# Chapter-6

# ANATOMY OF FLOWERING PLANTS

## POINTS TO REMEMBER

**Anatomy :** Anatomy is the study of internal structure of organisms. Plant anatomy includes organisation and structure of tissues.

**Tissue :** A group of similar cells alongwith intercellular substance which perform a specific function.

**Meristematic tissues :** The meristematic tissue is made up of the cells which have the capability to divide. Meristems in plants are restricted to a specialised regions and responsible to the growth of plants.

**Meristems**

| Apical meristem | Intercalary meristem | Lateral meristem |
|---|---|---|
| • Occurs at the tips of roots and shoots | • Occurs between mature tissue | •Occurs in the mature regions of roots and shoots |
| • Primary meristem | • Primary meristem | • Secondary meristem |
| • Increase the length of plant | • Capable of forming branch and flower | •Appears later than primary meristem and responsible for secondary growth |



**Axillary bud :** The buds which are present in the axils of leaves and are responsible for forming branches or flowers.

**Permanent tissues :** The permanent tissues are derived from meristematic tissue and are composed of cells, which have lost the ability to divide.

**Types of Permanent Tissue**

- **Simple**
  - Parenchyma
  - Collenchyma
  - Sclerenchyma
- **Complex**
  - Xylem
  - Phloem

**Parenchyma :** Thin walled cells, with intercellular spaces, cell wall is made up of cellulose. It performs the function like photosynthesis, storage, secretion.

**Collenchyma :** It is formed of living, closely packed isodimetric cells. It's cells are thickened at the corners due to deposition of cellulose and pectin. It provides mechanic support to the growing parts of the plant.

**Sclerenchyma :** It is formed of dead cells with thick and lignified walls. They have two types of cells : fibres and sclereids.

**Xylem :** Xylem consists of tracheids, vessels, xylem fibres and xylem parenchyma. It conducts water and minerals from roots to other parts of plant.

**Protoxylem :** The first formed primary xylem elements.

**Metaxylem :** The later formed primary xylem.

**Endarch :** Protoxylem lies towards the centre and metaxylem towards the periphery of the organ.

**Phloem :** Phloem consists of sieve tube elements, companion cells, phloem fibres and phloem parenchyma. Phloem transports the food material from leaves to various parts of the plant.

**Protophloem :** First formed phloem with narrow sieve tubes.

**Metaxylem :** Later formed phloem with bigger sieve tubes.

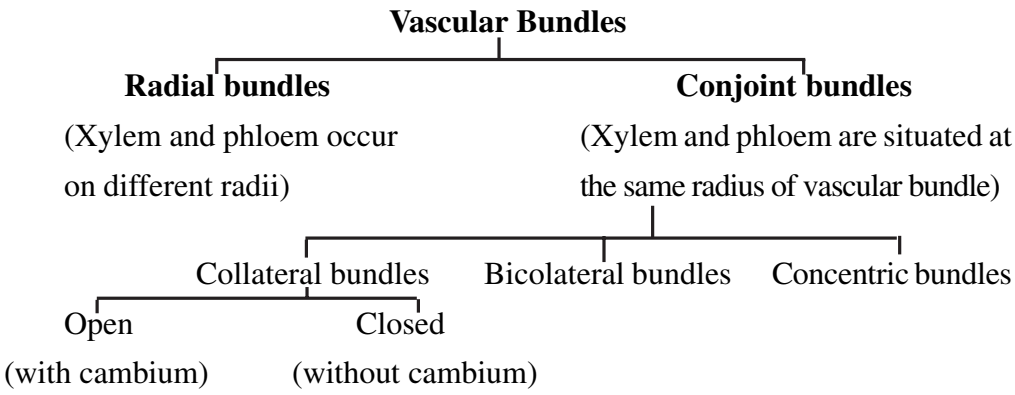
**The Tissue System :**

**1. Epidermal tissue system :** It includes cuticle, epidermis, epidermal hairs, root hairs, trichomes and stomata.



**2. The ground tissue system :** It is made up of parenchyma, collenchyma, sclerenchyma. In dicot stems and roots the ground tissue is divided into hypodermis cortex, endodermis, pericycle, medullary rays and pith.

**3. The vascular tissue system :** It includes vascular bundles which are made up of xylem and phloem.



**Anatomy of Root**

| Dicot Root | Monocot Root |
|---|---|
| 1. Cortex is comparatively narrow. | 1. Cortex is very wide. |
| 2. Endodermis is less thickened casparian stripes are more prominent. | 2. Endodermal cells are highly thickened Casparian strips are visible only in young roots. |
| 3. The xylem and phloem bundles varies from 2 to 5. | 3. Xylem and phloem are more than 6 (polyarch). |
| 4. Pith is absent or very small. | 4. Well developed pith is present. |
| 5. Secondary growth takes place with the help of vascular cambium and cork cambium | 5. Secondary growth is absent. |

**Anatomy of Stem**

| Dicot Stem | Monocot Stem |
|---|---|
| 1. The ground tissue is differentiated into cortex, endodermis, pericy and pith. | 1. The ground tissue is made up of similar cells. |
| 2. The vascular bundles are arranged in a ring. | 2. The vascular bundles are scat tered throughout the ground tissue. |
| 3. Vascular bundles are open, without bundle sheath and wedge-shaped outline. | 3. Vascular bundles are closed, surrounded by sclerenchymatous bundle sheath, oval or rounded in shape. |
| 4. The stem shows secondary growth due to presence of cambium between xylem and phloem. | 4. Secondary growth is absent. |
| 5. Stomata have kidney-shaped guard cells. | 5. Stomata have dumb bell-shaped guard cells. |

**Secondary growth in dicot stem :** An increase in the girth (diameter) in plants. Vascular cambium and cork cambium (lateral meristems) are involved in secondary growth.

1. Formation of cambial ring : Intrafascicular cambium + interfascicular cambium.
2. Formation of secondary xylem and secondary phloem from cambial ring.
3. Formation of spring wood and autumn wood.

4. Development of cork cambium (phellogen)

Cork Cambium —— Cork (phellem) - From outer cells
Sec. cortex (phelloderm) - From inner cells

(Phellogen + Phellem + Phelloderm) = Periderm

**Secondary growth in dicot roots :** Secondary growth in dicot root occurs with the activity of secondary meristems (vascular cambium). This cambium is produced in the stele and cortex, and results in increasing the girth of dicot roots.

**Anatomy of Leaf**

| Dorsiventral (Dicot) Leaf | Isobilateral (monocot) Leaf |
|---|---|
| 1. Stomata are absent or less abundant on the upper side. | 1. The stomata are equally distributed on both sides. |
| 2. Mesophyll is differentiated into two partsupper palisade parenchyma and lower spongy parenchyma. | 2. Mesophyll is undifferentitated. |
| 3. Bundle sheath is single layered and formed of colourless cells. | 3. Bundle sheath may be single or double layered. |
| 4. Hypodermis of the mid-rib region is collen-chymatous. | 4. Hypodermis of the mid-rib region is sclerenchymatous. |



## QUESTIONS

**Very Short Answer Questions (1 mark each)**

**1.** Name the tissue represented by the jute fibres used for making the ropes.

**2.** Which kind of roots have polyarch vascular bundles ?

**3.** What is heart wood ?

**4.** State the role of pith in stem.

**5.** Where are bulliform cells found in leaves ?

**6.** Which meristem does produce growth in length ?

**7.** What forms the cambial ring in a dicot stem during the secondary growth ?

**8.** Name the anatomical layer in the root from which the lateral branches of root originate.

**9.** Which tissue of the leaf contains chloroplast ?

**10.** A plant tissue when stained, showed the presence of hemicellulose and pectin in cell wall of its cells. Name the tissue.

**Short Answer Question-II (2 marks each)**

**11.** Why is cambium considered to be lateral meristem ?

**12.** Give any four differences between tracheids and vessels.

**13.** How are open vascular bundles differ from closed vascular bundles ?

**14.** What are trichomes ? State their functions.

**15.** Given below are the various types of tissue and their functions. Which out of these is not a matching pair and why :

| | | |
|---|---|---|
| (a) Collenchyma | : | provides mechanical support to the growing parts of plant. |
| (b) Sclerenchyma | : | photosynthesis, storage and secretion. |
| (c) Chlorenchyma | : | perform the function of photosynthesis. |
| (d) Xylem | : | conduction of water and minerals. |

**Short Answer Question-I (3 marks each)**

**16.** If you are provided with microscopic preparation of transverse section of a meristemic tissue and permanent tissue, how would you distinguish them ?

**17.** Differentiate between arenchyma and collenchyma on the basis of their structure and function.

**18.** Are there any tissue elements of phloem which are comparable to those of xylem ? Explain.

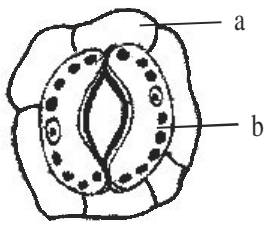
**19.** Palm is a monocotyledonous plant, yet it increases in girth. How is it possible ?

**20.** Observe the figure and answer the following questions :

(i) Name parts (a) and (b).

(ii) Are these types of stomata observed in monocot or in dicot plants ?

(iii) Which parts of stomata constitute the stomatal apparatus ?



**Long Answer Questions (5 marks each)**

**21.** (i) What are meristems ?

(ii) Name the various kinds of meristems in plants.

(iii) State the location and function of meristems.

**22.** (i) Suppose you are examining a cross section of a stem under compound microscope, how would you determine whether it is monocot stem or dicot stem ?

(ii) Write the characterstics of collenchyma.

**23.** What is secondary growth in plants ? Describe various steps of secondary growth in dicot stem with the help of diagrams.

## ANSWERS

**Very Short Answers (1 mark)**

**1.** Sclerenchyma.

**2.** Monocotyledonous roots.

**3.** The hard central region of tree trunk made up of xylem vessels.

**4.** Pith stores the food material.

**5.** Bulliform cells are found in the upper epidermis of monocot leaves.

**6.** Primary meristem.

**7.** Fascicular and intrafascicular strips of meristem.

**8.** Pericycle of mature zone.

**9.** Mesophyll tissue.

**10.** Chollenchyma.

**Short Answers-II (2 marks)**

**11.** The cambium is considered as a lateral meristem because it occurs along the lateral sides of the stem and roots and appear later than primary meristem. Cells of this meristem divide periclinally and increase the thickness of the plant body.

**12.**

| | Tracheid | Vessel |
|---|---|---|
| 1. | A tracheid is formed from a single cell. | 1. A vessel is made of a number of cells. |
| 2. | The ends are rounded or transverse. | 2. The ends are generally oblique and tapering. |
| 3. | They are comparatively narrower. | 3. They are comparatively wider. |
| 4. | The lumen is narrower. | 4. The lumen is wide. |

**13. Open Vascular bundles :** These vascular bundles contain a strip of cambium in between phloem and xylem. Open vascular bundles are collateral and bicollateral.

**Closed Vascular bundles :** Intrafascicular cambium is absent. Closed vascular bundles can be collateral or concentric.

**14.** Trichomes are multicellular epidermal hairs on the stem, seeds or fruits.

Trichomes help in protection, dispersal of fruits and seeds and reduction in water loss.

**15.** (b) Sclerenchyma : photosynthesis, storage and secretion is not a matching pair. The function of sclerenchyma is to provide mechanical support to organs.

**Short Answers-I (3 marks)**

**16. Meristematic tissues** are composed of cells that have the capability to divide. These cells are exist in different shapes without intercellular space. Cells are thin walled, rich in protoplasm, without vacuoles.

**Permanent tissues** are derived from meristematic tissue and are composed of cells have their definite shape, size and function. These cells may be thin walled (living) or thick walled (dead).

**17.**

| | Arenchyma | Collenchyma |
|---|---|---|
| (a) | Parenchymatous tissue containing space large air space. | (a) Tissue contains deposits of cellulose and large pectin7 at the corner of cells. |
| (b) | Thin walled cells, isodiametric in shape with intercellular space. | (b) Consists of oval and polygonal cells without intercellular space. |
| (c) | Provides buoyancy to the plant. | (c) Provides elasticity and mechanical strength. |

**18.** (a) The sieve elements of phloem is comparable to the vessel of the xylem because both lack nucleus.

(b) Phloem fibre is similar to the xylem fibre because both provide tensile strength to the tissue.

(c) Phloem parenchyma and xylem parenchyma is the living components of phloem and xylem respectively.

**19.** A palm tree is monotcotyledonous plant, hence do not have primary cambium in the vascular bundles of stem. However, with age the tree grows in diameter. A secondary cambium may be formed in the hypodermal region of the stem. The later forms the conjuctive tissue and patches of meristematic cells. The activity of meristematic cells results in the formation of secondary vascular bundles.

**20.** (i) a : epidermal cell

b : guard cell

(ii) In dicot plants.

(iii) The stomatal apparatus includes the stomatal aperture, guard cells and the surrounding subsidiary cells.

**Long Answers (5 marks)**

**21.** (i), (ii) and (iii) : Refer 'Points to remember'

**22.** (i) and (ii) : Refer. 'Points to remember'

**23.** • **Secondary growth :** Refer notes.

• **Steps of secondary growth :** Refer page 94-97, NCERT, Text Book of Biology for Class XI.

• Figure 6.9, page 95 NCERT, Text Book of Biology for Class XI.