



ANATOMY OF FLOWERING PLANTS

THE TISSUE SYSTEM

On the basis of their structure and location, there are three types of tissue systems. These are the epidermal tissue system, the ground or fundamental tissue system and the vascular or conducting tissue system.

Epidermal Tissue System

The epidermal tissue system forms the outer-most covering of the whole plant body and comprises epidermal cells, stomata and the epidermal appendages – the trichomes and hairs.

Epidermis

The outermost layer of the primary plant body. It is made up of elongated, compactly arranged cells, which form a continuous layer. It is usually singlelayered.

Epidermal cells are parenchymatous with a small amount of cytoplasm lining the cell wall and a large vacuole. The outside of the epidermis is often covered with a waxy thick layer called the cuticle which prevents the loss of water. It is absent in roots.

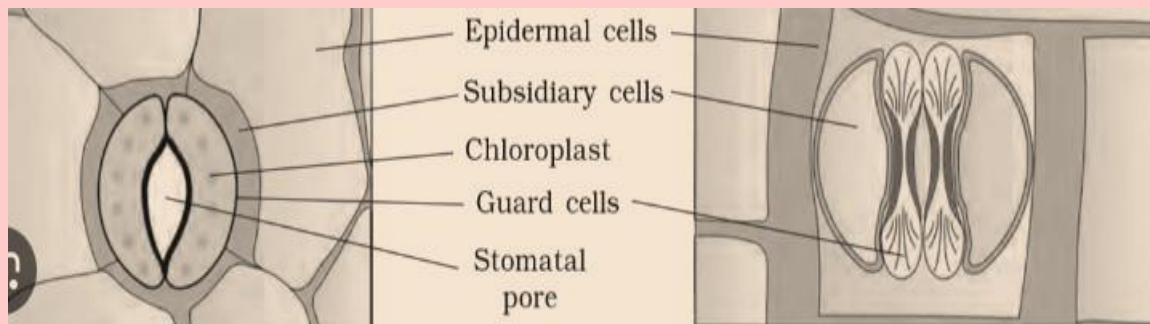
Stomata

It regulate the process of transpiration and gaseous exchange. Each stoma is composed of two beans shaped cells known as guard cells which enclose stomatal pore.

The outer walls of guard cells are thin and the inner wall are highly thickened. The guard cells possess chloroplasts and regulate the opening and closing of stomata.

A few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells.

The stomatal aperture, guard cells and the surrounding subsidiary cells are together called stomatal apparatus



The root hairs are unicellular elongations of the epidermal cells and help absorb water and minerals from the soil.

On the stem the epidermal hairs are called trichomes. The trichomes in the shoot system are usually multicellular. The trichomes help in preventing water loss due to transpiration.

The Ground Tissue System

It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma.

Parenchymatous cells are usually present in cortex, pericycle, pith and medullary rays, in the primary stems and roots.

In leaves, the ground tissue consists of thin-walled chloroplast containing cells and is called mesophyll.

The Vascular Tissue System

The vascular system consists of complex tissues, the phloem, and the xylem.

The xylem and phloem together constitute vascular bundles.

Open vascular bundles

In dicotyledonous stems, cambium is present between phloem and xylem. Such vascular bundles because of the presence of cambium possess the ability to form secondary xylem and phloem tissues, and hence are called open vascular bundles.

Closed vascular bundles

In the monocotyledons, the vascular bundles have no cambium present in them. Hence, since they do not form secondary tissues, they are referred to as closed.

Radial vascular bundles

When xylem and phloem within a vascular bundle are arranged in an alternate manner along the different radii, the arrangement is called radial such as in roots.

Conjoint vascular bundles

the xylem and phloem are jointly situated along the same radius of vascular bundles. Such vascular bundles are common in stems and leaves. They have the phloem located only on the outer side of xylem.

ANATOMY OF DICOTYLEDONOUS AND MONOCOTYLEDONOUS PLANTS

Dicotyledonous Root

The outermost layer is epiblema. Many of the cells of epiblema protrude in the form of unicellular root hairs.

The cortex consists of several layers of thin-walled parenchyma cells with intercellular spaces.

The innermost layer of the cortex is called endodermis.

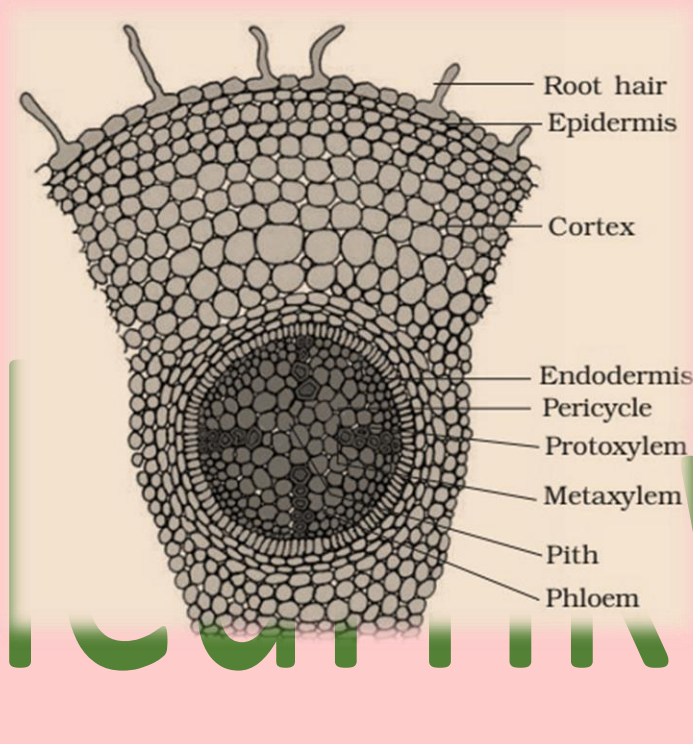
Next to endodermis lies a few layers of thick-walled parenchymatous cells referred to as pericycle.

Initiation of lateral roots and vascular cambium during the secondary growth takes place in these cells.

The pith is small or inconspicuous. The parenchymatous cells which lie between the xylem and the phloem are called conjunctive tissue.

There are usually two to four xylem and phloem patches.

All tissues on the inner side of the endodermis such as pericycle, vascular bundles and pith constitute the stele.

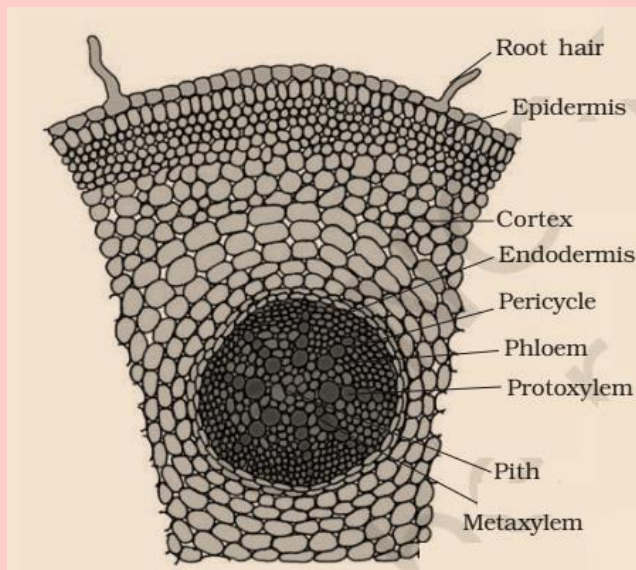


Monocotyledonous Root

It has epidermis, cortex, endodermis, pericycle, vascular bundles and pith.

As compared to the dicot root which have fewer xylem bundles, there are usually more than six (polyarch) xylem bundles in the monocot root.

Pith is large and well developed. Monocotyledonous roots do not undergo any secondary growth.



Dicotyledonous Stem

The epidermis is the outermost protective layer of the stem. Covered with a thin layer of cuticle, it may bear trichomes and a few stomata.

The cells arranged in multiple layers between epidermis and pericycle constitute the cortex.

It consists of three sub-zones. The outer hypodermis, consists of a few layers of collenchymatous cells just below the epidermis.

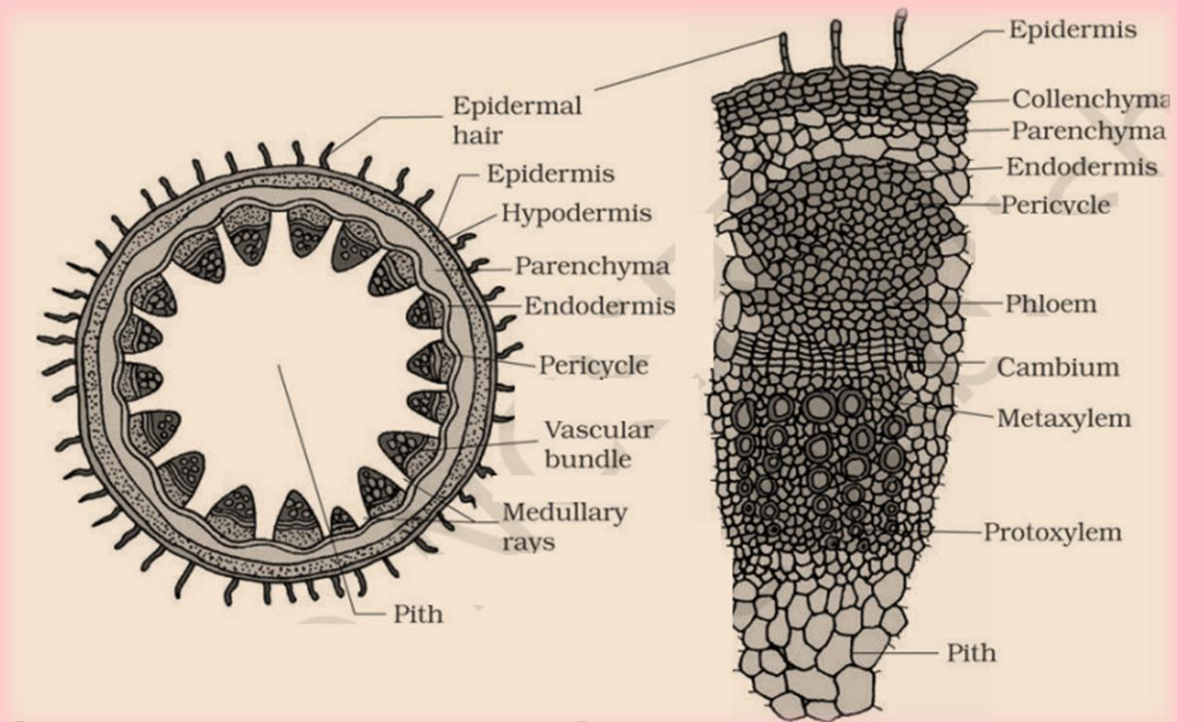
Cortical layers below hypodermis consist of rounded thin-walled parenchymatous cells with conspicuous intercellular spaces. The innermost layer of the cortex is called the endodermis.

Pericycle is present on the inner side of the endodermis and above the phloem in the form of semi-lunar patches of sclerenchyma.

In between the vascular bundles there are a few layers of radially placed parenchymatous cells, which constitute medullary rays.

A large number of vascular bundles are arranged in a ring. Each vascular bundle is conjoint, open, and with endarch protoxylem.

A large number of rounded, parenchymatous cells with large intercellular spaces which occupy the central portion of the stem constitute the pith.



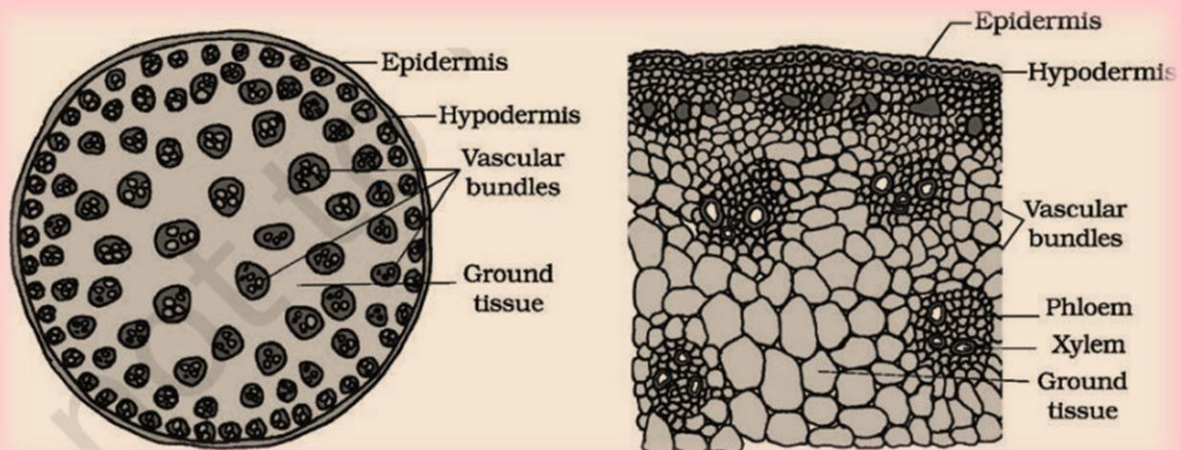
Monocotyledonous Stem

The monocot stem has a sclerenchymatous hypodermis, a large number of scattered vascular bundles, each surrounded by a sclerenchymatous bundle sheath, and a large, conspicuous parenchymatous ground tissue.

Vascular bundles are conjoint and closed.

Peripheral vascular bundles are generally smaller than the centrally located ones.

The phloem parenchyma is absent, and water-containing cavities are present within the vascular bundles



Dorsiventral (Dicotyledonous) Leaf

Shows three main parts, namely, epidermis, mesophyll and vascular system.

The epidermis which covers both the upper surface and lower surface of the leaf has a conspicuous cuticle.

The abaxial epidermis generally bears more stomata than the adaxial epidermis.

The tissue between the upper and the lower epidermis is called the mesophyll.

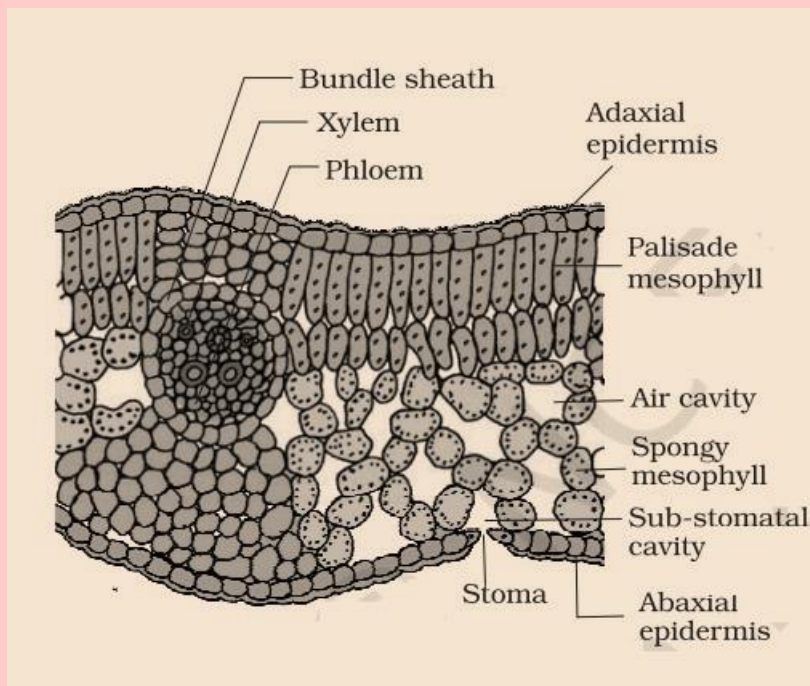
Mesophyll, which possesses chloroplasts and carry out photosynthesis, is made up of parenchyma. It has two types of cells – the palisade parenchyma and the spongy parenchyma.

The adaxially placed palisade parenchyma is made up of elongated cells, which are arranged vertically and parallel to each other.

The oval or round and loosely arranged spongy parenchyma is situated below the palisade cells and extends to the lower epidermis.

Vascular system includes vascular bundles, which can be seen in the veins and the midrib. The size of the vascular bundles are dependent on the size of the veins.

The veins vary in thickness in the reticulate venation of the dicot leaves. The vascular bundles are surrounded by a layer of thick walled bundle sheath cells.



Isobilateral (Monocotyledonous) Leaf

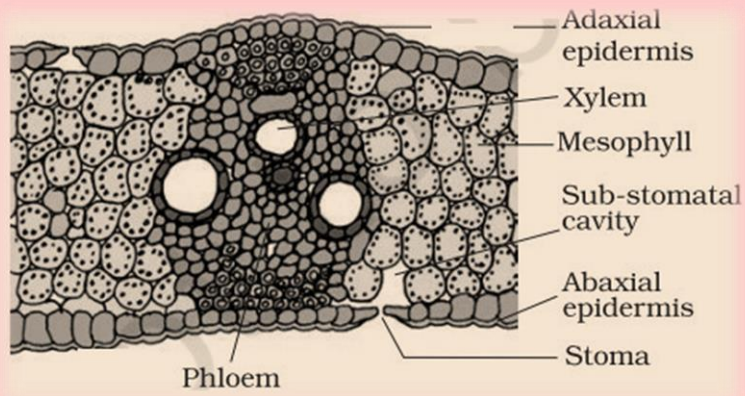
In an isobilateral leaf, the stomata are present on both the surfaces of the epidermis; and the mesophyll is not differentiated into palisade and spongy parenchyma.

some adaxial epidermal cells along the veins modify themselves into large, empty, colourless cells.

These are called bulliform cells. When the bulliform cells in the leaves have absorbed water and are turgid, the leaf surface is exposed.

When they are flaccid due to water stress, they make the leaves curl inwards to minimise water loss.

The parallel venation in monocot leaves is reflected in the near similar sizes of vascular bundles as seen in vertical sections of the leaves.



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