minerals are conducted from root to leaf by these cells.

q**Xylem fibre:** These are sclerenchymatous cells. Their main function is to give mechanical strength to the plant.

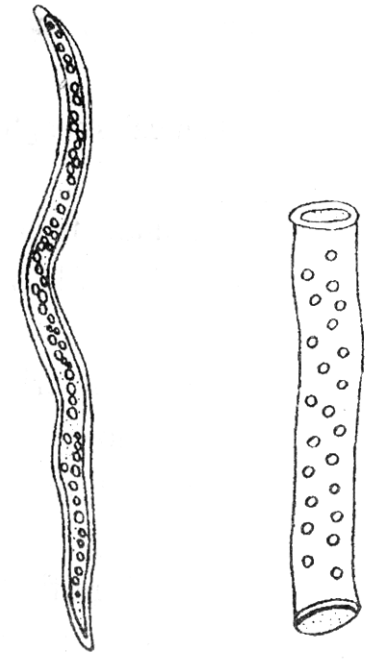


Fig. 4.6 Xylem Tissue

Xylem parenchyma: These are parenchymatous .
cells. Functions of these cells are storage and conduction of food materials.

Functions of xylem tissue: Their functions are to give mechanical strength to the plant body, conduction of water, minerals and food materials and storage of food.

Phloem tissue: Phloem tissue consists of four types of cells, namely: sieve tubes, companion cells, phloem fibres and phloem parenchyma.

Sieve tube: These are elongate hollow cells placed end-to-end forming.

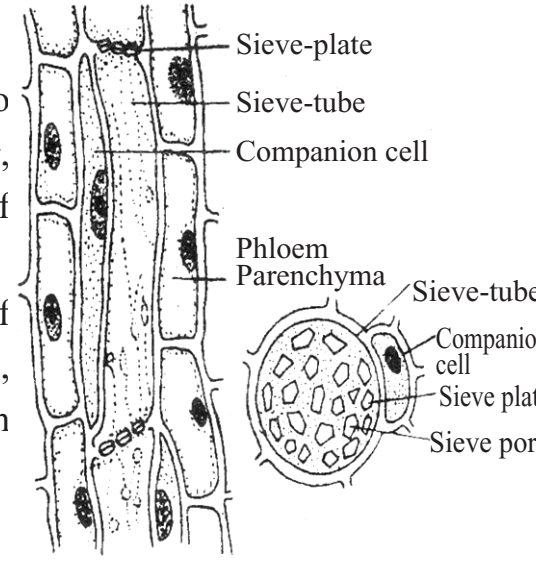


Fig. 4.7 Phloem Tissue

a long tube. The partition walls between two adjacent sieve cells are perforated and known as sieve plate. In m4;iture sieve tube there is. no nucleus in the cell. Conduction of food, prepared in the leaves is its main function.

q **Companion cells:** These are parenchymatous, narrow, elongated cells, and are closely associated with the sieve tube. They have dense cytoplasm and a large nucleus. Conduction with the sieve tube is done through the pores present on the walls of these cells. They help the sieve tubes in conduction of food materials.

Phloem fibre: These are Sclerenchymatous cells. They are also known as bast fibre. Its function is to give mechanical strength.

q **Phloem parenchyma:** These are parenchymatous cells. They help in storage and conduction of food materials.

Function of Phloem tissue:

q There main function is to conduct food materials, prepared in the leaves, to different parts of the plant.

q They give mechanical strength to plant organ.

q In case of necessity they store food materials.

Importance of Complex tissues:

In respect of physiological and economic aspects, complex tissues are of great importance.

Physiological importance:

Complex tissues perform the duty of conduction of raw food materials to leaves and prepared food materials to all the living cells.

q Beside preparation of food, water is necessary for various reactions. This water is conducted from root to stem through the complex tissue named xylem.

q Through xylem tissue dissolved minerals along with water also passes upwardly.

q Water used in transpiration also moves to leaf through xylem tissue.

Economic importance

q The most important economic crop in Bangladesh is jute fiber. Jute fiber is the secondary phloem or bast fiber.

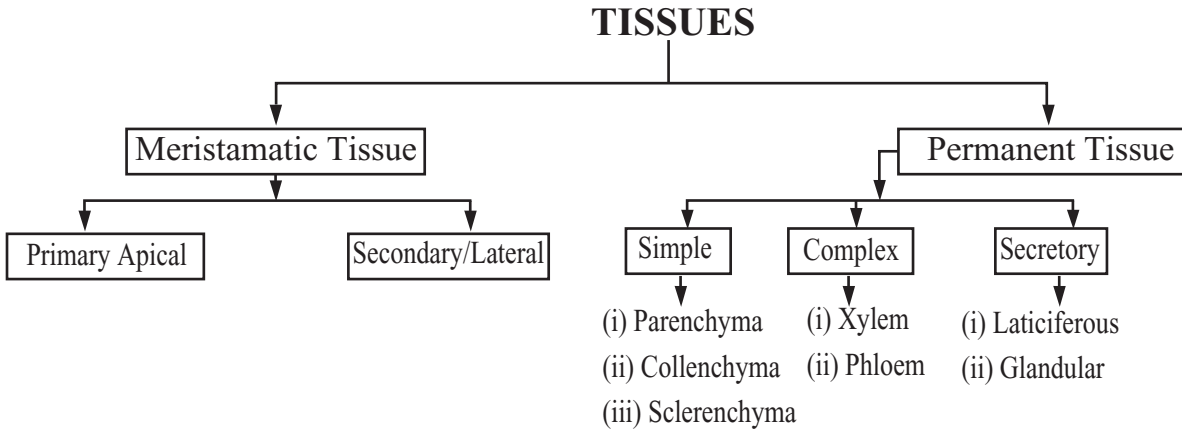
q The wood we use, in the construction of houses, in making furniture, boat or musical instruments or as fuel, is the secondary xylem.

(c) Secretory tissue: Secretoy tissues are those tissues, which secrets various liquids, Resins, gums, rubber etc. are collected from secretory tissues. They are of two types: .

Laticiferous tissues and Glandular tissues.

Laticiferous tissue: Latex is a white, yellow or colourless liquid Carbohydrates, protein, gums, and fats etc. are mixed in **Latex,** Latex is found in various plants like;- Musa **(KALA)** Ficus **(BOT),** Hevea **(RUBBER),** Papiver **(OPIUM),** Calotropis **(AKONDO),** Alstonia **(CHHATIM),** Argement **(SHIALKATA).**

Glandular tissue: Honey, Enzymes, Gums, Resins, Oils etc. are usually found in the glandular tissues :



Tissue System

When one or more kinds of tissues are united and together perform a similar function, then it is known as tissue system. They are classified into three types namely: i) **Epidermal Tissue System, ii) Ground Tissue System and iii) Vascular Tissue System.**

i) Epidermal Tissue System: - This tissue system makes the outer cover of plant organs like, roots stems, branches, leaves, fruits. etc. Typically it consists of a closely arranged single layer of parenchymatous cells. There may have unicellular or multicellular hairs.

Functions: To give protection to the internal portion of the plant organ.

ii) Ground Tissue System :

Theses are the main bulk of tissues of roots and stems. The ground tissue is differentiated into outer **cortical** region and inner medulla or **pith** region. In dicot stem the cortical region is ususlly subdivided into three zones namely:-

(a) Hypodermis, (b) General, Cortex and (c) Endodermis, Medulla and Medullary Rays encircled by, the **Pericycle** form the central Pith.

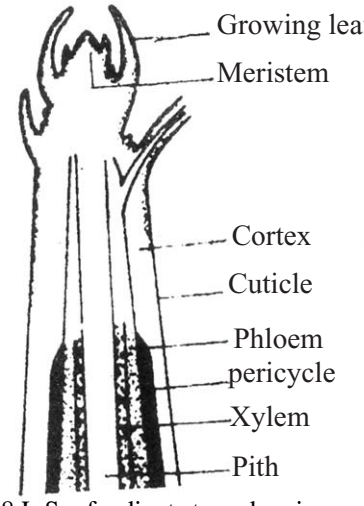


Fig. 4.8 L.S. of a dicot stem showing different tissue system

Functions : Functions of this tissue system are to give mechanical stregth to the stem and to store food materials.

iii) Vascular Tissue System:- Vascular tissue system comprises of two complex tixssue, namely; **Xylem** and **phloem,** These tissues are embedded in the ground tissues. In dicotyledonous stems xylem and phloem lie side by side on the same radius and between them there is a kind of **Meristamatic** tissue named **Cambium.** Phloem tissue lies towards the periphery and xylem toward center of the stem.

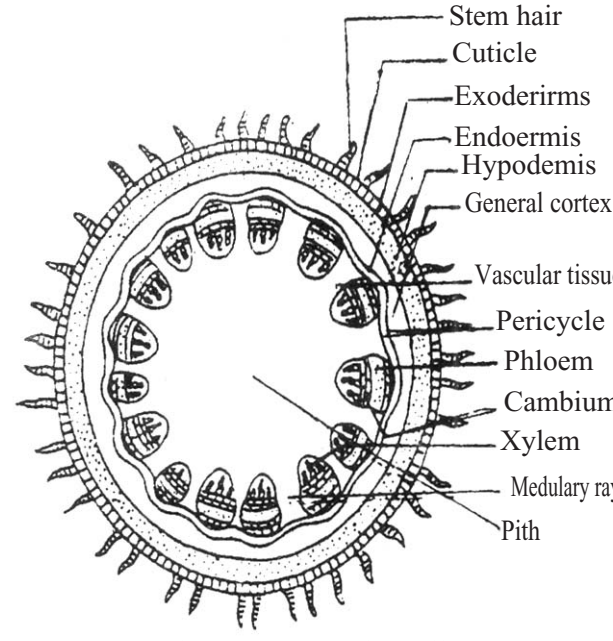


Fig. 4.9 T.S. of dicot stem showing different tissue system

Arrangement of different tissue system of a dicot stem is shown In longitudinal (I.S.) and transverse section (T.S) [Gig: -4.8 & 4.9]

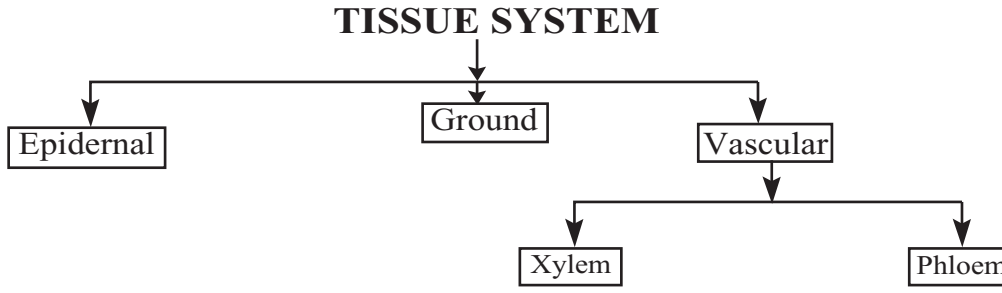
Function

Conduction of water and dissolved food materials.

Conduction of prepared food.

Give mechanical strength to the stem, and

Storage of food where necessary.



Exercise

Multiple choice questions

1. Which one has Aerenchyma?

a. in Murtha grass b. in Lily

c. in Bamboo d. In Guava

2. In case of permanent tissue-

i. The cell wall is comparatively thick

ii. The cell has vacuole

iii. The cytoplasm of the cell is thick.

Which one of the following is correct?

a. i b. ii

c. i & ii d. i, ii & iii

Give answer to the question no 3 & 4 on the basis of the following diagram.

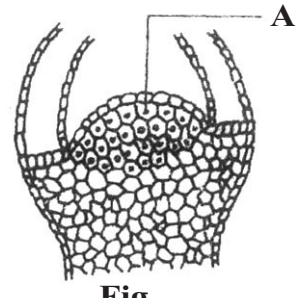


Fig.

3. In the diagram what is part labelled A?

a. Permanent tissue b. Meristamatic tissue

c. Xylem tissue d. Phloem tissue

2. For the part labelled A in the diagram the plant-

a. stem increases in girth b. stem increases in length

c. root increases in girth d. root increases in length.

Creative Questions

Bacteria, Amoeba and other living beings do not have tissues but Man, Mangoes, Berry etc. have tissues. The tissues are again of two types: Meristematic tissue and Permanent tissue. A part of the transverse section of stem of Dicot plant is shown below.

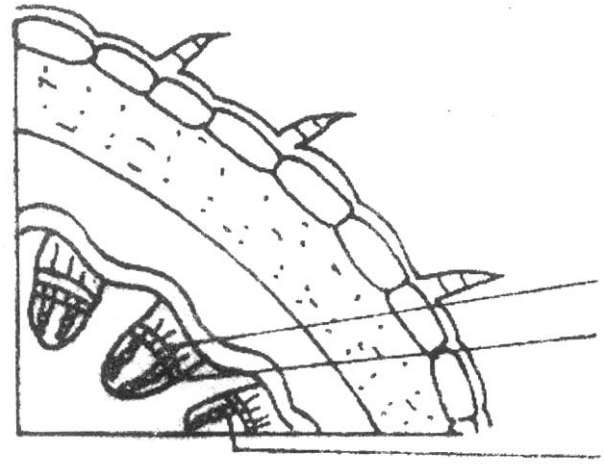


Fig.

a. What is meristamatic tissue?

b. Why bacteria do not have tissues explain.

3. Explain the function of the part B after drawing its labelled diagram.

4. Analyse the cause of creation of above B & C tissues in a mango tree.

CHAPTER-FIVE

ANIMAL TISSUE, ORGAN AND ORGAN SYSTEM

There is only one cell in the body of the animals of the phylum Protozoa. Animals of the Phylum Porifera are simplest multi-cellular animals. Their cells do not form actual tissue. Though tissues, organs and systems are not formed in members of the phylum Cnidaria (previously known as Coelenterata), their body cells are, however, arranged in two layers.

In the animals from phylum Platyhelminthes to Chordata, tissues, organs and organ systems are seen. Members of those phyla are three layered. From there three embryonic cell layers (namely ectoderm, mesoderm and endoderm), tissues, organs and systems are formed.

Tissue: In the body of multi-cellular animals some cells remain together and performa particular function. These cells are either formed from the ectoderm, mesoderm or endoderm of the embryo and remain close together. Inter-cellular materials or matrix are present between these cells. These cells may be similar or of different types. Arising from the embryonic cell layer when certain types of cells when remain in a particular place of the animals' body and collectively perform a common function, those cells and the inter-cellular materials or matrix secreted by them are collectively called the **Tissue.** That is to say, cells of a particular tissue are similar in its, origin, function and structure. The subject in which the different types of tissue are discussed is called **Histology.**

Differences between Tissue and Cell:

A. Tissue: Originating from a same place when more than one cell with similar structure and function performs a common function, then those groups of cells are called Tissue. For example, blood is a kind 'of fluid connective tissue. In the liquid matrix or plasma of blood there are red corpuscles, white corpuscles and platelets. Blood is developed from the mesoderm of the embryo.

B. Cell: Cell is the structural and functional unit of tissue. For example, Red blood corpuscles (Erythrocytes), White blood corpuscles (Leucocytes) and Platelets (Thrombocytes) are various types of blood cells. Of these the red