21

212en21

BUILDING BLOCKS OF LIFE — CELL AND TISSUES

When a small wall is built, a number of bricks are arranged end to end. Similarly cells are arranged variously to build the bodies of living beings. In fact, every organism begins life as a single cell which is the fertilized egg. Cells divide to give more cells. Cells form tissues. Tissues make organs. In this lesson, you will learn about structure and functions of the cell, how cells divide, how they collect to make a tissue and also how cells are being used to repair damaged parts through stem cell technology.

OBJECTIVES

After completing this lesson, you will be able to:

- *recognize cell as the structural and fundamental unit of all living organisms and state the cell theory.*
- *Differentiate between prokaryotic and eukaryotic cell;*
- *list the similarities and differences between a plant cell and an animal cell;*
- *describe cell organelles and state their functions;*
- *mention the importance of cell division;*
- *define a tissue and describe in brief the various plant and animal tissues;*
- *give an idea of stem cell technology and its use.*

21.1 CELL- THE STRUCTURAL AND FUNCTIONAL UNIT OF ORGANISMS

The invention of microscope helped in the discovery of the cells. Robert Hooke discovered the cell in 1665. He observed a thin piece of cork under his simple

microscope and saw many compartments arranged like the honey comb. He named these compartments **'cells'** (L. cella–compartment).

21.1.1 CELL THEORY CELL THEORY

Soon a cell theory was formulated by two German biologists, M J Schleiden (1838) and T Schwann (1839).

The cell theory states that

- Cell is the structural and functional unit of all living beings and bodies of all organisms are composed of cells.
- All new cells arise by division of pre-existing cells.
- The functions of an organism are an outcome of the combined activities and the interactions of the cells that make the organism.

A cell may be defined as **the structural and functional unit of living organisms which is capable of independent existence.**

ACTIVITY 21.1

Write a short paragraph comparing a cell of the body with a brick that forms the house and include the points of the cell theory in the comparison. At the same time think of five points in which a brick differs from a cell of an organism.

21.2 PROKARYOTIC AND EUKARYOTIC CELL

All cells have three basic parts:

- Cell membrabe which limits the cell and gives it shape.
- DNA which may be contained in a nucleus
- Fluid called cytoplasm filling in the space within the cell.

Whether DNA of the cell lies in the cytoplasm or is enclosed within a nuclear membrane, cells may be termed **prokaryotic** are **eukaryotic**.

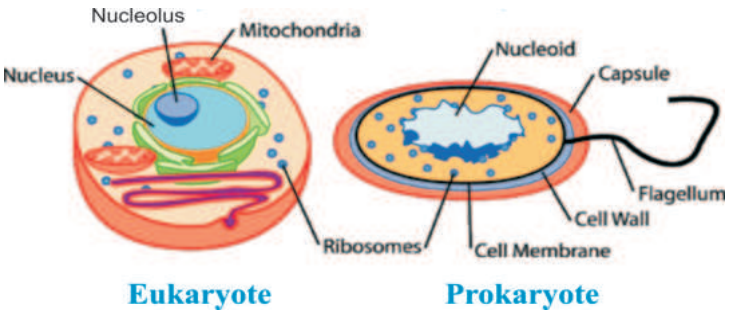
(i) Prokaryotic cell, and (ii) Eukaryotic cell

i. Prokaryotic cell ***(Gk. Pro-before; karyon-nucleus)***

These cells do not have a well-organized nucleus. The genetic material is a single molecule of DNA lying in the cytoplasm. Not only is the nuclear membrane absent, cell organelles like mitochondria, lysosomes, endoplasmic reticulum, chloroplast, nucleolus, etc are also not present in prokaryotic cells. Examples: Bacteria and blue-green algae.

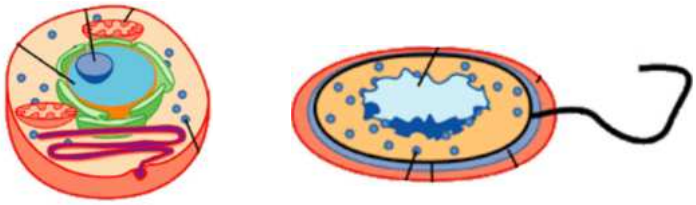
(ii) Eukaryotic cell *(Gk. Eu-true; karyon-nucleus)*

DNA is enclosed in a nuclear membrane forming a nucleus. The genetic material is made of two or more DNA molecules, which are present as a network of chromatin fibres when the cell is not dividing. Membrane-bound organelles, such as mitochondria, endoplasmic reticulum, lysosome, chloroplast, nucleolus, etc. are present within the cytoplasm. Examples: Cells of plants, fungi, protozoa and animals.



ACTIVITY 21.2

Given below are diagrams of cells. Label them as prokaryotic and eukaryotic.



21.3 STRUCTURE OF A TYPICAL EUKARYOTIC CELLSTRUCTURE OF A TYPICAL CELL

Cells within the body of a multicellular organism differ in shape, size and function, but have three basic parts—cell membrane, cytoplasm and nucleus. Generalized ultrastructure of a plant cell and an animal cell are given in fig:21.2.

Study the fig.21.2 and identify the various parts shown in table 21.1

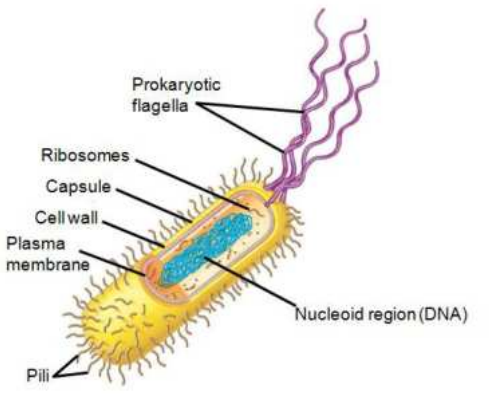


Fig. 21.2 (a) Prokaryotic cell

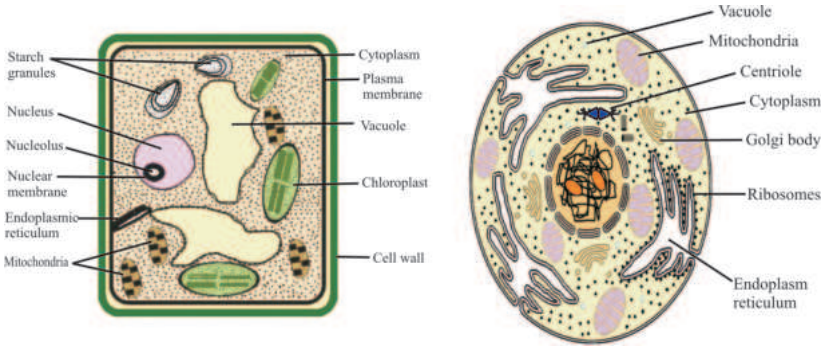
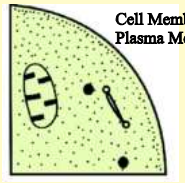
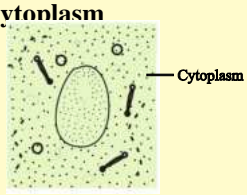
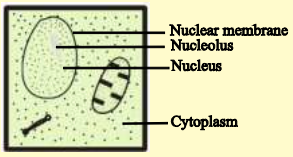
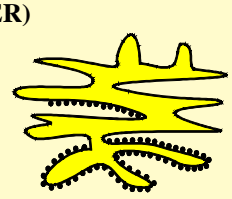
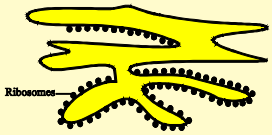
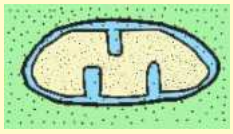
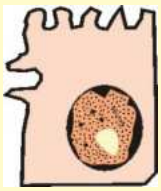
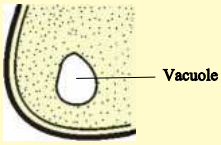


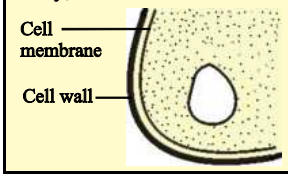
Fig. 21.2 (b)Eukaryotic cells- plant and animal Cell (Diagrammatic)

Table 21.1 Parts common to both animal cells and plant cell

Basic parts	Key features	Functions
Cell Membrane or Plasma membrane 	• A thin delicate membrane enclosing the cell • Forms outermost covering in animal cell and inner to cell wall in plant cell • Selectively permeable.	• Selectively permeable, so allows only selected substances to pass in and out of the cell. • Protects cell from injury. • Maintains shape of cell.
Cytoplasm 	• Translucent, homogeneous, colloidal semi fluid filling the space between plasma membrane and nucleus. • Cell organelles are present in it.	• Helps in manufacture and distribution of substances within the cell and in exchange of materials between different cell organelles.
Nucleus 	• Small ,located in or near the centre of the cytoplasm. • bound by a **nuclear membrane**. • Network of chromosomes present as **chromatin.** • One or more rounded **nucleoli** (*sing*. **Nucleolus**) present in the nucleus.	• Coordinates the activities of the entire cell. • Contains the genetic material or DNA.
Cell organelles found in cytoplasm:		
Endoplasmic reticulum (ER) 	• Irregular network of double membranes in the cytoplasm. • Ribosomes may be present on endoplasmic reticulum.	• Gives rigidity to the cell. • Helps in the synthesis and transport of various proteins and fats within the cell to the outside.

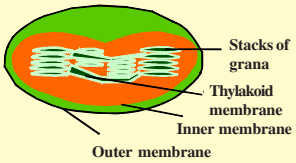
Ribosomes 	• Granules either scattered freely in the cytoplasm or attached to the endoplasmic reticulum.	• Sites for protein synthesis.
Mitochondria 	• Minute sausage shaped or rod shaped granular bodies scattered in the cytoplasm.	• Carry out cellular respiration. • Are called powerhouse of cell because energy gets released and stored in them during respiration.
Golgi bodies (also called **Golgi apparatus** or **Golgi complex**) 	• Stacks of flattened sacs or small vesicles generally located near the nucleus. Similar structures in a plant cell are called **dictyosomes**.	• Help in the secretion and storage of substances such as enzymes, hormones, etc.
Lysosomes 	• Lysosomes are small vesicles or sacs containing digestive enzymes, which destroy and digest the worn out cell parts.	• Help to rapidly destroy and digest damaged cells and their parts –hence these also known as **suicide bags.** They clean up the cell debris.
Parts other than the organelles: The vacuoles and granules are the non-living parts of a cell.		
Vacuoles 	• These are fluid filled membrane- bound spaces. • Large-sized vacuoles in plants and smaller and fewer ones in animals.	• Help in storage of water and other substances.
Granules	• These are small particles, crystals or droplets.	• Granules containing starch, fat, etc. serve as food for the cell.

II. Parts found in Plant Cell only

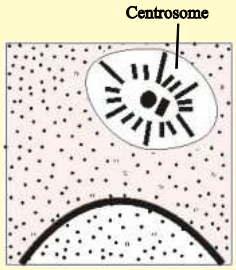
Name of the part and structure	Key features	Functions
Cell wall (plant cell only) 	• Outer, rigid, protective, supportive and semi-transparent covering of a plant cell made of **cellulose**.	• Provides a definite shape and rigidity to the cell. • Protects the plasma membrane and internal structures.

Notes

Change of colour from green to red during the ripening of tomato and chilies is due to the transformation of chloroplasts into chromoplasts. The orange colour of carrot (root) is due to chromoplasts.

Plastids  	• Plastids are of three types—**chloroplasts, chromoplasts** and **leucoplasts**. • Chloroplasts are green. They possess photosynthetic pigment—chlorophyll and carotenoids. • Chromoplasts contain yellow, orange or red coloured pigment. • Leucoplasts are **colourless** plastids.	• Chloroplasts help in photo-synthesis. • Chromoplasts provide colour to the flowers and the fruits. • Leucoplasts help in the storage of food.

III. Parts found in Animal Cell only

Name of the part and structure	Key features	Functions
Centrosome  	• Small body lying above the nucleus. Consists of two small granules called **centrioles**.	• Participates in cell division and help in spindle formation during cell division.

Protoplasm

Protoplasm is the living substance of the cell. The nucleus and cytoplasm together form the protoplasm.

ACTIVITY 21.3

You can make a beautiful model of a plant cell and / or an animal cell. For this, use differently coloured insulation wires and bindis of different size, shape and color. On a piece of thermocol or cardboard make the limiting membranes of the cell and nucleus with the help of wires. Use bindis to depict the organelles.

Note: Instead of bindis and wires you can use other materials like straws, plastercine etc. you may even use cotton and different coloured wool to make the model.or else,enclose within 5"/3" oval loop of wire some white cotton to make a base and use differently coloured wool to make various shapes representing the different organelles.

21.3.1 Differences between a plant and an animal cell

The differences between a plant cell and an animal cell are given in Table 21.2.

Table 21.2 Differences between an animal cell and a plant cell

Feature	Plant cell	Animal cell
Size and Shape	Larger in size and rectangular in shape.	Smaller in size and oval in shape.
Cell wall	Cell wall is made up of cellulose.	Cell wall absent.
Vacuoles	Vacuoles are large. In a mature plant cell, usually a single large central vacuole is present.	Vacuoles are mostly absent or if present are small in size and scattered.
Golgi bodies	Golgi bodies are diffused in the plant cells and are called dictyosomes.	Golgi bodies are well-developed and present near nucleus.
Centrosome	Centrosome and centrioles are absent.	Centrosome and centrioles are present.
Plastids	Present	Absent
Storage of reserve food	Reserve food is stored in the form of starch or oil.	Reserve food is stored in the form of glycogen.

INTEXT QUESTIONS 21.1

1. Mention whether the following statements are true (T) or false (F). Rewrite the wrong statements correctly.
   i) Cell membrane permits inflow and outflow of all molecules. T/F
   ii) Chloroplast and not chlorophyll is an organelle. T/F
   iii) Ribosomes are often called suicide bags. T/F

2. Name the part of the cell which:
   (i) provides rigidity to the plant cell. _____
   (ii) bounds semi-fluid content of the cell. _____
   (iii) helps in intra-cellular distribution of molecules, enzymes and nutrients within the cell. _____

3. Match the following items in Column A with those in Column B.

Column A	Column B
1. Master of the cell	**a.** chloroplast
2. Powerhouse of the cell	**b.** endoplasmic reticulum
3. Protein factories of the cell	**c.** mitochondria
4. Kitchen of the cell	**d.** nucleus
5. Circulatory system of the cell	**e.** ribosome

4. All cells of organisms have 3 basic parts. Draw and name them.

5. Explain in your own words the three salient points of the cell theory in one sentence each.

21.4 CELL DIVISION –PRODUCTION OF NEW CELLS

Just as clothes wear out with time, continuously used utensils become weak and crack. So do cells of the body wear out and need to be replaced.

New cells are required not only for replacement of worn out cells, but also for repair of cuts and injuries, for growth and for reproduction. New cells are obtained through cell division. But how does a cell divide to give two new identical cells?

21.4.1 Types of cell division

There are two types of cell division.

a) Mitosis: In mitosis, a cell gives rise to two identical daughter cells. Mitosis is needed for growth, and repair of worn out parts.

b) Meiosis: Cell division involved in production of sex cells which give rise to the egg in female and sperm in male.

21.4.1 Mitosis

Major events of both kinds of cell division are largely similar in both animal and plant cells. We will describe mitosis in an animal cell here .

(i) The sequence of events in mitosis:

Read each step of the cell division and correlate with the Figure 21.3

- The chromosomal material (chromatin network) inside the nucleus condenses to form **chromosomes** (b).
- The nuclear mem-brane disappears. (c)
- The centrosome (in animal cell) divides into two equal parts called centrioles, each of which migrates to opposite sides to orient the spindle which forms in the cytoplasm(c).
- A spindle of fibres appears between the centrioles.

- Each chromosome consists of two chromatids which are held by a centromere. The chromosomes arrange in the middle or equator of the spindle (c).
- Centromere splits. The chromatids (daughter chromosomes) of each chromosome now have their own centromere. The chromatids, now termed chromosomes separate from each other and subsequently, move to the opposite poles of the spindle.(d)
- Chromosomes lose their identity, and turn into a network of chromatin threads at the two poles.(e)
- Nuclear membrane reappears around each of the two new clusters of the chromatin material, formed at the poles.(f)
- In the middle of the cell, at the two sides a furrows appear in the cell membrane. The furrows deepen to divide the parent cell into two new identical daughter cells.

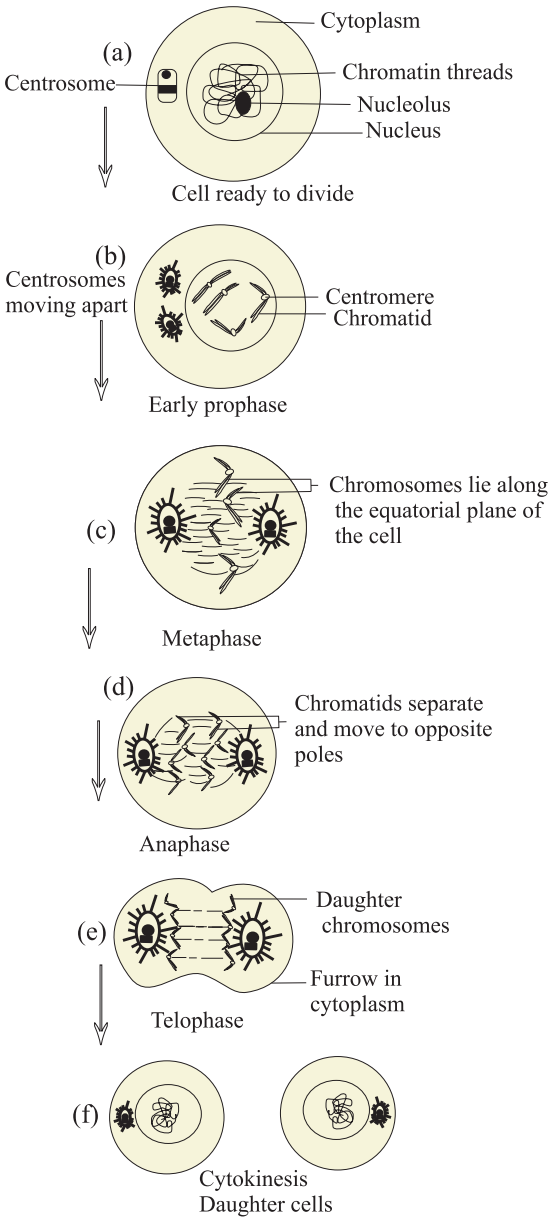


Fig.21.3 Stages of Mitosis

(ii) Two main differences in mitosis in a plant cell and an animal cell

- In plant cells, there is no centrosome but a spindle forms in the cytoplasm.
- Upon the completion of mitosis, the cytoplasm in plant cell does not constrict (furrow is not formed). Instead, a cell plate or a new cell wall is laid down in the cytoplasm in the middle of the cell. It divides the original cell into two daughter cells.

(iii) Significance of mitosis

- The daughter cells receive the same number of chromosomes as the parent cell. In other words **mitosis is an equational division in which the two daughter cells are identical to each other and to their parent cell.**
- Mitosis helps in wound healing and replacement of cells lost during wear and tear.
- It is responsible for the growth of an organism by addition of new cells.
- It is the method of asexual reproduction in single celled organisms like amoeba.

21.4.2 Meiosis

Meiosis is necessary for sexual reproduction. In animals, meiosis takes place in reproductive organs, such as the testis and the ovary, that produce eggs and sperms; and also in flowering plants it occurs in the anthers and ovaryto produce pollen grains and the ovule, respectively.

(i) Stages of meiosis (See figure 21.4 as you read)

Broadly, meiosis is completed in two phases (Fig.21.4).

Phase I: Two cells with half the number of chromosomes in each are formed at the end phase I. this is, therefore, a reduction division.

Phase II: The second division is equational as in mitosis and produces four cells at the end, each with half the number of chromosomes.

Sequence of events during meiosis— first meiotic division

- Chromatin fibres condense into chromosomes.

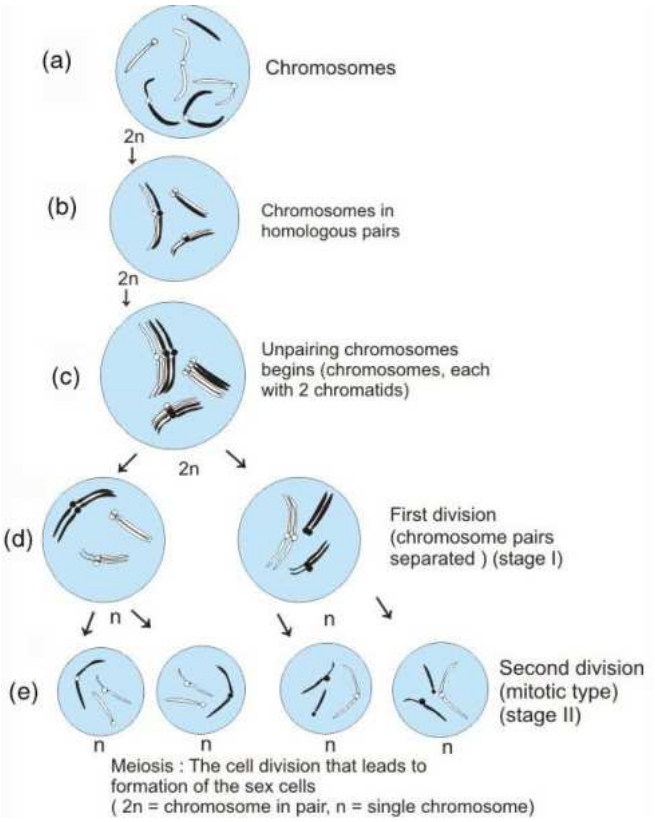


Fig. 21.4 Meiosis -the cell division that leads to formation of egg/sperms

- The chromosomes arrange in matching (or homologous) pairs. A matching pair means one chromosome having been received from the mother and the corresponding one received from the father. Both chromosomes of a pair bear same genes, but not necessarily the same alleles.
- Each chromosome in such a pair is made of two chromatids as duplication of chromosomes occurs before cell division begins. Thus, each pair of chromosomes is now a group of four chromatids.
- The nuclear membrane disappears, the homologous chromosomes which had paired now begin to separate and move apart.
- The cytoplasm divides into two cells, each of which has half the number of chromosomes originally present in the cell. Each chromosome is still made up of two chromatids as centromere has not divided.
- Meiosis II begins. it is exactly like mitosis.
- At the end of meiosis II, four cells form, each with half the number of chromosomes of the parent cell.

(ii) Significance of meiosis

- During meiosis, the number of the chromosomes is halved in the resulting sex cells so that when the male cell and the female cell combine during fertilization, the normal number of chromosomes in the species is restored.
- Also during meiosis, new combination of genes are obtained in the gametes that result from meiosis.

INTEXT QUESTIONS 21.2

1. A seedling grows into a small plant. What kind of division causes this — mitosis or meiosis?

   _____

2. Our nails have to be cut occasionally. Which kind of cell division makes the nails long?

   _____

3. Name the type of cell division that occurs during the following events:
   i) repair of skin and injury _____
   ii) formation of eggs and sperms in animals _____
   iii) increase in the length of stem in plants _____

4. Out of the following organs where does meiosis occur?

   Hair, liver, testis (male reproductive organ), cheek cell, ovary (female reproductive organ)

21.5 TISSUES

The house runs smoothly when different members of the family and the helpers perform different household work. Similarly different tissues perform different functions.

Various tissues of an organism work in co-ordination with each other in order to perform different processes that occur in the body.

A tissue can be defined as a group of cells similar in size, shape, performing the same function and having a common origin.

Plants are able to produce new tissues throughout their life. Animals can replace only some tissues under certain conditions. Muscles of heart and nervous tissue can never be formed again if damaged.

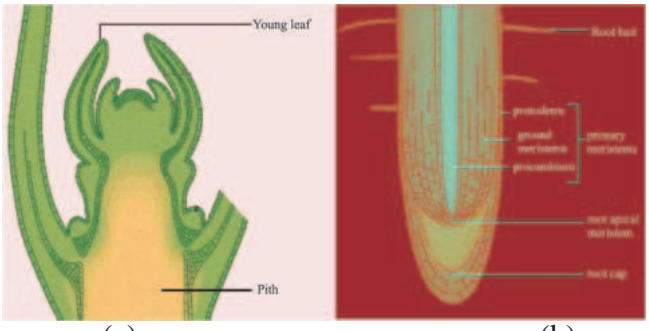
21.5.1 Plant tissues

Plant tissues are of two types:

- meristematic tissue, and
- permanent tissue.

a) **Meristematic tissue:** Found at the growing points of a plant such as at the tips of the roots, stems and branches. (fig.21.5) The main characteristics of meristematic tissue are as follows:

- aggregate of living cells, compactly arranged without intercellular spaces,
- thin-walled and may be rounded, oval, polygonal or rectangular in shape.
- The cells are small and have a large nucleus
- They are capable of dividing indefinitely and add new cells to the plant.
- They are usually found in the apices (open ends)of root and shoot.



(a) (b)

Fig. 21.5 (a) Longitudinal section of stem tip sharing apical meristem (b) Meristematic tissue

ACTIVITY 21.4

Uproot a weed and observe the various apices Draw and label the apices.

b) Permanent tissue: It is made up of cells, which have lost their ability to multiply. The permanent tissues are of three types.

i. **Protective tissue:** This tissue is made of cells with thick walls and occurs on the surface of leaves, stem and roots. (Fig. 21.6a)

ii. **Supporting tissue:** It provides support to various parts of the plant. This tissue includes cells that fill up the interior of potatoes, which store food; found in the leaf stalks etc. (Fig. 21.6b)

iii. **Conducting tissue:** It is also called the **vascular tissue**. It provides passage for the fluids to move up and down in the plant. It is of two types– **xylem** and **phloem** (Fig.21.6). Xylem is located more towards the centre of the stem. It allows water and minerals absorbed from the soil to travel upwards in the plant. **Phloem** serves to conduct the food (sugar) synthesized in the leaves to flow downward and upward so that food reaches all other regions.

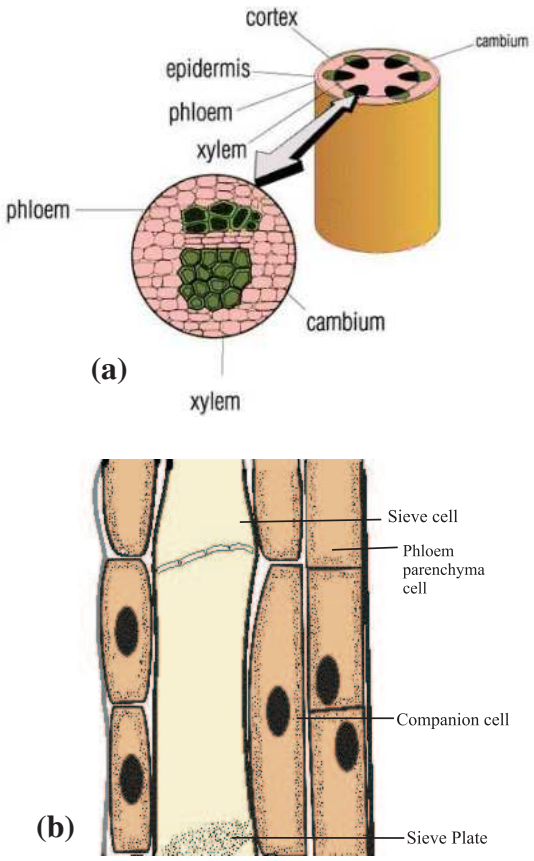


Fig.21.6 Conducting tissues- showing (a) xylem and phloem (b) Phloem cells

21.5.2 Animal Tissues

Animal tissues are grouped under four main categories: **epithelial, connective,** muscular and nervous tissues.

a) Epithelial tissue

- Thin protective layer (or layers) of cells.

- Generally located on the outer surface of the body, on the surface of the internal organs and the lining of the body cavities.

There are three distinct types of epithelial tissues namely Squamous, Cuboidal, Columnar Epithelium (Table 21.3, Fig. 21.7).

Table 21.3 Different types of epithelial tissues

Type	Nature of cells	Example/location	Function
Squamous epithelium  *Fig. 21.7(a)*	Hexagonal or irregular cells with thin walls.	Cells of the outermost layer of skin.	Protection of underlying parts in the body from injury, harmful substances and from drying up
Cuboidal epithelium  *Fig. 21.7(b)*	Thick cuboidal cells.	Some parts of kidney tubules and in glandular ducts.	Secretion
Columnar epithelium  *Fig. 21.7(c)*	Tall-elongated cells At some places have cilia at free ends (**ciliated columnar epithelium**)	Inner lining of the stomach and the intestine. Inner lining of trachea (wind pipe)	Secretion, absorption Lashing movement of cilia pushes the material forward

b) Muscular tissue

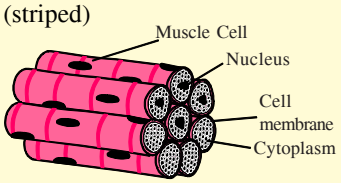
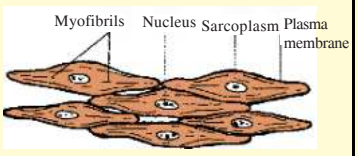
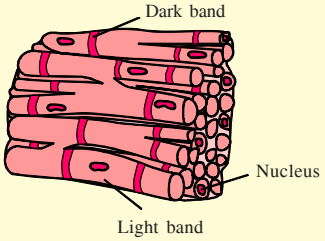
The muscular tissue consists of long, narrow cells called muscle fibres. Muscle fibres are the muscle cells. They are so named because of their long fibre like shape. Muscles bring about movement of body parts and locomotion in organisms.

Types of muscular tissue

- In human beings, three types of muscles are present Striated muscles, Unstriated muscles and Cardiac muscles (Table 21.4 fig. 21.8).

  (a) Striated muscle (b) Unstraited muscle (c) cardiac muscle

Table 21.4 Types of muscular tissues

Type	Nature of muscle	Example/location	Function
Striated or striped Their contraction is under ones control so called voluntary muscles	Multinucleated cells, show bundles of light and dark bands (striped) 	Muscles of arms, legs, face, neck, etc.	Cause movements that are under the control of our will
Unstriped or unstriated Also called smooth muscles as they lack transverse striations. Movement not under our will and hence called involuntary muscles.	Slender tapering cells 	Wall of blood vessels, urinary bladder, uterus, etc. muscles of alimentary canal contract to push that show peristalsis or food down.	Movement of the parts or contents of the part not under the control of our will.
Cardiac muscles (heart muscles) Exclusively present in the heart. They contract and relax rapidly, rhythmically and tirelessly, contracting and relaxing endlessly from early embryonic stage until death.	Striped seen on muscle fibre, short and branched, joined by intercalated discs. 	Heart muscles.	Contract and relax on their own.

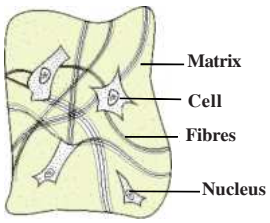
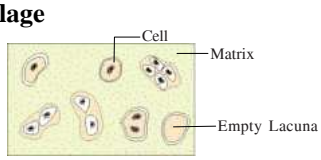
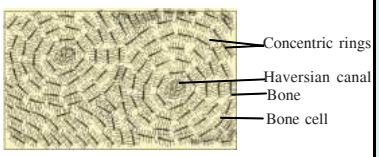
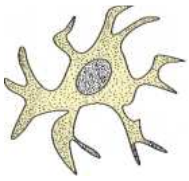
(c) Connective tissue

Connective tissue, as the name suggests, connects organs. Basically, connective tissue has matrix, connective tissue cells and connective tissue fibres. Example of connective tissue are areolar tissue, adipose tissue, cartilage, bone and blood.

Functions of connective tissue:

- It binds different structures with one another, e.g. Tendons bind bone to a muscle; ligaments connect bones.
- forms a supporting framework. e.g. cartilage and bones in the body.
- Adipose connective tissue helps in storage of fats. It also forms shock-proof; cushions around kidneys, ovaries and eyeballs.
- Blood is also a connective tissue.

Table 21.5: Types of connective tissues

Type	Nature of tissue	Example/location	Function
Fibrous tissue 	Cells usually separated from one another by intercellular spaces. This space is filled with solid or liquid material.	Tendon Ligament Adipose (fat) tissue	Connect muscle to bone; connect two bones; packing and binding of most organs; store fat
Cartilage 	Thick: semi-transparent and elastic.	In nose, ears, walls of windpipe and at ends of long bones	Provide support and strength
Bone  	Hard and porous; consists of both living cells and rigid mass of non-living cells.	Ribs, thigh bone, backbone, etc.	Provide support and strength; help in movement
Fluid connective tissue	Contains both cellular and fluid parts	Blood and lymph	Transport of gases and chemical substances; protection from disease- causing germs

NERVOUS TISSUE

Nervous tissue consists of nerve cells or **neurons**. A bundle of nerve fibres or axons of nerve cells forms nerves. A nerve cell or neuron is a structural and functional unit of the nervous system (Fig.21.10). A typical nerve cell consists of the following parts:

- Cell body or cyton
- Dendrons and dendrites

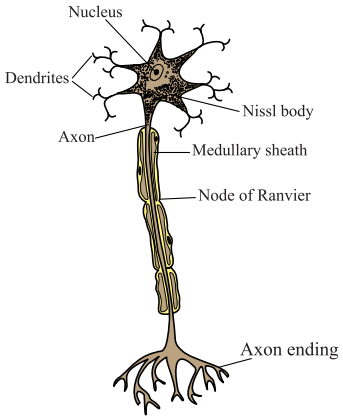


Fig.21.10 A nerve cell or neuron

- Axon

(See also Fig. 23.3 of lesson 23 entitled 'Control and Coordination')

Cell body or cyton has a prominent nucleus and cytoplasm, cell organelles like mitochondria, golgi-bodies, etc. are also present in the cytoplasm.

Several thread like extensions called **dendrons** arise from the cell body. One of them is long and called **axon**. The axon may be or may not be covered by myelin sheath or medullary sheath. This sheath is constricted at intervals which are known as **nodes of Ranvier**.

The space between axon endings of one nerve cell and the cell body or cyton of another nerve cell is the **synapse**.

ACTIVITY 21.5

Collect pictures of, or draw these organs of the body which contain (a) muscular tissue (b) connective tissue (c) epithelial tissue and (d) nervous tissue

21.6 STEM CELL TECHNOLOGY

Stem cells are undifferentiated (unspecialized) cells in our body which have the capacity to undergo mitosis and differentiate into specialized cell types and can redivide to produce more stem cells. Stem cells may be obtained from an embryo, the umbilical cord and bone marrow in adults.

Medical research shows that stem cell therapy can replace tissues damaged due to human disease. A number of adult stem cell therapies already exist, such as bone marrow transplant to treat blood cancer. Stem cells have potential uses as given below:

- To replace damaged tissues
- To study human development
- To test new drugs
- To devise methods of gene therapy

INTEXT QUESTIONS 21.3

1. Name the following:
   (i) The kind of tissues present at the stem tip of a flowering plant.

(ii) The tissue which connects muscle to the bone.

(iii) The kind of tissue which forms the inner lining of blood vessels.

(iv) Undifferentiated cells which can divide through mitosis and differentiate into specialized cell types.

2. Where do you find the following in the human body?

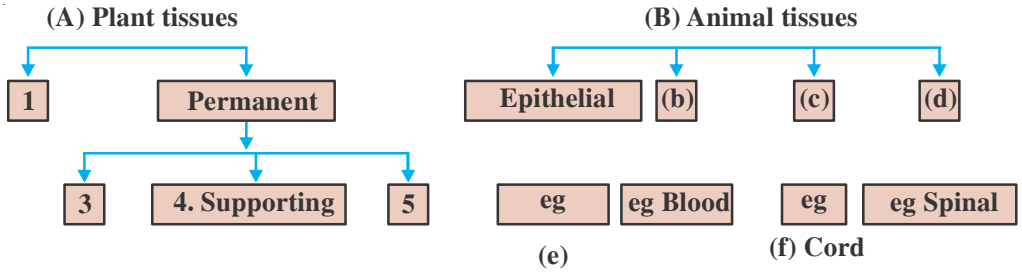
(i) Nodes of Ranvier

(ii) Ciliated epithelium

(iii) Smooth muscles

(iv) Fluid connective tissue

3. In the flow chart given below fill in the blanks



WHAT YOU HAVE LEARNT

- A cell is the structural and functional unit of all living beings.
- Cell membrane is selectively permeable; it allows only selected substances to pass through it.
- Nucleus controls all metabolic and other activities of the cell, hence it is called the master of the cell.
- Endoplasmic reticulum helps in intra-cellular transport, hence it is known as the circulatory system of the cell.

- Ribosomes help in protein synthesis inside the cell. Hence, they are called protein factories of the cell.
- Mitochondria are miniature biochemical factories, where foodstuffs are oxidized and energy is released which is stored in the form of ATP.
- Tissues can be defined as a group of cells more or less alike in size, shape, performing the same function and having a common origin.
- A permanent tissue is a group of cells in which growth is either stopped completely or for the time being.
- In epithelial tissue, cells are closely placed and form a continuous sheet. The cells of epithelial tissue rest on basement membrane.
- The muscular tissue consists of long narrow cells called muscle fibres which are held together by connective tissue.
- Blood and lymph are fluid connective tissue, they flow to all body parts, hence these are called connective tissues.
- Stem cells are biological cells which can divide through mitosis and differentiate into specialized cell types and can self renew to produce more stem cells.

TERMINAL EXERCISES

1. Name the kind of plant tissue found
   (i) at the growing parts of the plant.
   (ii) at the root tip.
   (iii) in vascular bundles.
   (iv) in the inner lining of the intestine.
   (v) Connecting the adjacent muscle fibres.
2. State one point of difference between the following (one key difference only).
   (i) Cytoplasm and protoplasm
   (ii) Cell wall and cell membrane
   (iii) Ribosomes and mitochondria
   (iv) Blood and lymph
   (v) Cell and tissue
   (vi) Cartilage and bone
   (vii) Meristematic tissue and permanent tissue

3. Answer these questions.

   (i) Which cell organelle is responsible for the release of energy in the form of ATP?

   (ii) What is the significance of cell membrane?

   (iii) Why are mitochondria known as the 'powerhouse' of the cell?

   (iv) What will happen to a cell if its nucleus is removed?

   (v) Is this statement true or false: Plant cells have chloroplasts, but no mitochondria? Justify your answer.

   (vi) Mention three features found only in plant cells and one found only in animal cells.

   (vii) Name three kinds of permanent tissues found in plants. Write one function of each.

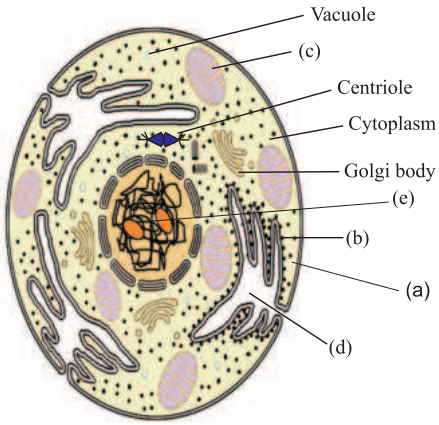
   (viii) What is a protective tissue? Why is epidermis considered as a protective tissue?

   (ix) What is stem cell technology? Give its two uses in disease control.

4. Given below is an incomplete table relating to certain structures found in animal/ plant cell, their location and function. Study the table and then give the appropriate answer in terms of structure, location and function for the blanks numbered from 1 to 9.

Structure	Location	Function
1 _____	2 _____	Photosynthesis
3 _____	Animal cell	Spindle formation during cell division
Cell wall	4 _____	5 _____
6 _____	7 _____	Selectively permeable membrane
Nucleolus	8 _____	9 _____

5. Given alongside is a figure of a cell.



   (i) Is this a plant cell or an animal cell?

   (ii) Name the parts labelled a, b, c, d and e.

   (iii) Which of these parts help(s) in protein synthesis?

   (iv) Which of these parts is also known as the powerhouse of the cell? Give reasons in support of your answer.

   (v) Write the most important function of part labelled 'a'.

ANSWERS TO INTEXT QUESTIONS

21.1

1. (i) F. It allows only selected substances to pass into and out of the cell.
   (ii) T.
   (iii) F. Lysosomes are often called suicide bags.
2. (i) Cell wall
   (ii) Plasma membrane
   (iii) Cytoplasm
3. 1. (d)
   2. (c)
   3. (e)
   4. (a)
   5. (b)
4. Cell showing cell membrane, cytoplasm and nucleus
5. (i) Body of all the living organisms are made of cells
   (ii) New cells arise by division of pre-existing cells
   (iii) Function of the body rebuilt from functions of its cells

21.2

1. Mitosis
2. Mitosis
3. (i) mitosis (ii) Meiosis (iii) Mitosis
4. testis, ovary

21.3

1. (i) Meristematic (ii) Fibrous tissue
   (ii) Unstriped or unstraited muscle (iii) Stem cells
2. (i) Nerve cell
   (ii) Inner lining of stomach/inner lining of intestine/inner lining of trachea (wind pipe).
   (iii) Wall of blood vessels/urinary bladder/uterus
   (iv) Blood and lymph
3. (A) (i) Meristematic, (3) Protective (5) Conducting
   (B) (b) Connective (c) Muscular (d) Nervous (e) Skin (f) Limb