Chapter-6

Structure of Living Organism

6. 1 Basis of Life - Cell

The body of living organisms is made up of cells. All the activities taking place in the body of organisms take place through cells. It is obvious that the body of each organism is made up of small units known as **cells**. Thus, cell is the chief structural and functional unit of organisms.

A British scientist **Robert Hooke**, in 1665 AD, observed thin sections of cork with a microscope. He saw empty spaces or cavities and named them **cell.** Actually, the cells observed by Hooke were dead cells. In 1674, Van Leeuwenhock improved the microscope and observed living cells. The branch of science concerned with the structure and function of cell is known as **Cytology**.

Unicellular organism, is an organism whose body is made up of only one cell. For example: Amoeba, Chlamydomonas etc. Organisms whose body is made up of more than one cell are known as **Multicellular organisms**.

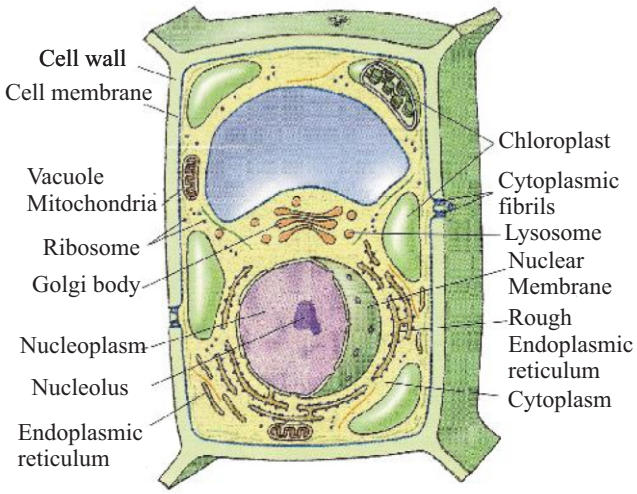

Fig. 6.1 Plant cell

All the biological processes, like, nutrition, respiration, excretion, growth and reproduction, are carried out by the single cell in a unicellular organism. In multicellular organisms, different type of cell groups are found for different functions. The cell aggregates (groups) are termed as **tissue**.

Majority of cells are minute and can be observed with microscopes only. Their average diameter is 0.5 to 20 microns. Some of the cells are very big for example the egg of an Ostrich which may range in size from 100 to 150 cm in diameter. The shape of cells vary according to the function they perform in the cells.

6.2 Cell theory and its exceptions :

On the basis of discoveries made in 19th century, scientists inferred that the body of all plants and animals is made up of cells. These cells are responsible for all the biological processes and biological characteristics. On this basis, Zoologist **Theodor Schwann** and Botanist **Mathias Schleiden** propounded the **cell theory** in the year 1838-39. According to this theory

1. The body of each living organism is made up of one or many cells.
2. The cell is the basic unit of life. All the life processes of a living being takes place in a cell.
3. The cell is the unit of heredity because hereditary material is present in its nucleus.
4. New cells are formed from the pre-existing cells.

On the basis of modern discoveries the cell theory does not appear to be logical at many points. For example, the virus do not have a cellular structure; all the organisms are not made up of cells and a prominent nucleus is not present in all the cells. In bacteria and blue-green algae a well defined nuclear membrane is not present around the nuclear material, which remains dispersed in the cytoplasm.

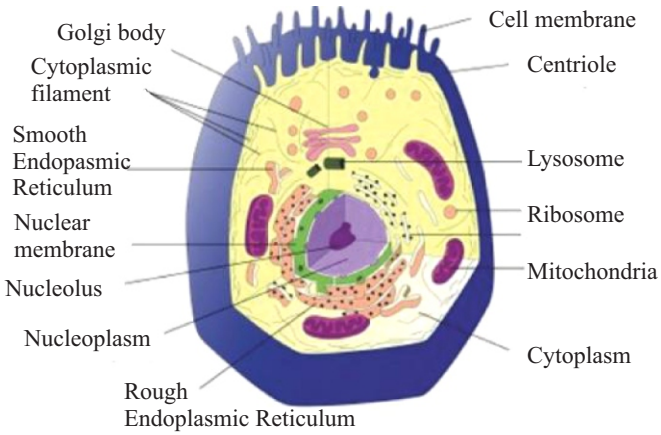

Fig. 6.2 Animal cell

6.3 Structure of a cell :

Microscopic studies have revealed that a typical eukaryotic cell has the following components :

1. Cell Membrane
2. Cytoplasm
3. Nucleus

6.3.1 Cell Membrane :

Cell Membrane is the outermost, living cover of the cytoplasm which separates the cell from the outer environment. Its thickness ranges from 75-105Aº, in different types of cells. It is a three layered cover made up of protein and phospholipid molecules.

Cell membrane controls the substances that enter or leave the cell. It permits the passage of some substances while prevents the movement of other substances. Hence it is referred to as **selectively permeable membrane**. Apart from this, cell membrane provides a definite shape to the animal cell and protects the cytoplasm.

In plant cells a non-living coat is present around the cell membrane. It is known as the **cell wall**. Cell wall is made up of cellulose, hemi cellulose, pectin and polysaccharides. The animal and plant cells are differentiated on the basis of the presence of cell wall. Cell wall gives the plant cell a definite shape and extra protection. Cell wall is absent in an animal cell.

6.3.2 Cytoplasm : The substance present in between the cell membrane and the cytoplasm, in a cell, is known as the cytoplasm. Cytoplasm is a fluid containing living structures (organelles) and non-living structures. Water, glycogen, fats and other substances are found in the fluid. The organelles present in the cell are :

1. **Mitochondria :** Mitochondria are present only in the eukaryotic cells and are absent in the prokaryotic cells. Mitochondria is also known as the '**power house**' of the cell because it produces the energy required by the cell. Their number is different in different cells of the same organism. The number of mitochondria is more in the cells whose energy requirement is more. Mitochondria was observed in 1880 by Kolliker. It was named as 'Mitochondria' by Benda.

   Mitochondria has a double-membrane. The outer membrane is smooth and flat and the inner membrane is projected in the cavity in the form of **cristae**. There are numerous stalked particles on the surface of the cristae. These particles are known as **oxysomes**. The region inner to the cristae is known as the **matrix**.

   Matrix is made up of 65-70% protein, 25% phospholipid and 0.5% RNA. Mitochondria also has DNA and ribosomes in it. The enzymes present in the mitochondria are responsible for the oxidation of nutrient substances during respiration.

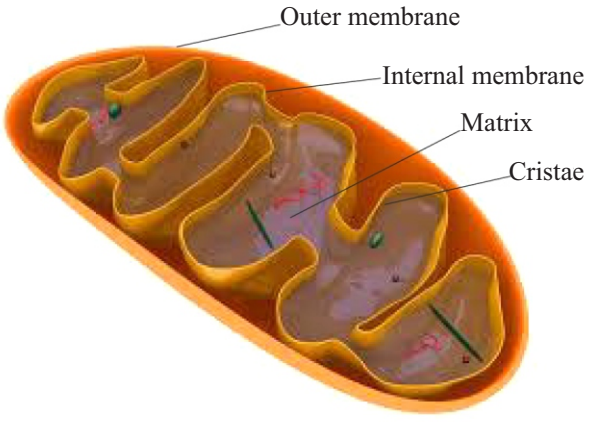

Fig. 6.3 : Mitochondria

2. **Plastids :** Plastids are present in the plant cells. Plastids appear to be of

different colour because of the presence of various pigments in it. Plastids are of different types on the basis of the different pgments present in them. For example : Chloroplast, Chromoplast and leucoplast. Chloroplast is the organelle of the cell in which carbohydrates are synthesised by the process of photosynthesis. Chloroplast is a double membrane bound organelle which are known as the outer membrane and the inner membrane. The space surrounded by inner membrane is known as the **stroma**. There is a complex membranous system in the stroma which is termed as the **thylakoid**. Thylakoid is arranged in two ways : The plate-like thylakoids are arranged like a stack of coins, known as **grana** and the thylakoids connecting two granum are known as **intergranum** (Grana-singular; Granum-plural).

The enzymes related to photosynthesis are present in the thylakoid membrane and the stroma. Even DNA and ribosomes are present in the stroma.

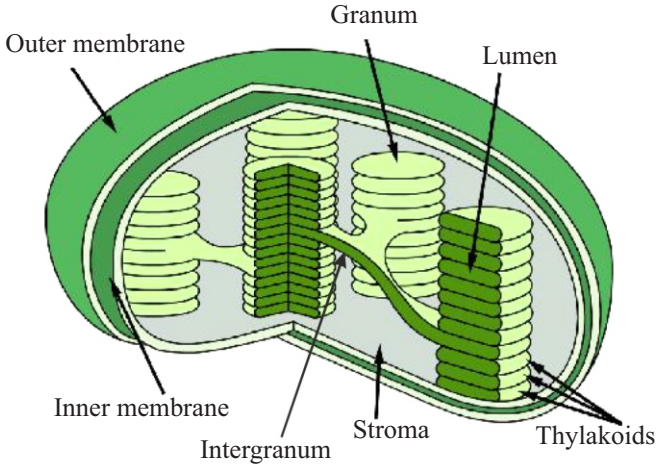

Fig. 6.4 Chloroplast

3. **Lysosome :** Lysosome was discovered by de Duve. Lysosome is a single membrane bound, sac like organelle. It is filled with granular fluid containing many hydrolytic enzymes, which break down sugar, fat, protein, nucleic acid etc. into simple molecules. Lysosomes are responsible for the breakdown of dead cell-organelles and cells. The enzymes present in it digests the entire cell once the membrane of the lysosome ruptures, therefore they are also known as the suicidal **bags**.
4. **Endoplasmic Reticulum :** The network of microtubules present between the nucleus and the cell-membrane is known as the endoplasmic reticulum. This also is a single membrane- bound structure. Ribosomes are present on the surface of **Rough Endoplasmic Reticulum** (RER) and are responsible for protein synthesis. The surface of the **Smooth Endoplasmic Reticulum** (SER) lacks ribosomes and it synthesises fat and lipid molecules.

   Endoplasmic reticulum transport substances between different parts of the cell and also between cytoplasm and the nucleus. It is also responsible for the formation of Golgi bodies.

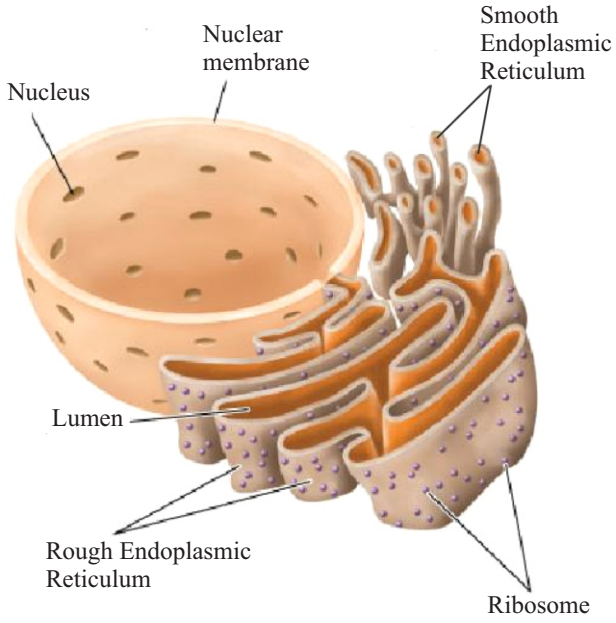

Fig 6.5 Endoplasmic Reticulum

5. **Ribosome :** Ribosome was discovered by Claude and was named as 'ribosome' by Palade. Ribosomes are present

independently in the cytoplasm and attached to the outer surface of the rough endoplasmic reticulum in the form of particles. Ribosomes are membrane less organelles i.e. they are not enclosed by membrane. They are made up of RNA and proteins. In eukaryotic cells the ribosomes are of 80S type while they are of 70S type in the prokaryotic cells. They are the sites of protein synthesis in the cell.

6. **Golgi body :** It was discovered by Camillo Golgi in 1898. It is present near the nucleus of the cell in the form of flattened tubes. It is made up of three type of structures : Vesicles, cisternae and vacuoles (sacs). It plays a major role in the synthesis and secretion of sugar, protein and pectin in the cell.

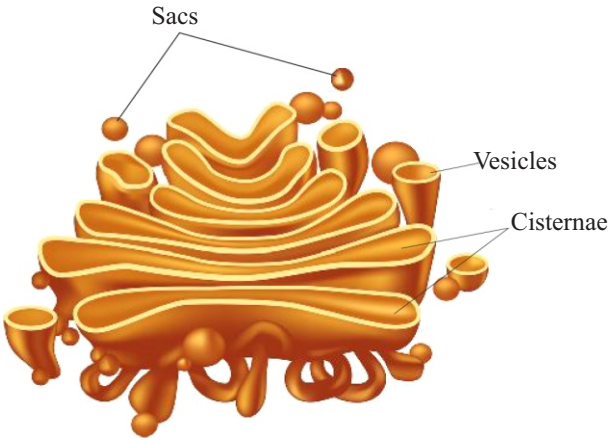

Fig. 6.6 Golgi body

7. **Centrosome :** It is mainly present in the animal cell near the nucleus in the form of a star shaped structure. Each centrosome is made up of two centrioles which are perpendicular to each other Centrosome was discovered by Van Beneden.

   Centrosome are responsible for the formation of spindle fibers in animal cells at the time of cell division. It forms the tail (flagellum) of the sperm. It forms the basal bodies of the locomotory organs of the micro-organisms i.e. the flagella and cilia.

8. **Vacuole :** The small or big, bubble like structures present in the cytoplasm of the cell are known as **vacuoles**. They are enclosed by a membrane termed as the **tonoplast**. The fluid present in the vacuole is known as the **cell sap**. Water, along with excretory substances and other waste products are present in the cell sap. Vacuoles keep the cells turgid and collects water and other waste substances. In plant cells the vacuole is quite large.

   Other organelles like **microbodies** and **peroxysomes** are also present in the cells.

6.3.3 Nucleus : Nucleus was discovered by Robert Brown in 1831. It is the most important organelle of the cell. Normally only one nucleus is present in each cell. In some cells more than one nuclei may be present. The mature Red Blood Corpuscles of human beings and the mature seive cells of plants lack nucleus.

In animal cell nucleus is spherical and is present in the center of the cell. However, in a plant cell nucleus is present near the periphery because of the presence of a large vacuole in the center.

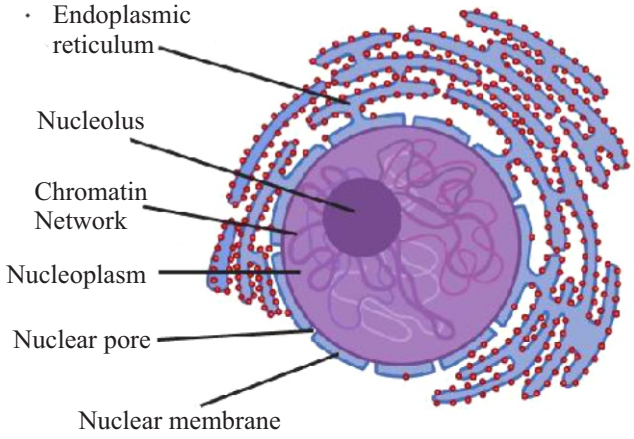

Fig 6.7 Nucleus

Nucleus is a double membrane bound organelle. Its membrane is known as the nuclear membrane. There are minute pores in the nuclear membrane through which there is exchange of substances between the cytoplasm and the

nucleoplasm. A fluid nucleoplasm is present in the nucleus. Proteins, nucleic acid and other carbonic compounds are present in this fluid. One or more small spherical structures present in the nucleus, are known as the **nucleolus**. A network of thin thread - like structures are present in the nucleoplasm. It is known as the chromatin network. At the time of cell division the threads of the chromatin network coils and appear thickened. They are known as the chromosomes. Nucleus is the main controlling organelle of the cell.

6.4 Plant and Animal cells :

The basic structure of the plant and animal cells is similar to each other, yet there are some structural characteristic on the basis of which they may be differentiated.

Character	Plant Cell	Animal Cell
1. Cell Wall	In plant cells a non-living cell wall made up of cellulose, is present around the cell membrane.	Animal Cell lacks cell wall.
2. Chloroplast	In plant cells the photo synthesizing organelle, chloroplast is present.	Chloroplast are not present in the animal cell.
3. Vacuoles	In plant cells two or more vacuoles are present.	In animal cells vacuoles are very small or are absent.
4. Centrosomes	Centrosomes are absent in the plant cell.	Centrosomes are present in the animal cell.
5. Golgi body	In plant cell, they are less developed.	They are well developed and active in animal cells.
6. Stored food	In plant cells, stored food material is in the form of starch.	The stored food in animal cell is found to be glycogen.

6.5 Cell Cycle :

In the process of cell division, daughter cell is produced by the division of parent cell. The daughter cell thus produced re-divides to produce new cells.

The various stages, from the formation of new cells to its division, are together known as the **cell cycle**.

The main phases of the cell cycle are :

1. **Interphase :** During this stage of the cell cycle the substances essential for cell division are synthesized. It is known as the phase of preparation for the cell division.
   Interphase has the following stage :
   (a) First growth period of the G-I phase : This step takes place nearly 30-40% of the time of the entire cell cycle. During this period the cell grows and the proteins and RNAs required for DNA synthesis are formed. It is the Gap-I (G-I) period.
   (b) Synthetic period or S-phase : It consumes 20-30% of the total time span of the cell cycle. The DNA is synthesized during this phase.
   (c) Second growth period or G-II phase : 10-20% time of the cell cycle duration is used in this phase of interphase. This is the Gap-2 or G-2 period in which the proteins required for the cell are synthesized.
2. **Division Phase (M-Phase) :** The remaining 5-10% time of cell cycle duration involves the division phase. During this step the nucleus of the cell divides to form two daughter nuclei and later on the cytoplasm also divides resulting in the formation of two daughter cells.

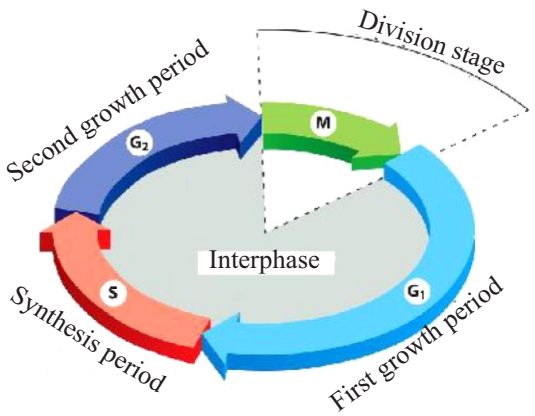

Fig. 6.8 Cell cycle

6.6 Cell Division :

New cells are always formed from the division of pre-existing cells. This pre-existing cell is known as the **Mother cell** or the **Parental cell**. The life of every multi-cellular organism starts with the uni cellular fertil`ised egg, the zygote. Embryo is formed by the division and differentiation of this cell. The embryo by repeated cell divisions develop into the multi cellular organism. Similarly, in the reproductive organs of the animals and plants, male and female gametes are formed from the reproductive mother cells. Thus the objectives, of formation of multicellular bodies and gametes, by cell division, are achieved. The rate of cell division in the growing organs of the organism, slows down after the maturation stage and is ultimately blocked.

During cell division, both, the nucleus and the cytoplasm divides but these are two different processes. The cell need not divide immediately after the nuclear division.

Types of Cell Division : The cell division is of two types depending on the number of chromosomes in the daughter cells formed.

I. Mitosis or Equational Cell Division :

Mitosis takes place in all the somatic cells i.e. in all the cells except the reproductive cells. In plants, this type of division takes place in the meristematic cells. During this type of cell division a parent cell divides into two daughter cells and the number of chromosomes in the daughter cells formed, is the same as that in the parent cell. Hence this division is also known as the **Equational Division**. The various events occurring during mitosis can be divided into the following stages :

(a) Interphase
(b) Karyokinesis
(c) Cytokinesis

(a) Interphase : This is the period in between two successive divisions when the cell prepares itself for division. During this phase the cytoplasm and the nucleus both are metabolically active. The cells synthesize and store all the essential substances required at the time of cell division.

(b) Karyokinesis : During this phase, the nucleus divides into two daughter nuclei. To simplify its study, this stage has been divided into four phases. These phases are Prophase, Metaphase, Anaphase and Telophase.

1. Prophase : Mitosis starts with prophase. During this stage :

(i) Due to condensation the chromatin material of the nucleus transforms into thin threads. These chromosomal threads are smaller in length and are thicker. They are known as the chromosomes.

(ii) During the last stages of the prophase both the chromatids of each chromosomes become more clearly visible. Both chromatids are attached with each other only at the centromere.

(iii) Nucleolus and nuclear membrane are not clear and gradually disappear by the end of prophase.

(iv) In the animal cell the centrosome divides to form two centrioles. Each centriole determines the pole.

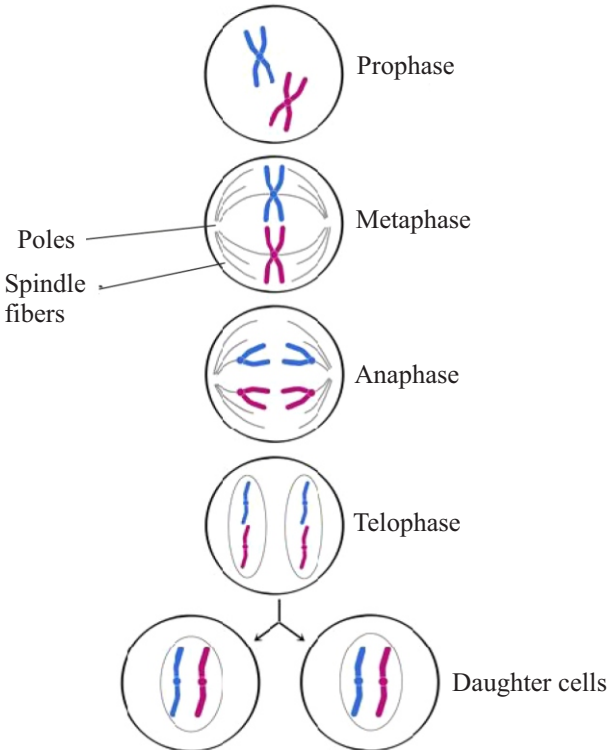

Fig. 6.9 : Different stages of mitosis

2. Metaphase :

(i) Formation of Spindle fibres and arrangement of chromosomes in the middle region of the spindle are the major events of this phase. Astral rays radiate out from each centriole. These astral rays together form the spindle fibres, which connects the centromere with the poles.

(ii) Chromosomes move towards the equatorial region and arrange themselves in such a manner that their centromeres lie at the metaphase plate with the arms of chromatids, extending outward, towards poles.

3. Anaphase :

(i) During this stage of mitosis the centromere divides, as a result the two chromatids separate from each other and are now known as Daughter Chromatids.

(ii) The daughter chromatids separate from each other and move towards

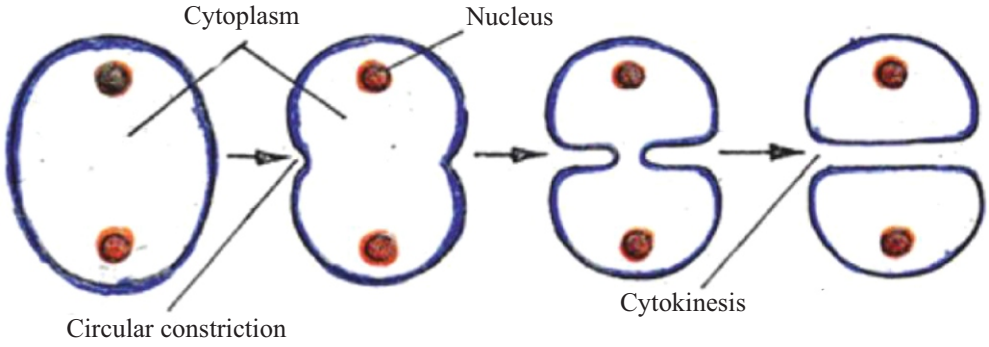

Fig. 6.10 : Cleavage Method

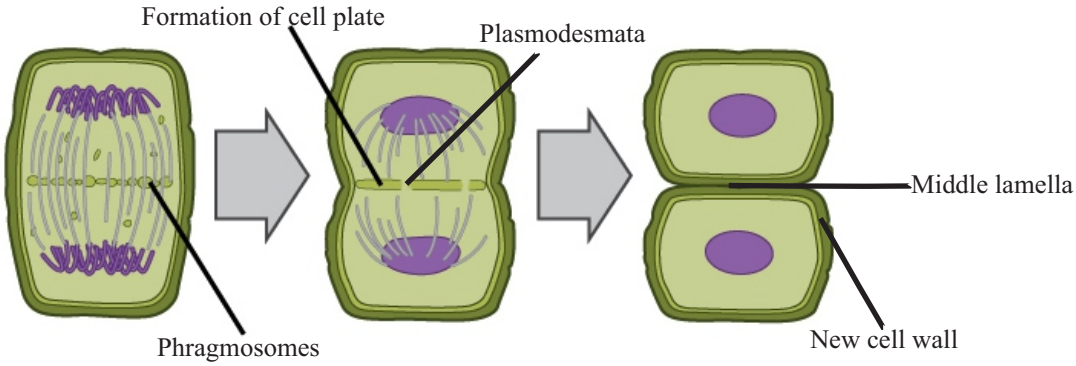

Fig. 6.11 : Cell Plate Method

II. Meiosis :

Meiosis takes place in the diploid reproductive cells at the time of reproduction. It results in the formation of haploid gametes. The number of chromosomes in the daughter cells formed, as a result of this type of division, is half of that present in the parent cell.

Stages of Meiosis : Meiosis completes in two stages. In this division the cell divides twice and results in the formation of four haploid cells from a single diploid cell. The two stages are :

1. **Meiosis I**
2. **Meiosis II**

1. Meiosis I : In this division there is the interphase prior to cell division, as is the case in mitosis. During interphase, the substances essential for the cell division are synthesized. After this the actual process of cell division begins. In meiosis I the parent cell divides to form two cells in which the number of chromosomes is reduced to half of that present in the parent cell. Hence, this stage of meiosis is also known as the **Reductive Division.** The various phases of this division are :

(a) Prophase I : It is a prolonged step consisting of complex events, as compared to the Prophase of mitosis. As in prophase of mitosis, in prophase I also there is condensation of chromosomes, division of centrosome, disappearing of nucleolus and the nuclear membrane etc. Apart from these events, the chromatids of the homologous chromosomes, i.e. the chromosomes having exactly the same genes, entwine (criss-cross) with each other, so that part of chromatids are exchanged between them. This phenomenon is known as **Crossing over**. Crossing over results in the formation of new group on genes on the homologous chromosomes. This exchange of genes taking place in homologous chromosomes during meiosis I generates variance in the traits (characteristics) of the next generation.

(b) Metaphase I : Poles and spindle fibres are formed during this stage and the homologous chromosomes arrange themselves on the metaphase plate as a double row. Spindle fibre from one pole of the cell attach to one chromosome of each pair, the other chromosome of the pair being attached to the other pole. The centromere of both chromosomes face towards the poles region i.e. metaphase plate.

(c) Anaphase I : During this stage the centromere does not divide, as it does during the anaphase of mitosis. The complete chromosome moves toward its pole because of the contraction of the spindle fibre. By the end of anaphase I a group of chromosomes is formed at each pole.

(d) Telophase I : During this stage of meiotic division the chromosomes uncoil and form the chromatin network. on both the poles nuclear membrane forms around the chromatin network and the nucleolus develops. Thus a haploid nucleus is formed at each pole. After the telophase I cytokinesis occurs in a way similar to that as in mitosis, resulting in the formation of two haploid cells.

2. Meiosis II :

In both the haploid cells formed by meiosis I one more division, similar to mitosis, takes place. It is known as Meiosis II.

In Meiosis II, two daughter cells are formed from each haploid daughter cell. Thus in Meiosis four haploid daughter cells are formed from a single diploid parent cell. The prophase of this division is not an extended process.

Significance of Meiosis : The number of chromosomes in the vegetative cells of the organisms, reproducing sexually, remains the same from generation to generation. New combinations of hereditary characters are formed by the crossing over that take place during prophase I of Meiosis. It generates

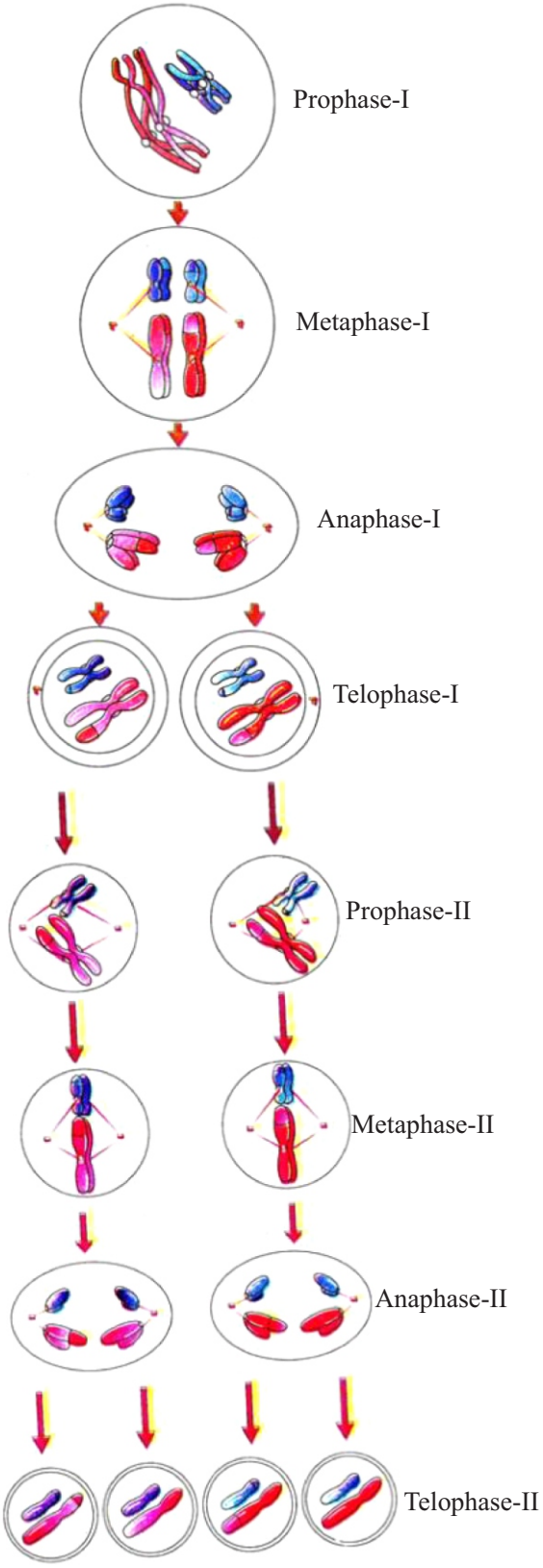

Fig. 6.12 Stages of Meiotic Division

hereditary variations in the organism, which form the basis of organic evolution.

6.7 Acellular organism - Virus :

Virus is considered to be an incomplete cell. It is not considered to be a 'cell' because it has only one characteristic feature, out of four, of a typical cell. It has hereditary material, DNA or RNA, because of which it has the capability of reproduction, heredity and mutation. In virus the cell membrane, metabolic machinery and the bio chemical mechanisms are not present. They can reproduce only in a living system.

They synthesize proteins and nucleic acids, after entering in a living cell, using its bio-synthetic machinery. This results in the increase in their number. Virus are parasites. They are found in the cells of animals, plants and bacteria. The virus remain inactive outside the nutritive cell. They can be stored in bottles like the crystalline particles of chemical compounds.

Structure of Virus : Virus are so small that they can be observed only with the help of electron microscope. They are 30 nm to 300 nm in size.

Each particle of virus is known as a **virion.** The virion consists of a protein coat, known as **capsid**, which encloses the nucleic acid : DNA or RNA.

Virus can be of three types on the basis of their source of nourishment.

(1) Animal Virus : Animal virus are present as parasites in the animal cells. Generally, the hereditary material in them is DNA, however, sometimes it may be the RNA. They are spherical or hexagonal. In human beings, diseases like small pox, polio, influenza etc are caused by virus.

(2) Plant Virus : They are parasitic on plant cells. Generally RNA is the hereditary material in them. Virus is the casual organism of the Tobacco Mosiac Disease.

(3) Bacteriophage : The virus which are parasitic on bacteria are known as the bacteriophage. The hereditary material in bacteriaphage is DNA. T_4 bacteriophage is parasitic on

Escherichia coli bacteria. It has a hexagonal head a small neck, a collar and a long cylindrical tail. There is a double stranded circular DNA in the head region.

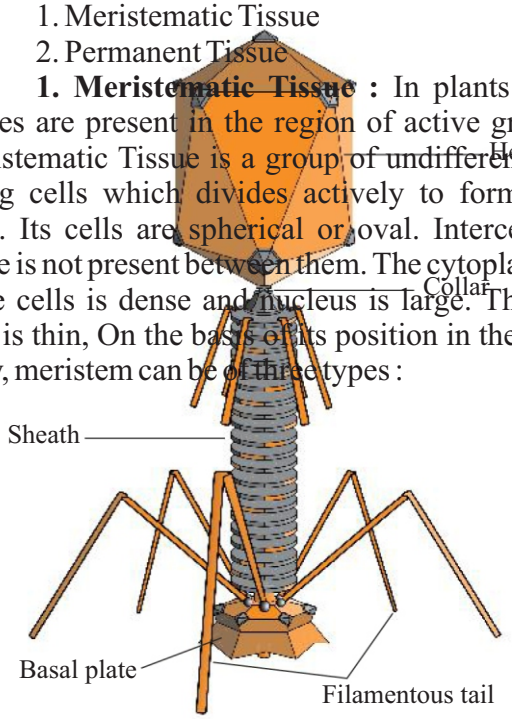

Fig. 6.13 Bacteriophage

6.8 Structure of Multicellular Organisms:

You have studied in this chapter, that in unicellular organism, all the processes like nutrition, excretion reproduction etc. are performed by a single cell. In multi-cellular organisms cells collectively form different types of tissues. Various tissues collectively form organs and organs together form a system. Now, we will study the various types of tissues present in the plants and animals.

6.9 Tissue :

"A group of cells having similar origin, development and functions, is known as a tissue."

6.10 Major Types of Animal and Plant Tissues :

A tissue performs a specific function. Tissues can be classified into two main groups on the basis of their development.

I. Plant Tissue
II. Animal Tissue

I. **Plant Tissue** :
Plant tissue are of the following types :
1. Meristematic Tissue
2. Permanent Tissue

1. Meristematic Tissue : In plants these tissues are present in the region of active growth. Meristematic Tissue is a group of undifferentiated living cells which divides actively to form new cells. Its cells are spherical or oval. Intercellular space is not present between them. The cytoplasm of these cells is dense and nucleus is large. The cell wall is thin, On the basis of its position in the plant body, meristem can be of three types :

Fig. 6.14 : Meristematic Tissue

(a) Apical Meristem : It is present in the apical region of the stem and the root. It is responsible for the increase in length of the plant.

(b) Intercalary Meristem : Actually, it is a part of the apical meristem but is separated from it because of the intervention of the permanent tissue. This tissue is present at the base of the nodes of grasses and other monocot plants.

(c) Lateral Meristem : This tissue is

present in the lateral regions of the stems and roots. The thickness of the stem and root increases because of the activity of this tissue.

2. **Permanent Tissue :**

Permanent Tissue is a group of undividing cells which are differentiated, having a definite shape and size and are responsible for specific functions. Permanent Tissue are of two types :

1. Simple Tissue 2. Complex Tissue

(a) Simple Tissue : Simple tissue is made up of similar cells having same origin, shape and functions.

Simple tissue are of the following types :

(a) Parenchyma (b) Collenchyma

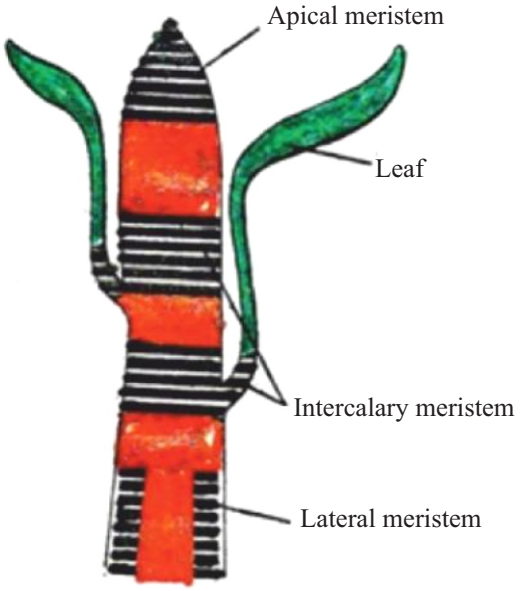

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Fig. 6.15 Parenchyma

(b) Collenchyma : The cells of this tissue are living and roundish oval or polygonal. In these cells, cell walls are thickened at the inner and outer corners of the intercellular spaces. The thickening of the cell wall are due to the deposition of cellulose and pectin. This tissue provides flexible strength to plant parts.

Fig 6.16 : Collenchyma

(c) Sclerenchyma : The cells of this tissue are generally elongated, narrow with tapering ends. The cell wall is uniformly thickened because of the lignin depositon. Their lumen is destroyed i.e. is not present and the mature cells lack cytoplasm. They are dead cells and are present in hard parts of the plant. It provides mechanical strength to the plant.

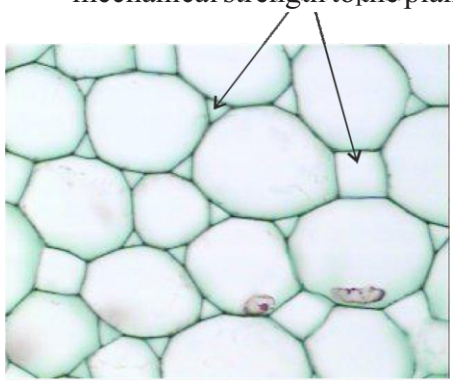
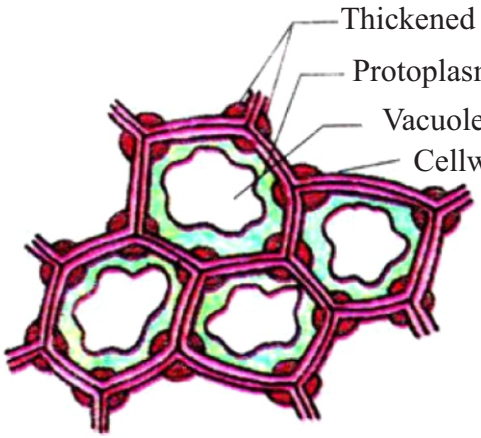


Fig. 6.17 : Sclerenchyma

(B) Complex Tissue : Complex tissues are made up of more than one type of cells. These cells, together, function as a unit. All the cells of this type of tissue

cooperate with each other to perform some specific function. Complex tissue are of two types :

(a) Xylem : The main function of Xylem is conduction of water and



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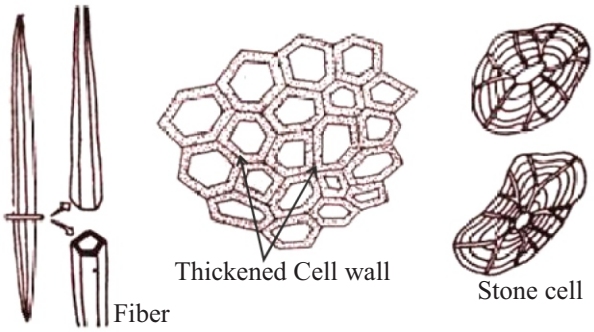

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with broad lumen. They join with each other forming a tube like structure. Even their cell walls are lignified and they are dead cells. **Xylem fibres** are elongated thin cells with obliterated cell lumen because of thick lignin depositions. They are dead cells. **Xylem parenchyma** are thin walled living cells like other parenchymatous cells.

(b) Phloem : The main function of phloem is conduction of food material in the stem and roots of the plant. Phloem has four types of cells

(i) Sieve tubes
(ii) Companion cells
(iii) Phloem fibres
(iv) Phloem Parenchyma

Sieve tubes are living cells with soft wall and large lumen. Their length is more as compared to their width. The cross walls at the ends of the sieve tube cells is perforated. These perforated transverse walls are known as the **sieve plates**. Nucleus is not present in these cells. Food material is transferred in soluble state through the sieve tubes in the plants. Adjacent to each sieve tube is a parenchymatous cell with dense cytoplasm and a large nucleus. It is known as the **companion cell** and controls the sieve tube. The fibres present in the phloem are made up of sclerenchymatous cells. They are the only dead cells of the phloen tissue. Their walls are lignified and they provide mechanical strength. They are known as the **bast fibres**. Phloem parenchyma are like the normal parenchyma.

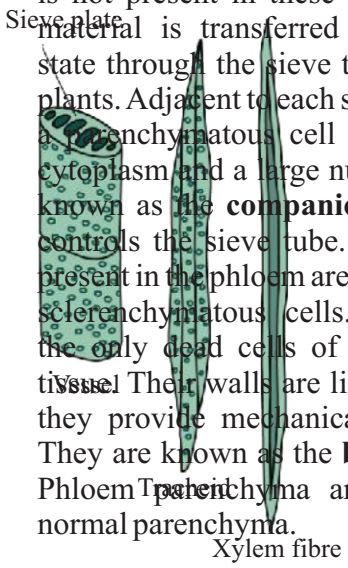
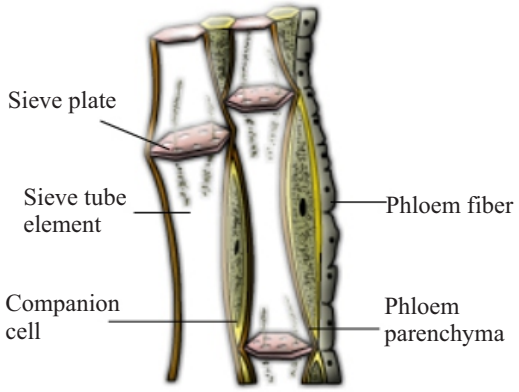


Fig. 6.19 Phloem

II. Animal Tissue : In multicellular animals there are mainly four type of tissues on the basis of their function and structure :

1. Epithelial Tissue
2. Connective Tissue
3. Muscle Tissue
4. Nervous Tissue

1. Epithelial Tissue : The epithelial tissue covers the body surface of the animals, thus, it is in contact with body fluid on one side and the environment on the other side. It also lines the body cavity. The epithelial tissue is of two types on the basis of arrangement of layers : **Simple Epithelium** and **Stratified Epithelium.** The simple epithelium is made up of a single layer of cells. It forms the lining of the body cavity and the vessels. The simple epithelium is of different types on the basis of the form of the cells. The squamous epithelium is made up of flat scale-shaped cells; cuboidal epithelium made up of cuboidal cells and columnar epithelium made up of elongated thin cells. The stratified epithelium is made up of two or more than two layers of cells. It lines the body parts where frictional phenomenon occurs. For example the skin of animals is a stratified epithelium.



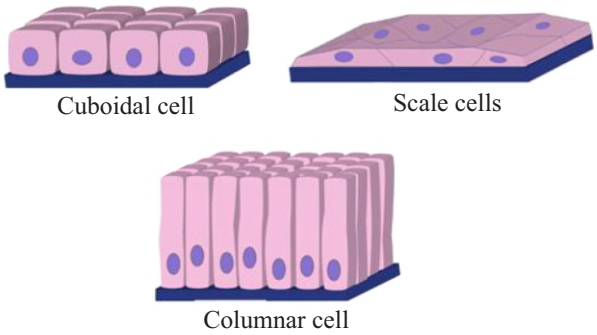


Fig. 6.20 Epithelium Tissue

2. Connective Tissue : This tissue binds and supports the body parts, hence it is known as the connective tissue. It includes the loose connective tissue, cartilage, bone, adipose tissue and blood.

Except blood, the cells of all connective tissues secrete a structural proteins known as the collagen tissue. It is the most abundant protein in the body. It provides strength, elasticity and flexibility to the tissue. The cells of this tissue also secrete poly saccharides which function as a matrix between the cells of the connective tissue and the collagen fibers. Cartilage is present in the nose of human beings, the external ear lobes etc. Bone is a mineral-rich, solid connective tissue. it forms the structural frame-work of the soft parts of the body and provides support and protection to other tissues.

Adipose tissue is a loose connective tissue which is present beneath the skin. Fat is stored in the cells of this tissue. Blood is a fluid connective tissue, containing plasma, Red Blood Corpuscles, White Blood Corpuscles and Thrombocytes. Blood transports various substances in the body.

Fig. 6.21 : Connective Issue

3. **Muscular Tissue :** It is made up of elongated, cylindrical fibres, arranged parallel to each other. Each fibre is made up of many fibrils, known as the myofibrils.
   All the muscle fibres contract in an integrated manner in response to a stimulus and again relaxes. Body and its organs move in response to environmental stimuli by the activity of the muscular tissue.
   The muscle tissue are of three types :
   (a) Skeletal muscles
   (b) Smooth muscles
   (c) Cardiac muscles

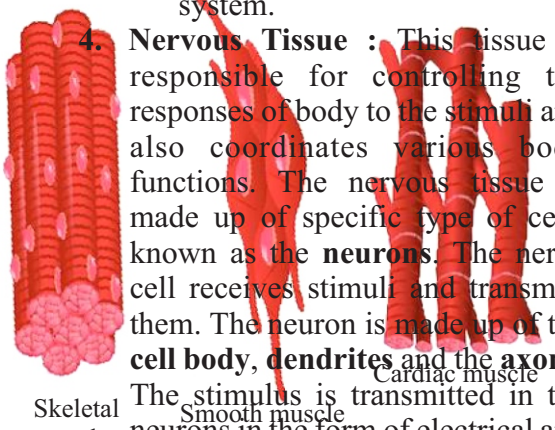
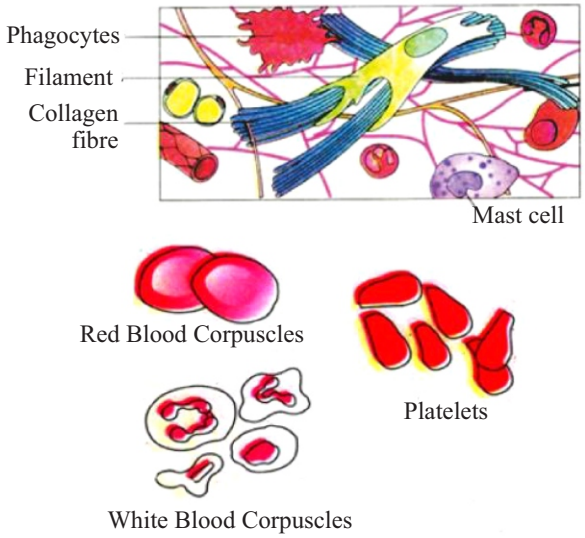


Fig. 6.22 : Muscular Tissue



muscles are located in the inner walls of the internal body organs like the digestive tract, reproductive tract etc. They are known as the '**unstriated muscles**' because they lack stripes and since they are not under the voluntary control of the nervous system, they are also known as the '**involuntary muscles**'.

(c) **Cardiac muscles :** They are the heart muscles. They are **striated** because of the presence of stripes but are **involuntary** because they are not under the voluntary control of the nervous system.

4. **Nervous Tissue :** This tissue is responsible for controlling the responses of body to the stimuli and also coordinates various body functions. The nervous tissue is made up of specific type of cells known as the **neurons**. The nerve cell receives stimuli and transmits them. The neuron is made up of the **cell body**, **dendrites** and the **axons.** The stimulus is transmitted in the neurons in the form of electrical and chemical signals, which are known as impulse.

6.11 Structure of Organs and Systems :

So far we have studied, in this chapter, about different type of tissues and the cells present therein. Now we are going to study about the structure and functions of the various systems made up of these tissues.

On the basis of their organization and position, the plant tissue system may be of three types :

1. Epidermal tissue system
2. Ground tissue system
3. Vascular tissue system

1. **Epidermal tissue system :** The epidermal tissue system is the outermost covering of the plants. It consist of the epidermal cells pores and trichomes (hairy outgrowths). The cells of the

epidermis are barrel shaped and are present close to each other. They are the parenchymatous cells. A waxy coating is present on the outer surface of the epidermis. It is known as the **cuticle**. Pores are present on the epidermis of plants which perform the function of transpiration and exchange of gases with the atmosphere. Trichomes and other hairy outgrowths are present on the cells of the epidermis. The hair present on the roots are known as the **root hairs**. They are unicellular. The hairs present on the stems may be multicellular or unicellular and are known as the **epidermal hairs**. Root hairs absorb water and minerals and the trichomes or the epidermal hairs may be of secretory nature. They reduce transpiration.

2. **Ground Tissue System :** The tissue present between the epidermis and the vascular tissue system is known as the ground tissue. It is made up of parenchyma, collenchyma and sclerenchyma.
3. **Vascular tissue system :** Xylem and phloem are present in the vascular tissue system. Together the two type of tissues form the vascular bundles which perform the function of transportation of different substances, like water, minerals, food etc. in the plant body.

As it is in plants, in animals also tissues together form the systems, organs and organ systems. In animals the various systems formed by the tissues, include : Nervous system, epidermal system, muscular system, digestive system, respiratory system, excretion system, reproductive system etc.

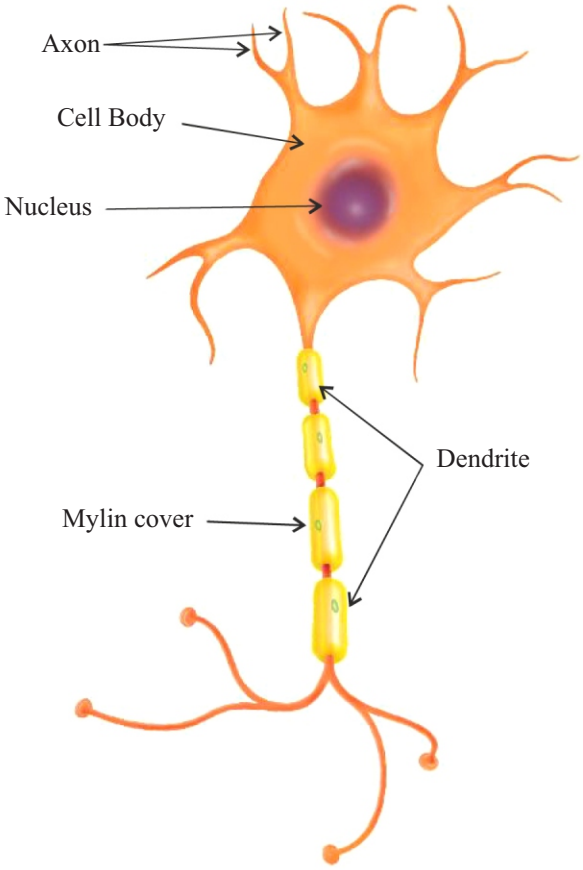


Fig. 6.23 Neuron

Important Points

1. Cell is the structural and functional unit of the body of organisms.
2. The longest cell of the human body is a neuron.
3. The cell membrane is made up of molecules of protein and lipid.
4. The cell wall of plant cell is made up cellulose, hemicellulose, pectin and polysaccharides.
5. Mitochondria is also known as the power house of the cell.
6. Lysosomes are also known suicide bags.
7. Cytokinesis in plant cell takes place by the formation of cell plate while in animal cell it is by means of cleavage method.
8. In plant cell the stored food is in the form of starch while in animal cell it is in form of glycogen.
9. Various stages from the time of cell formation to its division are known as the cell cycle.
10. The number of chromosomes remains the same from generation to generation by meiotic division.
11. In the stem of a plant, there is increase in length because of the activity of apical meristem while the lateral meristem results in the increase in

thickness of the stem.
12. In plants, xylem and phloem are the conductive tissue.
13. In animals, epidermal tissue, connective tissue, muscular tissue and nervous tissue are present.
14. Blood is a type of connective tissue.

Questions

Objective type questions :

1. Which cell organelle is known as the suicide bag ?
   (a) Mitochondria (b) Lysosomes
   (c) Ribosomes (d) Nucleus
2. The nucleus was discovered by :
   (a) Robert Brown (b) Robert Hooke
   (c) Leuwenhoek (d) Schleiden
3. DNA is synthesized during which stage of cell cycle ?
   (a) G-1 phase (b) S phase
   (c) M phase (d) G-2 phase
4. The tissue responsible for imparting flexible strength to plants is :
   (a) Parenchyma (b) Collenchyma
   (c) Sclerenchyma (d) None of the above
5. Write the name of the scientist who observed a living cell for the first time.
6. Write the names of any two unicellular organisms.
7. Name the longest cell of the human body.
8. What is the function of cell wall in a plant cell?
9. Name the plastids present in the plant cell.
10. What is the function of ribosomes in a cell?
11. Which type of cell division takes place in somatic cells?
12. Why is the meiotic division also known as the reductive division?
13. Cytokinesis takes place in plant cells by which method?
14. Which substance in deposited on the cell wall of the collenchymatous tissue?

Short answer type questions :

1. What are unicellular and multicellular organisms? Give examples.
2. Explain the cell theory.
3. Explain the structure and function of mitochondria.
4. Write four differences between animal cell and plant cell.
5. Why lysosomes are known as the suicide bags.
6. Describe the structure and function of the nucleus.
7. Explain the cell cycle.
8. Explain the methods of cytokinesis in plant and animal cells.
9. Explain the metaphase of mitotic division with the help of suitable diagram.
10. Explain the anaphase movement in relation to the cell division.
11. Write the significance of meiosis.
12. Explain the structure and function of xylem.
13. Draw a well labelled diagram of a neuron.
14. Describe the various type of muscles present in animals.
15. Explain the structure of a virus and draw a well labelled diagram of a bacteriophage.

Essay type answer questions :

1. Draw a well labelled diagram of a plant cell and describe the structure and function of the following organelles :
   (a) Chloroplast (b) Endoplasmic reticulum
   (c) Mitochondria (d) Nucleus
2. What is mitosis? Describe the various phases of mitosis with the help of suitable diagrams.
3. What is a tissue? Describe the types of simple tissue with the help of suitable diagram.
4. Describe the various type of tissues present in the animals.
5. Give account of the following :
   (a) Vascular bundle
   (b) Neuron
   (c) Bacteriophage
   (d) Sclerenchyma

Answer Key

1. b 2. a 3. a 4. b 5. b