# ANATOMY OF FLOWERING PLANTS THE TISSUE SYSTEM

## TISSUE SYSTEM:

- It is a group of tissues derived from a portion of meristem that performs a similar function in the plant body irrespective of its position. These tissues form tissue system. They may have no structural or morphological similarity and may also differ in their origin.
- On the basis of **location and structure**, **Sachs** (1875) distinguished three tissue system in plants-
- (a) Epidermal tissue system
- (b) Ground or Fundamental tissue system
- (c) Vascular or Fascicular tissue system.
- (a) Epidermal tissue system:
- The epidermal tissue system forms the outer-most covering of the whole plant body and comprises
- (i) Epidermal cells
- (ii) Stomata and the
- (iii) Epidermal appendages the trichomes and Hairs.
- (i) Epidermis :
- It is uniseriate in most of the plant organs but in some plants it may be **multilayered. e.g. Ficus**, **Nerium, Pepromia.**
- Its cells are parenchymatous living and compactly arranged. The outer tangential walls are usually thicker as compared to inner wall.
- Each cell has a large central vacuole & a peripheral thin cytoplasm. They may contain chloroplasts, anthocyanin pigments, tannins, oils and crystals etc.
- Some upper epidermal cells in some monocot leaves become larger, thin walled, have vacuoles & are called **bulliform cells**. They play an important role in folding of leaves during deficiency of water **e.g. Grasses**.

- In **aerial roots** of **epiphytes**, the multiple epidermal cells are modified to **velamen** which absorb **moisture from atmosphere**.
- (ii) Stomata:
- Stomata are minute pores in the epidermis. Each **stoma** is surounded by two **kidney shaped** cells, called as **guard cells**.
- Guard cells are **dumb-bell shaped** in the members of **Gramineae** family (Monocots).
- Guard cells contain chloroplasts. Inner wall of guard cell is thickened. Usually there is a large air cavity below each stomata. It is called substomatal cavity.
- Sometimes, a few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells.
- Stomata are absent in roots, underground parts and submerged hydrophytes.
- In **xerophytes stomata** are **sunken** in grooves due to which transpiration is greatly reduced, stomata are embedded in **Pinus, Capparis etc**.
- The function of stomata is exchange of gases and control of tranpiration.



**Cuticle:** 

- Cutin is a fatty substance deposited over the outer surface of epidermal cells in the form of a separate layer which is called **cuticle**.
- The cutinised walls are less permeable to water. The impermeability depends upon the thickness of cutin.

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- Cuticle is
- Thick in xerophytes,
- Thin in mesophytes and
- Absent in submerged parts of hydrophytes.
- It is also absent in underground parts.

(iii) Epidermal Appendages : Trichomes:

• The trichomes in the shoot system are usually multicellular. They may be branched or unbranched and soft or stiff. They may even be secretory. The trichomes help in preventing water loss due to transpiration.

### Root Hairs (Epidermal extensions):

- The root hairs are unicellular elongations of the epidermal cells and help absorb water and minerals from the soil
- **Ground tissue system** :- It is the largest tissue system. All tissues except epidermis and vascular bundles constitute the ground tissue It includes hypodermis, general cortex, endodermis, pericycle and medullary rays (pith rays), pith. In leaf G.T.S. consists of mesophyll. GTS is also called fundamental tissue system. G.T.S. is made of simple tissues such as parenchyma. collenchyma & sclerenchyma. The GTS forms the main bulk of the plant.
- **Vascular/conducting tissue system :-** The V.T.S. consists of complex tissues. xylem and phloem. It is also called specific tissue system.

**Note:** Primary structure of plant organ or primary plant body is mainly composed of parenchyma.

## Types of development of primary xylem :-

(i) Centrifugal :- In this type of development, the protoxylem is formed towards the centre (pith) and metaxylem is formed away from the centre. it means towards the periphery. In this condition xylem is known as end arch ex. Stem of angiosperms & gymnosperms

- (ii) Centripetal :- In this type of development protoxylem is formed towards the periphery (near the pericycle) and metaxylem is formed towards the centre (pith). In this condition xylem is called exarch. ex. Roots.
- (iii)Centrifugal and Centripetal :- Elements of metaxylem are formed on both sides of the elements of protoxylem. In this condition xylem is known as mesarch. ex. Fern rhizome (underground stem).

#### **VASCULAR BUNDLES**

- Xylem and phloem are collectively termed as vascular bundles. Which may or may not have cambium.
- On the basis of relative position of xylem & phloem following types of vascular bundles are recognized.



- (1) Radial : When xylem & phloem are located on different radii, in an alternate manner the bundles are called radial. e.g. roots.
- (2) Conjoint : A vascular bundle having both xylem & phloem together, is called conjoint. Normally. The xylem & phloem occur in the same radius. These are found in stem. They are of two types.
- (a) Collateral: In this type, phloem lies towards outside & xylem towards innerside. e.g. sunflower.
- **(b) Bicollateral :** In such vascular bundles, two patches of phloem one on each side of xylem are present. **e.g. Cucurbits**.



- (3) Concentric: In this type, any one of the two, xylem or phloem is present in the centre and the other surrounds it. They are also of two types.
- (a) Amphivasal (Leptocentric): Here, the xylem completely surrounds the phloem. e.g. Dracaena, Yucca.
- (b) Amphicribal (Hadrocentric): In this, xylem is in centre surrounded on all sides by phloem.e.g. Ferns.

On the basis of presence or absence of cambium, the bundles are classified into two categories.

- (a) Open : When cambium lies between xylem & phloem elements, the bundle is said to be open.e.g. dicot stem. This cambium is called as intrafascicular cambium.
- (b) Closed : When there is no cambium inside, the bundle is described as closed e.g. monocot stem.

On the basis of relative position of proto and metaxylem elements, the following two xylem conditions are differentiated.

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- (a) Exarch : When the Protoxylem lies at periphery and metaxylem in the centre, the condition is said to be exarch. Here the direction of development is centripetal. e.g. Root.
- (b) Endarch : When the protoxylem lies towards the centre and metaxylem at the periphery, the condition is called endarch. Here the direction of development is centrifugal. e.g. Stem.