CHAPTER

7 Anatomy of Flowering Plants

- A plant is made up of different kinds of tissues.
- Tissues are classified into two main groups, namely, **meristematic and permanent tissues** based on whether the cells being formed are capable of dividing or not.
- Meristematic tissues
  - Retain the capacity to divide.
  - Are of two types
    - **Primary:** They appear early in life, can be apical or intercalary.
    - **Secondary:** Appear later in life, are responsible for secondary growth. Fascicular vascular cambium, interfascicular cambium and cork-cambium are examples of lateral meristems.
- Following divisions of cells in both primary and as well as secondary meristems, the newly formed cells become structurally and functionally specialised and lose the ability to divide. Such cells are termed permanent or mature cells and they give rise to permanent tissues. The permanent tissues can be simple (table 1) or complex.

Table. 1: Comparison of simple permanent tissues

Characteristic	Parenchyma	Collenchyma	Sclerenchyma
Cells type	Living	Living	Dead
Function	Form bulk of the plant, may be photosynthetic	Provide mechanical support to growing parts of the plant, may be photosynthetic	Provide mechanical support to plant organs
Pits	Absent	Absent	Present
Intercellular spaces	Present	Absent	Usually absent
Cell wall	Cellulosic	Cellulosic, hemicellulosic or pectic	lignified

- Xylem and Phloem are **complex** tissues made up of different types of cells.
- Xylem
  - Conducts water and minerals from roots to leaves.
  - Endarch in stems and exarch in roots.
  - Made up of
    - **Xylem tracheids:** dead, lignified with wide lumen, transports water and minerals
    - **Xylem vessels:** dead, lignified with wide lumen, transports water and minerals, characteristic feature of angiosperms
    - **Xylem fibres:** dead, highly thickened walls and obliterated central lumens
    - **Xylem parenchyma:** living, thin-walled, store starch or fat, and tannins.
- Phloem
  - Conducts food from leaves to all parts of plant.
  - Made up of
    - **Sieve tubes:** living, long, tubular, enucleated, pores at the ends, joined with each other for transporting food materials.
    - **Companion cells:** living, specialised parenchymatous cells that help in maintaining the pressure gradient in the sieve tubes.
    - **Phloem fibres:** dead, elongated, unbranched and have pointed, needle like apices.
    - **Phloem parenchyma:** living, elongated, tapering cylindrical cells, store resins, latex and mucilage.
- **Gymnosperms** have albuminous cells and sieve cells. They lack sieve tubes and companion cells.
- Three types of tissue systems are present in plants:
  - **Epidermal:** made up of epidermis, cuticle, stomata, subsidiary cells, trichomes and root hairs
  - **Ground:** all tissues except epidermis and vascular bundles constitute the ground tissue system.
  - **Vascular tissue** system: made up of xylem and phloem.
- In **conjoint** type of vascular bundles, the xylem and phloem are jointly situated along the **same radius** of vascular bundles.
- Open and closed vascular bundles are those which possess and lack **cambium** between xylem and phloem, respectively.

Table. 2: Comparison of dicot and monocot root anatomy

Characteristic	Dicot root	Monocot root
Pericycle	Gives rise to secondary (lateral) roots and vascular cambium	Gives rise to lateral roots only
Vascular bundles	Diarch to hexarch, i.e., vascular bundles are 2 to 6 in number	Polyarch, i.e., usually more than 6 vascular bundles are present.
Cambium	Develops at the time of secondary growth	Cambium is absent. No secondary growth
Pith	Small and inconspicuous	Large and well developed

Table. 3: Comparison of anatomy of dicot and monocot stem.

Characteristic	Dicot stem	Monocot stem
Ground tissue	Differentiated into cortex and pith	Not differentiated into cortex and pith
Hypodermis	Collenchymatous	Sclerenchymatous
Endodermis	Single layered	Absent
Pericycle	Made up of parenchymatous and/or sclerenchymatous cells.	Absent
Vascular bundles	Almost all are of uniform size Arranged in a ring Conjoint and open Water-containing cavities are absent.	Larger towards centre and smaller towards periphery. Scattered Conjoint and closed water-containing cavities are present
Pith	Made up of parenchymatous cells, situated in the centre	Absent
Medullary rays	Found in between the vascular bundles	Absent

Table. 4: Comparison of anatomy of angiospermic stem and root

Characteristic	Root	Stem
Epidermis	Without cuticle	May have cuticle
Hypodermis	Absent	Present-collenchymatous in dicot and sclerenchymatous in monocot
Endodermis	Distinct	Poorly developed
Vascular bundles	Radial	Conjoint
Xylem	Exarch	Endarch

Table. 5: Comparison of Anatomy of Dicot and Monocot leaf

Characteristic	Dicot leaf	Monocot leaf
Type of leaf	Dorsiventral	Isobilateral
Stomata	Usually more in number on lower epidermis.	Equal in number on lower and upper epidermis.
Mesophyll	Differentiated into two types of tissues-palisade and spongy parenchyma.	Not differentiated into palisade and spongy parenchyma.
Bulliform cells	Absent	Present, particularly in grasses.
Vascular bundles	Differ in size due to presence of reticulate venation.	Nearly similar in size due to presence of parallel venation.

- Apart from primary growth most dicotyledonous plants exhibit an increase in girth due to the activity of two lateral meristems: vascular cambium and cork cambium.
- Vascular cambium gives rise to secondary xylem and phloem, while cork cambium gives rise to secondary cortex and cork.
- Periderm = Phellem (cork) + Phellogen (cork cambium) + Phelloderm (secondary cortex)
- Intra- and interfascicular cambium form a continuous ring of vascular cambium. This cambium cuts off cells on both sides (inner secondary xylem and outer secondary phloem).
- The amount of secondary xylem produced is more than secondary phloem. The primary and secondary phloems get gradually crushed due to the continued formation and accumulation of secondary xylem. The primary xylem however remains more or less intact, in or around the centre.
- In the spring season, cambium is very active and produces a large number of xylary elements having vessels with wider cavities to form spring wood or early wood. In winter, the cambium is less active and forms fewer xylary elements that have narrow vessels, and this wood is called autumn wood or late wood.