Anatomy of Flowering Plants

Tissue

- It is a group of cells that are similar in structure and are organised together to perform a specific function.

- It is of two types: Meristematic tissues and Permanent tissues

- **Meristematic tissue**

- It consists of actively dividing cells that are found in those regions of the plant body that show growth.

- The examples include root tip, shoot tip, and base of the leaves.
- It is classified into three types:

i. **Apical meristem:** They are present in the growing tips of stems and roots. Function – helps in increasing the length of the stem and root
ii. **Intercalary meristem:** They lie at the base of leaves or internodes.
Function – helps in the longitudinal growth of plants
iii. **Lateral meristem:** They lie on the lateral sides of the stem and root.
Function – helps in increasing the thickness of stem and root

- Apical meristem and intercalary meristem help in the formation of the primary plant body. Therefore, they are called primary meristems.
Lateral meristem is formed in the mature regions of roots and shoots of plants. Hence, they are known as secondary meristem.

- **Complex tissues:** They are made up of more than one type of cells. All these cells work in coordinated manner to perform one common function.

- **Xylem:**It conducts water and minerals from roots to different parts of the plant.

- **Tracheids and vessels** are long tube-like structures with thick walls and tapering ends. Presence of vessels is the characteristic feature of angiosperms.

  Function: to transport water and minerals vertically

- **Xylem fibre** is made up of dead cells.

  Function: support to the cell

- **Xylem parenchyma** is made up of living cells. Function: Storage of food and helps in radial conduction of water

- **Phloem:**
- It transports food material from leaves to different parts of the plant.
- Sieve tubes are tubular cells with perforated walls.

  Function: to transport food material

- **Companion cells** are specialised parenchymatous cells, closely associated with sieve tube elements. These are characteristic features of angiosperms.

  Function: to maintain the pressure gradient in sieve tubes

- **Phloem parenchyma** is composed of living cells that help in storage of food.
- **Phloem fibres**, also called bast fibres, provide mechanical support to the cells.

Tissue System

- **Epidermal tissue system:**
- It comprises of epidermal cells, stomata, trichomes, and hairs.
- Epidermis is protective in function. Cuticle is the waxy layer present outside the epidermis.
- Cuticle prevents the loss of water. It is absent in roots.
- Stomata help in gaseous exchange and transpiration.
- Root hair helps in absorption of water and mineral from soil.
- Trichome prevents water loss due to transpiration.

- **Ground tissue system**
- It comprises of all tissues except epidermis and vascular bundles.

- **Vascular tissue system**
- It comprises of complex permanent tissues - xylem and phloem. Cambium may or may not be present.

- **Open vascular bundle:** It contains cambium between xylem and phloem. Cambium has the ability to form secondary tissues. It is the characteristic feature of dicotyledonous stem.

- **Closed vascular bundle:** It lacks cambium between xylem and phloem. Since cambium is absent, it lacks the ability to form secondary tissues. Closed vascular bundle is the characteristic feature of monocotyledonous stems.

- **Radial vascular bundle:** Xylem and phloem are arranged alternately on different radii. Such types of vascular bundles are present in roots.

- **Conjoint vascular bundle**: Xylem and phloem are arranged at the same radius of vascular bundle. Such types of vascular bundles are found in stems and leaves.

Dicotyledonous roots

- The outermost layer is epidermis whose cells protrude in the form of root hairs.
- The layer next to epidermis is cortex.
- It is composed of several layers of parenchymatous cells.
- Endodermis is innermost layer of cortex, which bears the deposition of water impermeable waxy material called suberin. These are known as casparian strips.
- In the cells of pericycle, initiation of lateral roots and vascular cambium takes place during secondary growth.
- Pith is small.
- They possess 2-4 patches of xylem and phloem.
- Vascular bundles along with pith and pericycle constitute stele.
- Dicot roots undergo secondary growth.

Monocotyledonous roots

- It has epidermis, cortex, endodermis, pericycle, xylem, phloem, and pith.
- Pith is large and well-developed.
- It does not undergo secondary growth.
- Xylem bundles are more than six i.e., polyarch.

Dicotyledonous Stem

- Epidermis is covered with cuticle; may bear trichomes and stomata.
- Cortex is differentiated as outer hypodermis (having collenchymatous cells), middle cortical layer, and inner endodermis.
- Endodermal cells are rich in starch grains. Hence, the layer is also known as starch sheath.
- Vascular bundles are many and arranged in a ring form.
- Vascular bundle is conjoint, open, and with endarch protoxylem.
- Pith is well-developed.

Monocotyledonous Stem

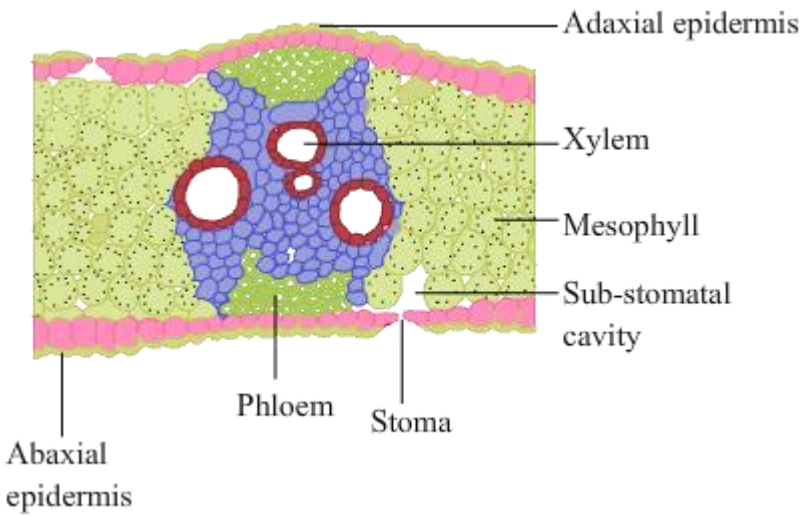
- Vascular bundles are scattered.
- Vascular bundles are surrounded by sclerenchymatous bundle sheath.
- It is conjoint and closed.

Dicotyledonous leaf

- It is also known as dorsiventral leaf.
- The abaxial (lower) epidermis bears more stomata than adaxial (upper) epidermis.
- Mesophyll is the tissue between upper and lower epidermis. It carries out photosynthesis.
- Mesophyll has two types of cells:
- **Palisade parenchyma**

Spongy parenchyma

- The vascular bundles are present in the veins and midrib region of leaves.



Monocotyledonous leaf

- It is also known as isobilateral leaf.
- Some adaxial epidermal cells in grasses are modified to form bulliform cells.
- Both the surfaces of epidermis bear stomata.
- Mesophyll cannot be differentiated into spongy and palisade parenchyma.

Secondary Growth

- Secondary growth is absent in monocotyledons, but present in dicots.
- Tissues involved are **-** Vascular cambium and Cork cambium
  Together, vascular cambium and cork cambium are known as lateral meristem.

Vascular cambium

- Intrafascicular cambium- The cells of cambium present between primary xylem and primary phloem.

- The cells of medullary rays, adjoining these intrafascicular cambium become meristematic and form the interfascicular cambium.
- Cambial ring then cut off new cells to form secondary xylem (towards pith) and secondary phloem (towards periphery).

Spring wood (Early wood): During spring season, cambium is active and forms a wood with many xylary elements that have wider vessels.
Autumn wood (late wood): Cambium is less active and forms less number of xylary elements with narrow vessels.

- The alternate concentric rings of spring (lighter in colour) and autumn (darker in colour) form an annual ring. These rings are used to estimate the age of tree.
  Heart wood contains dead elements, which gives mechanical support to stem.
  Sapwood helps in conduction of water and minerals from root to leaves.

Cork cambium (Phellogen)

- **Phellogen** is a meristematic tissue that cuts off the cell into cork or phellem (outer side) and secondary cortex or phelloderm (inner side).
- Phellogen, phellem, and phelloderm are collectively known as **periderm.**
- **Bark** – It includes periderm and secondary phloem.
- **Lenticels** – help in exchange of gases