

Tissue: A tissue may be defined as the group of cells that are similar in structure and organization and work together to perform a particular function. This cluster of cells is arranged and designed in such a way that the highest possible efficiency of function is achieved. Some tissues are blood (Fluid connective tissue), xylem and phloem (conductive tissue) etc.

Plants and animals have different types of tissues.

Plant Tissues

Plants body is composed of different types of tissues to perform different functions. Various types of plants tissue are discussed under:-

A) Meristematic Tissue:-

The tissues in plants which divide continuously to bring plant growth are called Meristematic tissue. The main characteristics of the meristematic cells are.

1. They may be rounded, oval, polygonal or rectangular in shape.
2. They have cell walls made up of cellulose.
3. They lack intercellular spaces.
4. They do not have vacuoles.
5. They have dense granular cytoplasm and large nuclei.

Functions of Meristematic tissue:-

1. Meristematic tissues have the ability to divide, hence they continuously produce new cells which keep differentiating to form specialized cells of the plant.
2. The cells at the root and shoot tip bring about an increase in the length of the plants.
3. The cells in the lateral region i.e. cambium bring about an increase in the girth (thickness) of the plant.

Types of Meristematic tissue:-

Depending upon positions of meristematic tissue in plant body, meristematic tissues are of following types.

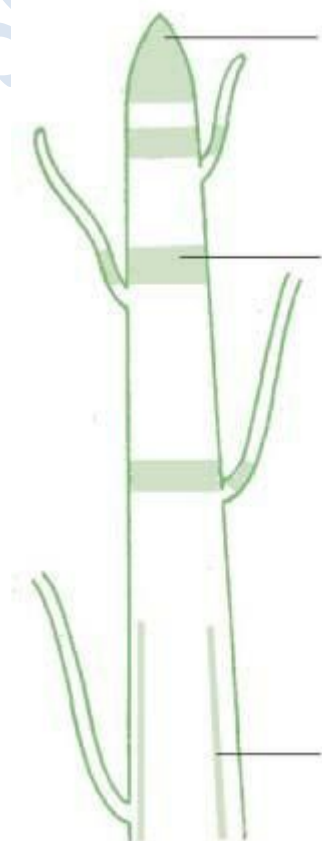
1. **Apical meristem:-** It is found at the apices of the stem and roots i.e. at the growing units.
2. **Intercalary meristem:-** This type of meristem is usually found at the base of internodes leaves.
3. **Lateral meristem:-** These meristem occur laterally in the axis, parallel to the sides of stems and roots. The lateral meristem is responsible for increase in thickness by the addition of secondary tissues and this phenomenon is known as secondary growth.

B) Permanent Tissues:-

A permanent tissue is a group of cells in which the growth has either stopped completely or for the time being. These cells may be dead or alive thin-walled or thick walled.

Permanent tissues have been classified as:

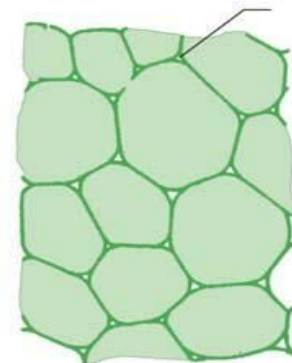
1. Simple tissues
2. Complex tissues
3. Special or Secretory tissues.





1. **Simple permanent tissue:-**

Simple permanent tissue is a group of cells which are all alike in origin, form and function. The following are the main types of simple permanent tissue:-



Parenchyma:-

Structure:-

1. Parenchyma cells are isodiametric i.e. more or less equally expanded on all sides.
2. They could be oval, spherical or polygonal in shape.
3. They have thin cell walls. Their cell walls are made up of cellulose.
4. There may or may not be intercellular spaces between them.
5. They are living cells and contain dense cytoplasm.
6. The cells have a distinct nucleus and a large central vacuole.

Location:-

Parenchyma is the most common and the least specialised tissue. It is regarded as the fundamental or ground tissue. It is widely distributed in the stem, root, leaves, flowers and fruits. It is present in all soft parts of the plant like pith and cortex of stem and in the roots and mesophyll of leaves.

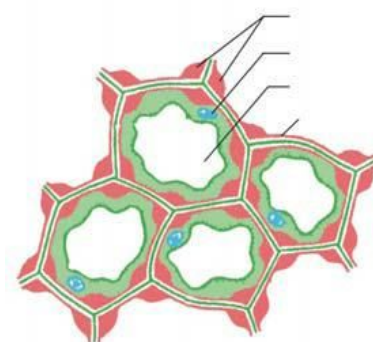
Functions:-

1. The main function of parenchyma is storage of food material. For example, potato tubers store starch in amyloplasts.
2. It basically forms the packing tissue between more specialised tissues.
3. By maintaining the turgidity of cells, they give mechanical strength to the stems of herbaceous plants.
4. Being thin walled, they allow transport of water and mineral salts in plants.
5. In certain plants, parenchymatous cells store waste products like tannins, essential oils, resins, gums, mineral crystals etc.
6. In leaves, spongy parenchymas have number of intercellular spaces between them allowing exchanges of gases.
7. Parenchyma cells of leaves contain chlorophyll and are called chlorenchyma. They carry photosynthesis and manufacture sugar and starch.

Collenchyma: -

Structure:-

1. Collenchyma consists of somewhat elongated cells with corners which may be circular, oval or polygonal in a cross-section.
2. They have thin cell walls but are irregularly thickened at the corners where numbers of cells join together.
3. These corners are thickened due to extra deposition of cellulose and pectin.
4. There is no intercellular space between the cells.
5. Their cell walls may have simple pits here and there.
6. Like parenchyma, they are living cells and have a distinct nucleus and dense cytoplasm.
7. They often contain chloroplasts.





Location:-

They are generally distributed in the peripheral portions of stems and leaves. They frequently occur in regions of the plants which are growing rapidly and need to be strengthened. They are present below the epidermis in dicot stems and in the petiole and midrib of dicot leaves.

“They are absent in dicot-root, and in monocot stems, roots and leaves.”

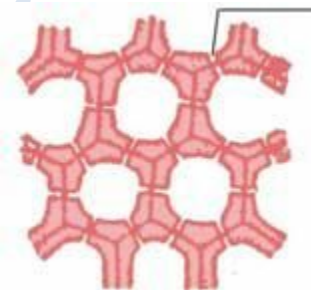
Functions:-

1. Their primary function is to give mechanical support to herbaceous plants and leaves.
2. They provide tensile strength and flexibility to the organ in which they occur.
3. Since they contain chloroplast, they also manufacture sugar and starch.

Sclerenchyma:-

Structure:-

1. Unlike parenchyma and collenchymas, sclerenchyma cells when mature are dead and without any protoplasm.
2. They are long, narrow and thick walled cells with tapered ends.
3. They have thick walls due to deposition of a waterproof material called lignin.
4. Often depositions on the walls are so heavy that they almost fill the entire cell and so the cell cavity or lumen is nearly absent.
5. They have simple, often oblique pits in their cells. Pits are the places where lignin is not deposited.
6. Sclerenchymatous cells are closely packed without intercellular spaces.



Location:-

1. The sclerenchyma cells are found in abundance in stems, roots, veins of leaves, seeds and nuts.
2. They occur collectively in patches and are packed into bundles.
3. Fibres are aggregated into stands. Jute and coir are obtained from thick bundles of fibres.

Functions:-

1. Their main function is to give mechanical support to the plant.
2. They give rigidity to the plant and enable it to withstand various strains like when strong winds or other forces bend the plants, they prevent tearing of the plant body.
3. Fibres being strong and flexible are used in the manufacture of ropes and textiles. Jute and coir are obtained from thick bundles of fibres.
4. Sclereids impart toughness to seed coats and shell and grittiness to fruit pulp.



2. Complex tissues:-

Complex tissues are comprised of different kinds of cells, all adapted to perform a common function and work together as a single unit. Xylem and phloem are two main complex tissues.

Xylem:- It is a complex tissue meant for upward conduction of water and minerals from roots to aerial parts of plant. Xylem consists of four types of cells:-

- Tracheids
- Xylem vessels
- Wood parenchyma
- Wood fibres

- 1. Tracheids:-** These are tube-like dead cells with thick and lignified walls. Tracheids are mainly concerned with the conduction of water and minerals from roots to the leaves.
- 2. Vessels:-** These are also known as tracheae and resemble tracheids in structure and function. But unlike tracheids these are like long tubes arranged in vertical rows formed of cylindrical cells arranged end to end with their end wall completely or partially dissolved.
- 3. Wood parenchyma:-** These are also known as xylem parenchyma. These are living parenchymatous cells. They serve for the storage of reserve food and also assist in the conduction of water through tracheids and vessels.
- 4. Wood fibre:-** These are dead sclerenchymatous fibres. They provide mechanical strength to xylem.

Functions of xylem:

Xylem has two basic functions in a plant.

- Xylem conducts water and mineral salts upwards from roots to leaves and to different parts of the plant. Vessels and tracheids form continuous channels. Water passes through the empty lumens without any obstruction by the living tissues.
- The components of xylem like tracheids, vessels and sclerenchyma have thick lignified walls and so they give mechanical strength to the plant body. Xylem sclerenchyma does not conduct water but adds to the strength of the tissue.
- Xylem parenchyma, the only living tissue of xylem, helps in lateral conduction of water and storage of metabolic wastes.

Phloem:- Phloem is another type of complex tissue. It aids in the conduction of food from leaves to other parts of a plant. It is composed of following types of cells:-

- Sieve tubes
 - Companion cells
 - Phloem parenchyma
 - Phloem fibres or Bast fibres
- e) Sieve tubes:-** The sieve tubes are composed of living, slender and elongated tubular cells placed end to end. They have large cavities. The cell walls are thin and made up of cellulose. They aid in conduction of synthesized food such as amino acids and carbohydrates from leaves to other parts of plant body.
- f) Companion cells:-** They have derived this name because of their association with sieve tubes. These are living elongated cells with thin walled lying parallel to sieve tubes.
- Phloem parenchyma:-** These are living cylindrical parenchymatous cells. They are usually absent in monocotyledons.
 - Phloem fibres or Bast fibres:-** These are the sclerenchymatous cells commonly found in secondary phloem but absent in primary



Functions:

The main function of phloem is translocation of prepared food material from leaves to various parts of the plant for storage and growth.

Difference between Xylem and Phloem:

Xylem	Phloem
(i) Conducts water and minerals from root to leaves.	(i) Translocates prepared food from leaves to different parts of the plant.
(ii) Only one type of cell that is xylem parenchyma is living cells.	(ii) Have three types of living cells sieve tubes, companion cells and phloem parenchyma.
(iii) The main conducting cells the vessels are dead cells.	(iii) The main conduction cells – the sieve tubes are living cells.
(iv) Also provide mechanical strength to the plant.	(iv) Do not provide mechanical strength to the plant.

3. Special tissues:-

These are also known as secretory tissues. These are special structures or glands associated with the secretion or excretion of certain products like germs, resins latex etc.

Animal Tissues

Animal have different kinds of tissue to perform different body functions. The main animal tissues are:-

1. Epithelial tissue:-

The epithelial tissue forms the covering on external body surface and internal body organs and lines the body cavities and cavities of hollow body organs blood

vessels and ducts. The term epithelium (epi-upon, thelio-to grow) was used by Dutch Anatomist Raysch. The cells of epithelial tissue are closely packed and form continuous sheets. Epithelial cells possess power of regeneration. Epithelial tissue is of following types:-

1. Simple epithelial tissue
2. Stratified (multilayered)
3. Specialised

1. Simple epithelial tissue:- It is composed of only one layer of epithelial cells. It is of following types:-

a) Squamous epithelium:- It is formed of a single layer of flattened, palte-like or scale-like (sqiama-scale) polygonal cells. These are closely fitting like the tiles in mosaic floor.

b) Cuboidal epithelium:- It consists of a single layer of isodiametric cubical cells with centrally located round nucleus. It carries out the function of secretion, absorption and excretion.

c) Columnar epithelium:- Its cells are long and pillar like. Their height exceeds their width. Their nuclei are also elongated and lie in the basal part.

2. Stratified or Compound Epithelium:- The compound epithelium is formed of several layers of epithelial cells. Its innermost layer is formed of continuously dividing cells known as germinative layer or Malpighian layer. Its outer layer is made of dead cornified cells known as stratum corneum.

FUNCTIONS of epithelial tissue:

1. Protection: Epithelial tissue covers the entire body surface, thereby it protects the underlying cells from drying, injury, bacteria or viral infections and from harmful effects of chemicals. Inside the body, it forms the lining of the mouth and alimentary canal and protects these organs.

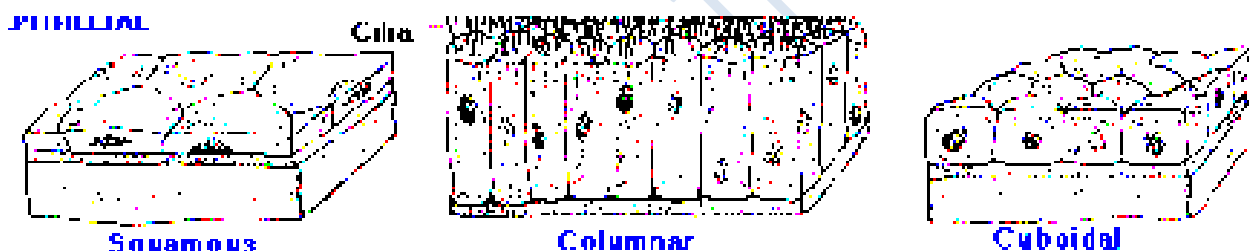
2. Exchange of materials: Being extremely thin, simple epithelium allows diffusion of gases or materials e.g. in the lungs and blood capillaries.

3. Absorption: Epithelial cells may have a number of infoldings at their surface, thereby increasing the surface area. Such cells help in absorption of water and other nutrients as in intestine.

4. Elimination of waste products: Some epithelial cells like those in nephron and sweat glands help in removal of wastes from the body.

5. Secretion: number of epithelial cells is modified to produce secretions which could be in the form of mucous, enzymes or hormones.

6. Sensory: the epithelial cells having sensory cells and nerve endings are specialized to receive external stimuli and give response e.g. skin.



It is the binding and supporting tissue. It is distributed throughout the body and forms about 30% of the body. The connective tissue is formed of three components viz., the cells, matrix and fibres.

1. Cells:- Cells are found scattered in the matrix and may store fat, produce new blood cells ingest bacteria and cell debris etc.
2. Matrix:- It is non-living intercellular substance. It may be homogenous, amorphous etc.
3. Fibres:- Fibres are elongate and found scattered in the matrix.

Types of Connective Tissues

Connective tissue is of following types:-

- 1. Areolar tissue:-** The areolar tissue is most abundant in the body. It forms the frame work of all body organs and acts as packaging material between the body organs. Its matrix is thick homogenous and transparent. It contains white and yellow fibres.
- 2. Adipose tissue:-** In adipose tissue fibres are scanty. The cells are large and closely packed. They store fat in the form of large fat globules and squeeze the cytoplasm to periphery and nucleus to one side. The adipose tissue lies beneath the skin. The adipose tissue lies beneath the skin. It forms a padding between the organs and around viscera. The adipose tissue contains reserve food and insulates the body against heat loss and protects the joints against friction.

3. Supporting connective tissue:- The skeletal tissue forms a strong frame work. It supports the body, protects vital organs and provides hard surface for the insertion of muscles. The skeletal tissue occurs in two forms i.e. bone and cartilage

a) Cartilage:- It is tough transparent and homogenous formed of a special glycoprotein known as chondromucoid. The cartilage increases in size by the addition of new layer of matrix. There are four types of cartilages.

i) Hyaline cartilage:- It is glassy bluish white. Its matrix is translucent homogenous, fibreless and somewhat elastic. It occurs between ribs and sternum, in the nasal septum, larynx and tracheal rings. Hyaline cartilage forms the embryonic skeleton. The matrix of hyaline cartilage is called chondrin.

ii) White fibrous cartilage:- It contains thick dense bundles of collagen fibres in the matrix. IT is very firm. It is found between the vertebral where it acts as cushion and makes the joints strong.

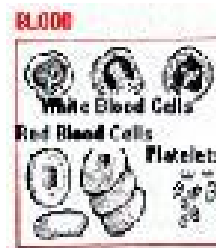
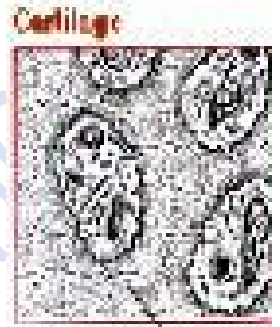
iii) Elastic cartilage:- It contains yellow elastin fibres which provide elasticity. It is found in external ear, eusta chain tube and epiglottis. IT is firm but flexible.

iv) Calcified cartilage:- It has calcium salts deposited in the matrix. IT is very hard and inelastic.

b) Bone:- Bone is very hard and rigid tissue. Its matrix is hard, formed of a protein called ossein. It contains interlacing white collagenous fibres and is heavily deposited with salts of calcium and phosphorous. The organic and inorganic matter in the matrix form about 30% and 70% respectively. The bone cells are called osteocytes.

4. Blood: Blood is red coloured tissue. It is salty in taste, slightly basic (pH 7.3-7.5). It forms 7% of the body weight (about 5 litres). Blood is complex transparent medium. It performs vital pickup and delivery services for the body. It is formed of

1. Fluid matrix-Plasma
2. Blood cells-Corpuscles.



1. Plasma:- Plasma is a straw coloured fluid and makes up about 60% of total blood volume or about 5% of the body weight.

It contains:-

a) Water:- It forms 85 to 90% of the total plasma

b) Inorganic ions:- Constitute about 0.9% of plasma. The anions are chlorides, bicarbonates phosphates and sulphates and cations are sodium, potassium, calcium and magnesium

Organic compounds are:-

1) Plasma proteins or serum proteins. They make up 6-8% of plasma

2) Blood corpuscles:- these are found suspended in plasma and are discussed under:-



- 1. Erythrocytes:-** These cells contain haemoglobin and help in transport of oxygen and to some extent CO₂. Mammalian RBCs are smaller enucleated and roughly circular and biconcave when mature these are without nucleus, Golgi body, ER, mitochondria, ribosomes and centrosome. Normal erythrocyte is:
 - a) Man 5 to 5.5 million RBC per cubic millimeter of blood.
 - b) Woman 4.5 to 4.8 million RBC per cubic millimeter of blood.
- 2. Leucocytes:-** White blood corpuscles WBCs white blood corpuscles are nucleated amoeboid cells. These are colourless, rounded or irregular. These number 5000 to 9000 per cubic millimeter of blood. The new WBCs are formed in lymph nodes, spleen and thymus. The process of their formation is called leucopoiesis. Leucocytes exhibit phagocytosis and amoeboid movement. These are described as mobile factor of the body's defence system

Functions of connective tissue:

Connective tissue is basically a binding and a packaging tissue but has many other important functions as well.

1. It binds various tissues together like skin with the muscles and muscles with the bones.
2. The areolar tissue forms sheaths around the body organs and makes a kind of packaging tissue.
3. The adipose tissue stores fat and insulates the body against heat loss.
4. The bones and cartilage give shape and form framework of the body.
5. The blood circulates and connects various parts of the body.
6. The lymph helps in building immunity by producing antibodies.

Muscular Tissue:-

Muscular tissue is formed of greatly elongated and highly _____ muscle cells which are called muscle. These are placed together in the connective tissue to form bundles. The intercellular substance or matrix is absent. Muscles are responsible for all outward manifestations of life. There are three types of muscular tissue.

1. Smooth muscles or unstriated muscles.
 2. Striped muscles or striated muscles.
 3. Cardiac muscles
- 1. Smooth muscles or unstriated muscles:-** These are also known as plain or smooth or non-skeletal muscles. These are found in close association with the connective tissue. These muscles form contractile portion of the wall of hollow. Visceral organs digestive tract and of the urinary and genital ducts.
 - 2. Striped or striated muscles:-** The striated muscles form the flesh of the body and about 80% of the mass of soft tissue of the body. These are mostly attached to the skeleton. Hence they are known as skeletal muscles.
 - 3. Cardiac muscles:-** The cardiac muscles are exclusively found in the heart. These contract rapidly rhythmically and tirelessly, contracting endlessly from early

embryonic stage until death. The cardiac muscles are branched and form a network on the wall of heart.

Nervous Tissue:-

The nervous tissue is specialized for receiving and transmitting stimuli. It consists of

1. Nerve cells or neurons
2. Nerve fibres
3. Neuroglia

1. Nerve cells:- The neurons are large polymorphic cells consisting of cell body or cyton. These usually comprise several short dendrites and a single axis cylinder or axon. The cyton consists of large nucleus surrounded by cytoplasm, the perikaryon. The dendrites through their synapses with the axon endings receive nerve impulses from other neurons and carry them to the cell body. Thus these are the chief receptive organelles of neuron.

2. Nerve fibres:- Each nerve fibre consists of a central core of axon, a drawn out portion of neuroplasm which is now known as axoplasm and the encircling plasma membrane called axilemma or neurilemma.

3. Neuroglia:- Associated with the neurons in the central nervous system are seen special cells which are known as neuroglia.



Functions of Nervous Tissue:

Neurons are specialized cells which receive and conduct sensation in the form of electrical impulses.

1. A nerve impulse always travels from the cell body towards the axon. The dendrites receive the impulse and the axon takes impulse away from cell body.
2. The impulses travel from one neuron to another through junction points called synapses.

