

PUC I YEAR SEMESTER-II

UNIT-IV. INTERNAL ORGANIZATION IN PLANTS

Module 20: PLANT TISSUE SYSTEMS

TISSUE SYSTEMS

The **tissues** vary depending on their location in the plant body. Their structure and function would also be dependent on location. On the basis of their structure, function and location in plant body, three types of tissue systems are recognized namely:

1. The epidermal tissue system,
2. The ground or fundamental tissue system and
3. The vascular or conducting tissue system.

Epidermal tissue system or dermal tissue system:

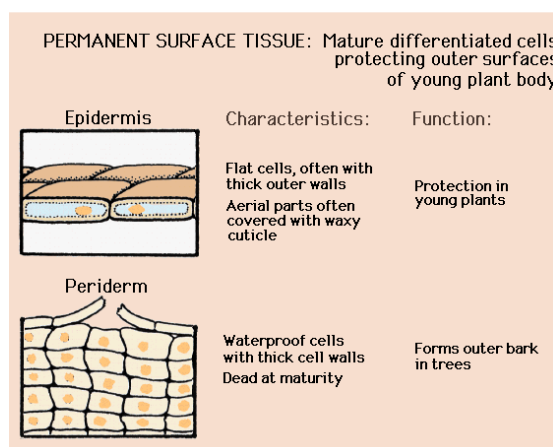
Epidermal tissue system is the outermost layer of cells on plant surface. It is derived from apical meristem. It includes **epidermis**, **stomatal complex/stomatal apparatus** and **trichomes/hairs**.

The epidermis is commonly described as the skin of the plant body. It is usually represented by a single layer of compactly arranged, barrel-shaped parenchyma cells. Rarely, it is multilayered as in **velamen roots** of Orchids and leaf of *Nerium*. The epidermal cells are made up of small amount of cytoplasm, large vacuole and devoid of chloroplasts.

In the stem and the leaf, the outer walls of epidermal cells are thick-walled and are meant for protection. In roots, the epidermal cells (called **epiblema**) are thin-walled, since they are mainly involved in the absorption of water and mineral salts. In the leaf, there are two epidermal layers, one

on each surface of the leaf. Rarely multilayered epidermis is also observed in the leaves like *Nerium* and *Ficus*.

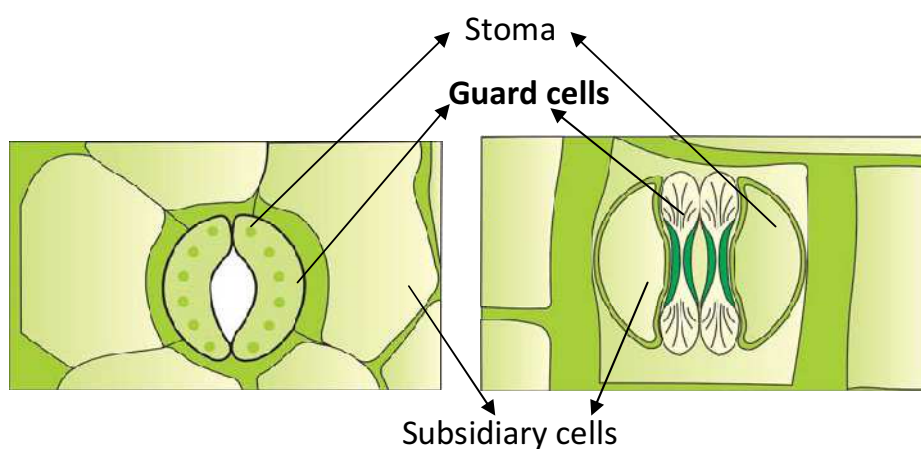
The epidermis usually forms projections known as **epidermal hairs**. The epidermis of root is described as epiblema. The tubular extensions called root hairs are produced from the smaller cells (**trichoblasts**) of the epiblema. The root hairs are unicellular and penetrate between the soil particles to absorb water. In the stem and the leaf, the epidermal hairs are multicellular or unicellular and known as **trichomes**. They are involved in the secretion of some **terpenoid compounds**, helps in preventing water loss due to **transpiration**. The cotton fibers are economically important trichomes.



The outer walls of epidermis of the stem and the leaf are usually surrounded by a thin covering called **cuticle** and sometimes with **epicuticular waxes**. It is formed by a waxy substance called **cutin**. It is meant for preventing excessive evaporation of water. Cuticle is absent in the root epidermis.

The epidermis of the leaf, flower, fruit and herbaceous stem (green stem) contains numerous minute openings called **stoma**. Each opening is surrounded by a pair of modified epidermal cells called the **guard cells**. The

guard cells in turn are surrounded by variable number of **subsidiary cells** or **accessory cells**. The opening along with guard cells and subsidiary cells is usually known as **stomatal complex** or **stomatal apparatus**. Thus, each stoma (pl. stomata) constitutes the opening and pair of guard cells. The shape of the guard cells in dicot is like kidney or bean while in monocots they are dumbbell shaped. The outer wall of the guard cell is thin and inner wall is thick. The guard cells possess chloroplasts and regulate the opening and closing of the stomata. The stomata take part in vital physiological functions such as **transpiration**, **respiration** and **photosynthesis**. The stomata tend to be more on underside of the leaves of many land plants. Stomata are absent in the epidermis of the root, woody stem and submerged hydrophytes.



Stomatal complex in dicot leaf and monocot leaf

Ground tissue system (GTS):

The **ground tissue system** occupies greater portion of the plant body, than the other two tissue systems, namely epidermal and vascular tissue systems. In primary plant body of stems and roots, it comprises the whole of cortex and part of stele i.e. **hypodermis**, **general cortex**, **endodermis**, **pericycle**, **pith** and **pith rays**. However, these regions are not clearly

demarcated in monocot stems. The GTS is made up of simple tissue, mostly the parenchyma. In leaves, the GTS is known as **mesophyll**, which may be further distinguished into **palisade** and **spongy tissues**. The parenchyma surrounding the vascular bundles of the leaf is known as **bundle parenchyma** and **sclerenchymatous** patches also when present are GTS only.

The functions of ground tissue system vary with type of the tissues and position. The different functions include protection, storage, support, assimilation and transport.

Vascular Tissue System:

The vascular tissue is composed of two major conducting systems: the **xylem** and the **phloem**. The xylem transports water and mineral **ions** from the root to the rest of the plant. The phloem distributes the products of photosynthesis and a variety of other **solutes** throughout the plant. They are in the form of discrete bundles known as **vascular bundles**. A vascular bundle may contain either only xylem or only phloem or both. Accordingly, based on the relative position of xylem and phloem the bundles can be distinguished into three types.

1. **Conjoint**
2. **Radial**
- and 3. **Concentric**.

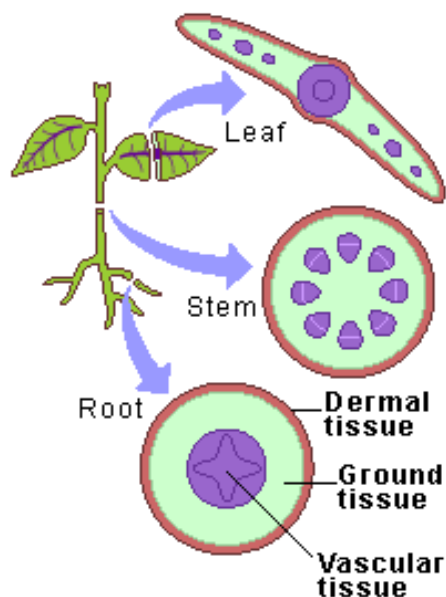
In conjoint type of vascular bundles, one unit of xylem and one unit of phloem are close to one another and situated on the same axis. Hence, they are known as collateral. In dicot stems, in addition to vascular tissues a meristematic tissue called **cambium** is present in between xylem and phloem. Then the vascular bundles are said to be open. The cambium is responsible for secondary growth. In monocot stems, cambium is absent, the vascular bundles are said to be closed hence no secondary growth takes

place. In the bicollateral bundles, phloem is present on either side of xylem separated by cambia. The bicollateral bundle is always open. The **conjoint bundles** are characteristic of the leaf and the stem.

In **radial** type of the vascular tissues, the xylem and phloem lie close to one another but on different axis. In both dicot and monocot roots, the xylem and phloem form separate bundles.

In **concentric type**, the xylem is surrounded by phloem or vice-versa. They are always closed due to the absence of cambium. They are present in lower vascular plants and some monocots.

Different tissue systems – Location, composition and function



Check points

- The cells in a plant are grouped together into various tissues. These tissues can be simple, consisting of a single cell type, or complex, consisting of more than one cell type.
- There are three types of tissue systems: Dermal Tissue System, Vascular Tissue System and ground tissue systems.

- The dermal tissue system is outermost covering of the plant. It consists of the epidermis and the periderm.
- The **ground tissue system** occupies greater portion of the plant body. The different functions include protection, storage, support, assimilation and transport.
- Xylem and phloem make up the vascular tissue system. Xylem allows water and other nutrients to be transported throughout the plant. Phloem allows the transportation of organic solutes.

Short answer Questions:

1. What is the epidermal tissue system? Give an account of epidermis.
2. Give an account on stomata and its functions.
3. What is referred to ground tissue system?
4. Which tissues comprise the vascular system of a plant? What is its function?
5. Differentiate trichoblasts and trichomes. Give their importance.
6. Describe briefly conjoint vascular bundles.
(a) Write short notes on: Radial and concentric vascular bundles.

Long answer Questions:

1. Describe in detail the non-conducting tissue systems in a plant. Give an account of their functions.
2. What are conducting tissues systems in a plant? Add a note on types of vascular bundles.

MCQS

1. The ground tissue system consists of
A. Whole of cortex only

- B. Endodermis only
 - C. Pith and pith rays only
 - D. Cortex, endodermis, pericycle, pith and pith rays**
2. The conjoint bundles are characteristic feature of
- A. Both leaf and stem**
 - B. Leaf but not stem
 - C. Stem but not leaf
 - D. Root
3. A bicollateral vascular bundle:
- A. Has one set of xylem and two sets of phloem.**
 - B. Is represented by the fusion of two vascular bundles.
 - C. Possesses no vascular cambium.
 - D. Has only one layer of xylem and of phloem.
4. Pores on the leaf surface that function in gas exchange are called
- A. Hairs
 - B. Xylem cells
 - C. Phloem cells
 - D. Stomata**
5. Which of the following cell types are found in ground tissue?
- A. Vessel elements, tracheids
 - B. Parenchyma, collenchyma**
 - C. Vascular cambium
 - D. Primary xylem
6. Which of the following plant parts would not have a cuticle covering the epidermis?
- A. Roots**
 - B. Stems

- C. Leaves
 - D. None of the above
7. Which of the following is NOT considered as one of the "ground tissues"?
- A. Parenchyma
 - B. Sclerenchyma
 - C. Collenchyma
 - D. Xylem**
8. Which of two tissues together makes the vascular system of a angiospermic plant
- A. Xylem and pericycle
 - B. Xylem and pith
 - C. Phloem and pith
 - D. Xylem and phloem**
9. Which of the following statement regarding epidermal tissue system is correct?
- A. It is multilayered only
 - B. The cells do not have a vacuole
 - C. In stem it is thin walled
 - D. It is devoid of chloroplasts**
10. The vascular bundle is said to be open if
- a. Xylem is present
 - b. Both xylem and phloem are present
 - c. Cambium is present between xylem and phloem**
 - d. Cambium is absent.