TISSUE

PLANT TISSUES

Plant tissues are characterized and classified according to their structure and function. The organs that they form will be organized into patterns within a plant which will aid in further classifying the plant.

Types of Plant Tissues

1. MERISTEMATIC TISSUE

- Meristematic tissue is growth tissue and the location of most cell division.
- It is known as undifferentiated tissue because cells in the meristematic tissue will eventually become vascular, ground, or dermal tissue.
- Plants generally grow where meristematic tissue is present. At the tips of roots and stems, the meristematic tissue is called the apical meristem.
- There are 3 meristematic regions in the plant:
- **Apical meristems** are located at the apices or tips - at root and shoot tips and are directly involved in their elongation. They create derivatives which form primary growth. These primary meristems will produce the cells that will form the primary tissues.
- The protoderm which forms the outer dermal layer of tissues,
- The ground meristem which forms the cortical cells.
- The procambium which forms the vascular tissue.

II. **Lateral meristem** are responsible for horizontal expansion(secondary growth)

a. **Vascular meristem or cambium :** internal growth in girth which involves secondary tissues (xylem and phloem). In the fasicular region the cambial cells which divide toward the center form xylem tissue and towards the outside phloem tissue. Interfasicular indicates the cambium between the 'fasides of xylem & phloem.

b. **Cork cambium :** external girth growth beyond the phloem area. They form the characteristic corky layer as well as an internal layer. It is only found in woody plants, as it will produce the outer bark.

III. **Intercalary meristem**

- Intercalary meristems are found in grasses and related to plants that do not have a vascular cambium or a cork cambium, as they do not increase in girth.
- These plants do have apical meristems and in areas of leaf attachment, called nodes, they have the third type of meristematic tissue.
- This meristem will also actively produce new cells and is responsible for increase in length.
- The intercalary meristem is responsible for the regrowth of cut grass.
- **Primary Growth:** The primary growth of the plant occurs in the apical meristem. The growth in length of a plant part is due to primary growth.
- **Secondary Growth:** Lateral growth or growth in thickness in a plant is called secondary growth, which occurs in lateral meristem tissue. Woody trees and shrubs display secondary growth when the plants become enlarged and thickened.

2. PERMANENT TISSUE

- When the cells formed by meristematic tissue take up a specific role and lose the ability to divide. As a result, they form a permanent tissue.
- This process of taking up a permanent shape, size, and a function is called differentiation.
- Cells of meristematic tissue differentiate to form different types of permanent tissue.

1. Simple permanent tissues

- These tissues are called simple because they are composed of similar types of cells which have common origin and function.It is also known as Ground tissue as it generally forms either the pith, cortex or bulk of leaf (mesophyll). They are further classified into:

(I) Parenchyma

(II) Collenchyma

(III) Sclerenchyma

Parenchyma:

- Parenchyma is Greek word where "paren" means besides and "enchien" means to pour.
- Parenchyma is the most specialized primitive tissue. It mainly consist of thin-walled cells which have inter-molecular spaces between them.
- The cell wall is made up of cellulose.
- Each parenchymatous cell is iso-diametric, spherical, or oval in shape.
- It is widely distributed in various plant organs like root, stem, leaf, flowers and fruits. They mainly occur in cortex epidermis, pith and mesophyll of leaves.

Function of Parenchyma:

- The main function of parenchymatous tissue is assimilation and storage of reserve food materials like starch, fats and proteins.
- They also store waste products such as gums, resins, and inorganic waste materials.

Specialized parenchyma:

- Chlorenchyma- photosynthetic cells; have high density of chloroplasts
- Aerenchyma- prominent intercellular spaces that improve gas exchange capacity of the tissue; provide maximum support with a minimum metabolic requirement, abundantly present in aquatic plants.
- Transfer cells- specialized for short distance transfer of solutes between cells; have secondary cell walls; they are inner extensions of wall that increase surface area.

Collenchyma

- Collenchyma is Greek word where "Collen" means gum and "enchyma" means infusion.
- It is a living tissue of primary body like Parenchyma. Cells are thin-walled but possess thickening of cellulose and pectin substances at the corners where number of cells join together.
- This tissue gives a tensile strength to the plant and the cells are compactly arranged and do not have inter-molecular spaces.
- It occurs chiefly in hypodermis of stems and leaves. It is absent in monocots and in roots.

Functions of Collenchyma:

- Collenchymatous tissue acts as a supporting tissue in stems of young plants.
- It provides mechanical support, elasticity, and tensile strength to the plant body.
- It helps in manufacturing sugar and storing it as starch.
- It is present in margin of leaves and resists tearing effect of the wind.

Sclerenchyma:

- Sclerenchyma is Greek word where "Sclerenes" means hard and "enchyma" means infusion.
- This tissue consists of thick-walled, dead cells. These cells have hard and extremely thick secondary walls due to uniform distribution of lignin.
- Lignin deposition is so thick that the cell walls become strong, rigid and impermeable to water.
- Sclerenchymatous cells are closely packed without intra-cellular spaces between them. Thus, they appear as hexagonal net in transverse section.
- The cells are cemented with the help of lamella. The middle lamella is a wall that lies between adjacent cells.
- Sclerenchymatous cells mainly occur in hypodermis, pericycle, secondary xylem and phloem. They also occur in endocarp of almond and coconut. It is made of pectin, lignin protein.

Types of Sclerenchyma

- Fibres- Fibres are long, elongated sclerenchyamtous cells with pointed ends.
- Sclerides- Sclerenchymatous cells which are short and possess extremely thick, lamellated, lignified walls with long singular pits. They are called sclerides.

Function of Sclerenchyma: The main function of Sclerenchymatous tissues is to give support to the plant.

2. Complex permanent tissue

A complex permanent tissue may be classified as a group of more than one type of tissue having a common origin and working together as a unit to perform a function. These tissues are concerned with transportation of water, mineral, nutrients and organic substances. The important complex tissues in vascular plants are xylem, phloem.

Xylem : Xylem is a chief , conducting tissue of vascular plants. It is responsible for conduction of water and inorganic solutes. It can be divided into 4 types.

Tracheids : Trachids are elongated, tube-like dead cells with elongated end-walls. End walls remain intact and possess pits. In transverse section, they usually occur as polygonal cells and lignified walls.

Vessels : Vessels are placed one upon another. Their end walls are perforated. They form long tubes or channels for conduction of water and minerals.

Xylem Parenchyma : Xylem Parenchymatous cells are living cells present in xylem. They help in lateral conduction of organic solutes and storage reserves.

Xylem Fibres : Xylem Fibres are lignified fibres present in xylem which provide mechanical strength to the plant body.

Xylem is a major conducting tissue of vascular plants. It serves in upward movement of water and minerals from root to different parts of plant.

Phloem : Phloem is a chief conducting tissue of vascular plants. It is regarded as a living tissue responsible for translocation of organic solutes. It can be divided into 4 types.

Sieve tube : Sieve tubes are long tubular structures composed of elongated sieve tube elements placed one above other forming a continuous tube.

Companion cell - Companion cells are living cells always associated with sieve tubes. Sieve tube elements and companion cells arrive from the same, initial cell and therefore forms a single functional unit. Each companion cell shows presence of fine pits with all the living components of the cell.

Phloem Parenchyma - These cells are living parenchymatous cells that are present in phloem. These cells help in storage of food.

Phloem Fibres - Phloem fibres are formed by dead, sclerenchymatous fibres.

The main function of phloem is translocation of organic solutes from the leaves to the storage organ and later from the storage organ to the growing part. Sieve tube allows free diffusion of soluble, organic substances across sieve plates due to the presence of large number of sieve pores.

Theories explaining growth of the plant at its apex and root tip

- There are two important theories that explain the growth of a plant at the extremities of shoot and root. They are

  (1) Tunica corpus theory (2) Histogen theory.

Tunica Corpus Theory :

- Tunica corpus theory was developed for vegetative shoot apex.
- According to this theory, there are two zones of tissues in the apical meristems the tunica (Tunic = cover) consisting of one or more layers of peripheral layers of cells, and the corpus (corpus = body) a mass of cells enclosed by the tunica.
- According to the theory, different rates and methods of growth in the apex set apart two regions.
- The layers of tunica show anticlinal (perpendicular to periphery) divisions and bring about surface growth.
- In the corpus, cell division is irregular and at various planes resulting in growth in volume of the mass.
- Tunica gives rise to epidermis and cortex. Corpus gives rise to endodermis, pericycle, pith and vascular tissue.

Histogen Theory

- According to this theory, apical meristem of stem and root are composed of small mass of cells which are all alike and divide fast (meristematic)
- These meristematic cells form promeristem, which differentiate into three zones dermatogen, periblem and plerome.
- Every zone consists of a group of initials called a histogen (tissue builder).
  (i) Dermatogen gives rise to epidermis of stems and epiblema of roots.
  (ii) Periblem (middle layer) gives rise to cortex of stems and roots.
  (iii) Plerome gives rise to central meristematic region - pericycle, pith and vascular tissue.