

Primary Structure of Root, Stem and Leaves

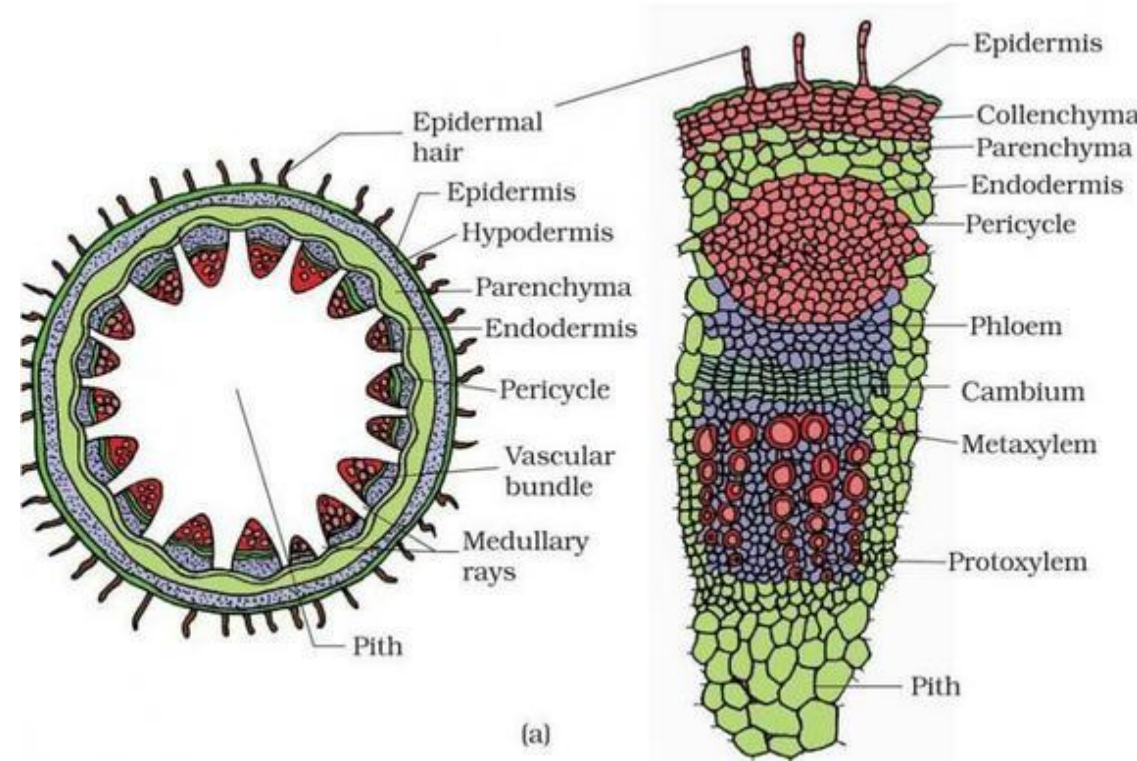
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UNIT-2

DR. ARINDAM MANDAL
Assistant Professor in Botany
Bejoy Narayan Mahavidyalaya
Itachuna, Hooghly

Internal Structure of Dicot Stems

1. Epidermis:

- Epidermis is the outermost layer of the stem.
- It is single layered and lack of chloroplast.
- Multicellular hairs (trichomes) and stomata are found on epidermis.
- Outer side of epidermis a layer is present which is made up of cutin is called cuticle.
- Epidermis plays a significant role in protection.



Internal Structure of Dicot Stems

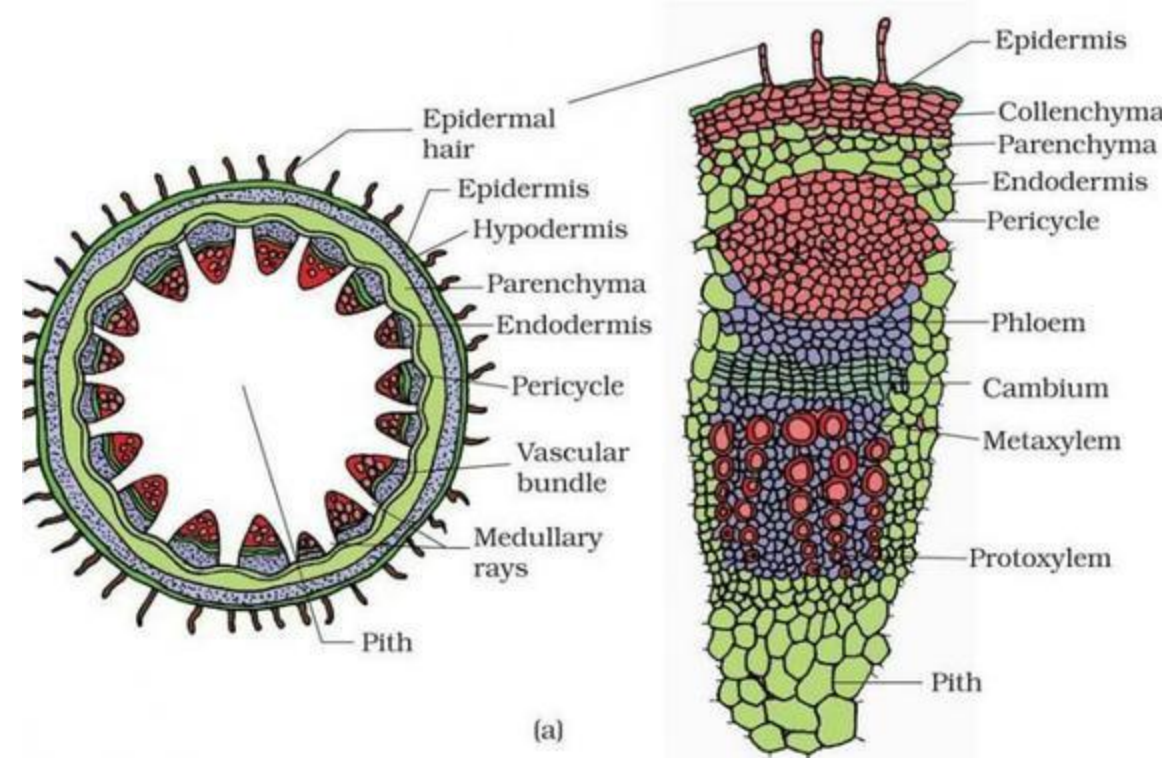
2. Cortex:

In dicotyledon stem cortex divided into three parts:

(a) **Hypodermis:** It is present just below the epidermis. It provides additional support to epidermis. It is thick multicellular layer. This layer is composed of collenchyma and their cells contain chloroplast. So hypodermis is green and photosynthetic.

(b) **General Cortex:** This part is composed of parenchyma. Storage of food is the main function of the cortex. Resin canal/ mucilage canal are present in it. These are schizogenous in origin. The innermost layer of the cortex is called endodermis.

(c) **Endodermis:** It is single celled thick layer. The cells of endodermis are barrel shaped. These cells accumulate more starch in stem of dicot. Thus it is known as "Starch sheath".



Internal Structure of Dicot Stems

3. Pericycle:

This layer is situated in between the endodermis and vascular bundles. The pericycle of stem is multilayered and made up of sclerenchyma. Sclerenchymatous pericycle is also known as Hard bast.

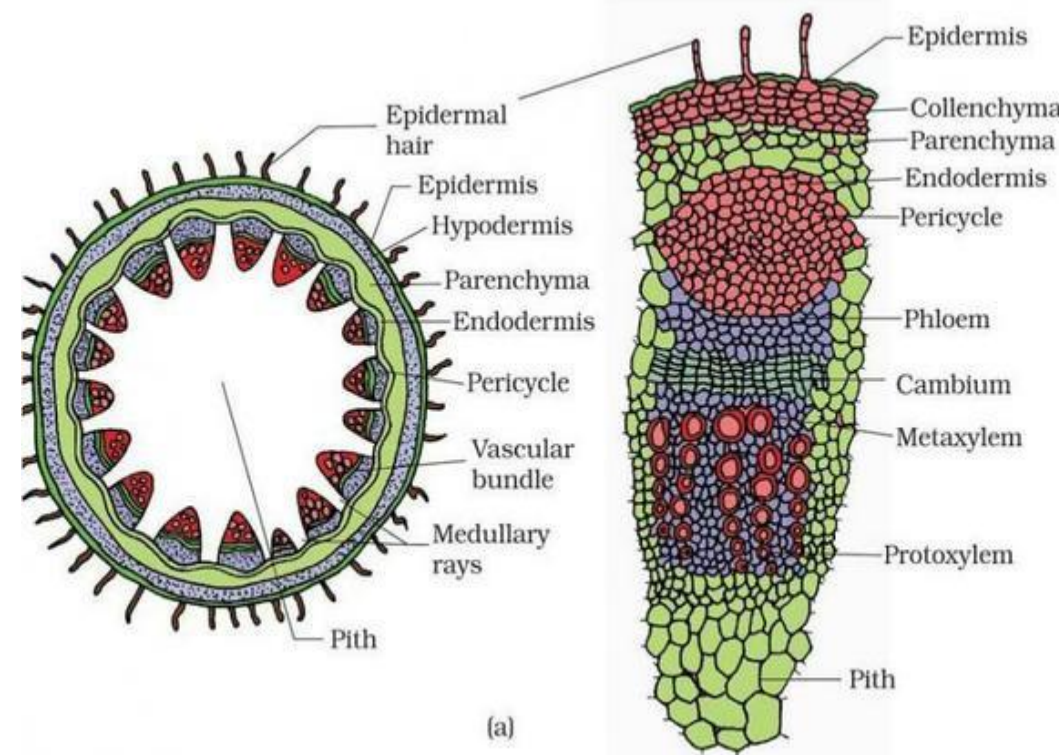
4. Vascular Bundle:

The vascular bundles (wedge shaped) are arranged in a ring. Each vascular bundle is conjoint, collateral and open. Each vascular bundle is made of phloem, cambium and xylem. Eustele is present in dicotyledon stems.

5. Pith:

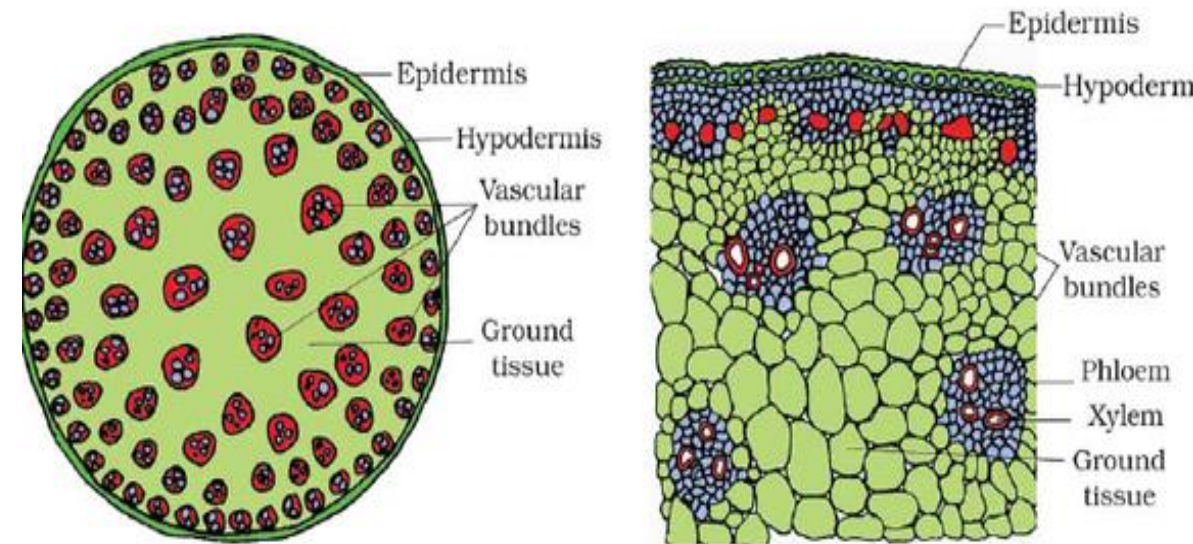
This is well developed region, spreading from ring of vascular bundle to the centre. The cells of this region mainly made up of parenchyma.

Function of pith: Storage of water and food.



Internal Structure of Monocot Stem

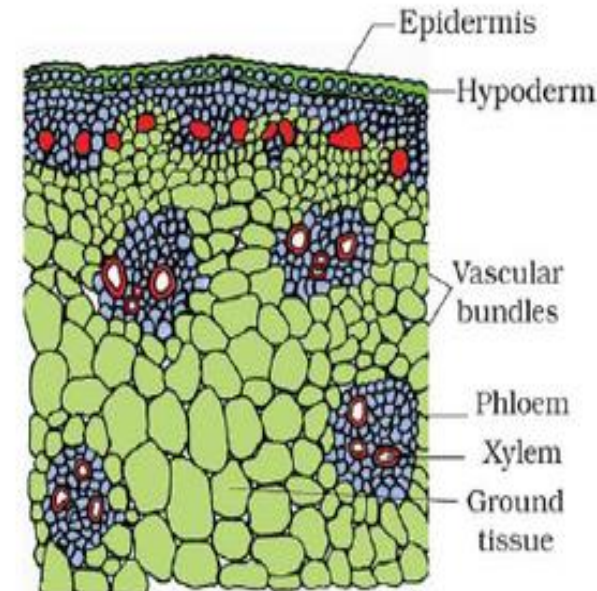
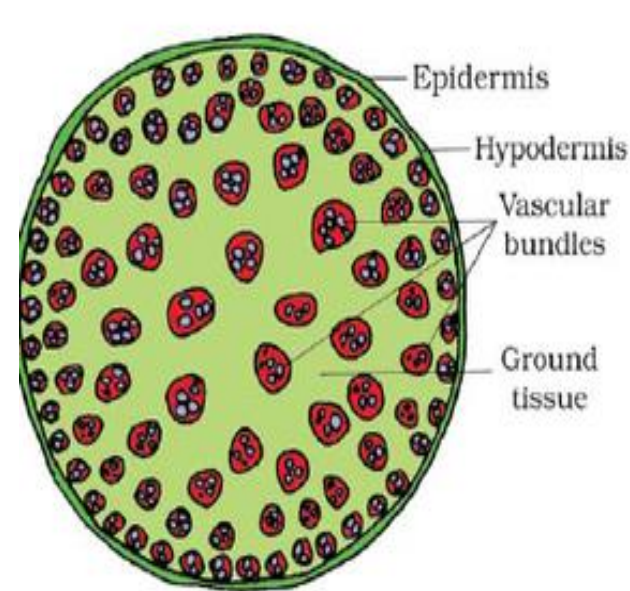
- 1. Epidermis:** Epidermis is the outer most single celled thick layer. It is covered with thick cuticle. Multicellular hairs are absent & stomata are also less.
- 2. Hypodermis:** Hypodermis of monocotyledor' stem is made up of sclerenchyma. It is 2-3 layered monocot stem rigidity is more in hypoderrrus where as in dieot stem elasticity is more. It provides mechanical support to plant.



Internal Structure of Monocot Stem

3. Ground tissue: The entire mass of parenchyma cells next to hypodermis and extending to the centre is called ground tissue. There is no differentiation of ground tissue in monocotyledon stem. It means ground tissue is not differentiated into endodermis, cortex, Pericycle etc.

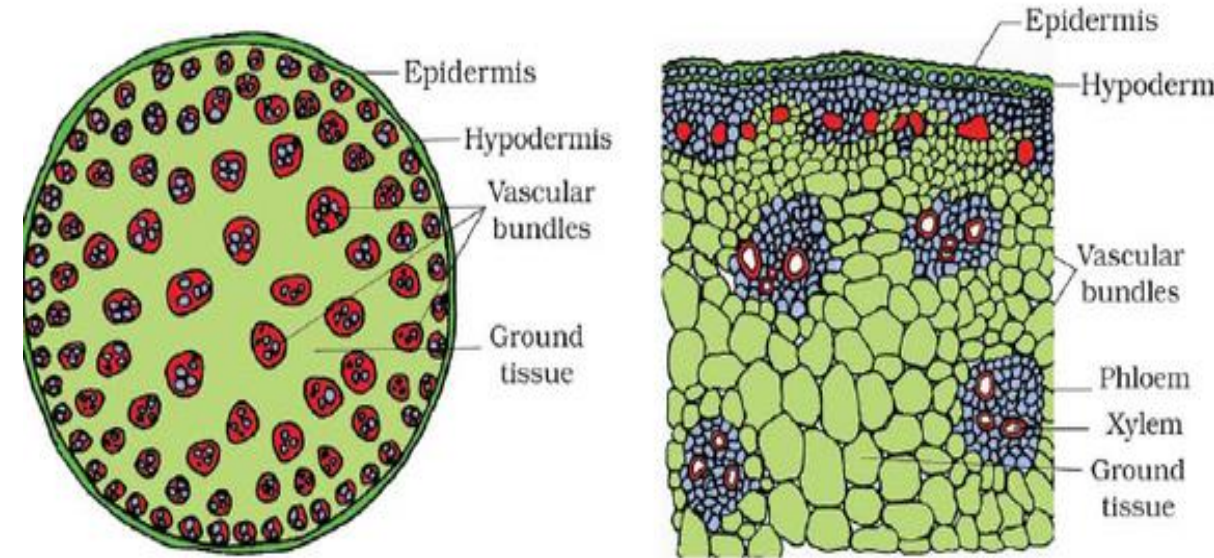
Note: Sometimes in some grasses, wheat etc. the central portion of ground tissue becomes hollow and is called Pith cavity.



Internal Structure of Monocot Stem

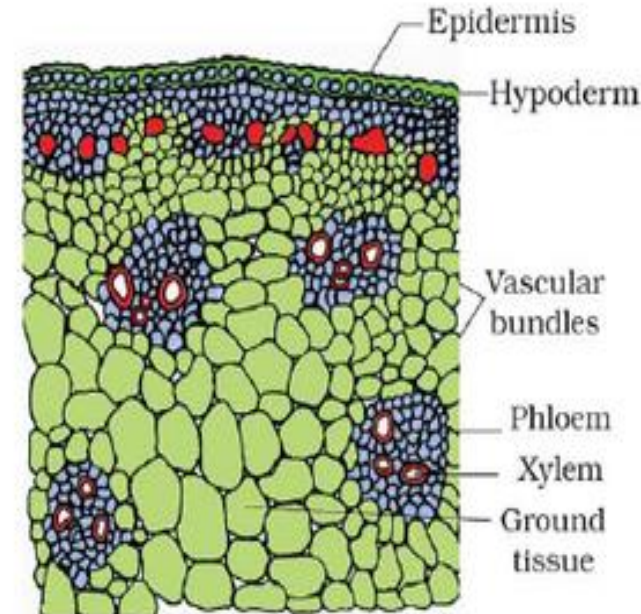
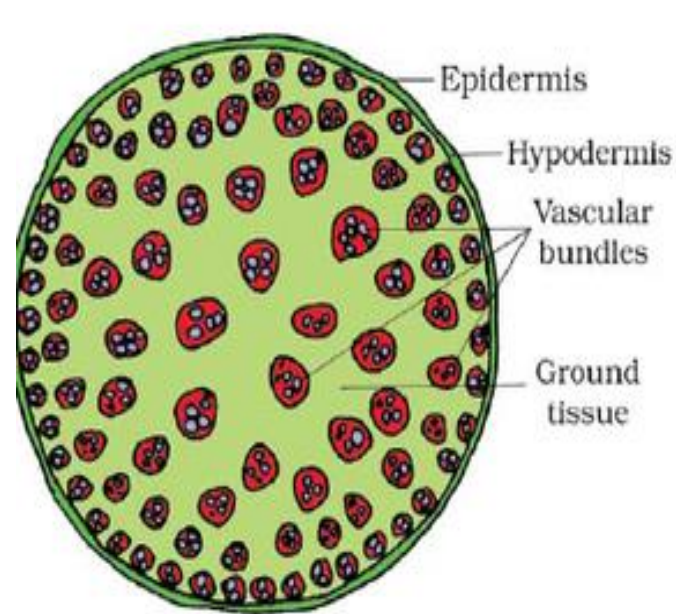
4. Vascular Bundle:

- Many vascular bundles are scattered in the ground tissue and V.B. are generally oval shape.
- Vascular bundles lies towards the centre are large in size and less in number.
- Vascular bundles situated towards the periphery are small in size but more in number.
- Each vascular bundle are conjoint, collateral and closed.
- Vascular bundles surrounded by the layer of sclerenchymatous fibre are known as bundle sheath.
- So vascular bundles are called fibro vascular bundles.



Internal Structure of Monocot Stem

5. Pith: Pith is undifferentiated in monocotyledon stems. Atactostele is found in monocotyledon. This is highly developed stele.



Internal Structure Of Typical Dicot Root

1. Epiblema:

- It is uniseriate outermost layer.
- It comprising tubular living components. Cuticle and stomata are absent.
- Unicellular root hairs are formed due to elongation of some cells of epiblema.
- Epiblema also known as Rhizodermis or Piliferous layer.
- Root hair are present in maturation zone of root.
- Cells of epiblema which develop root hair called trichoblast.

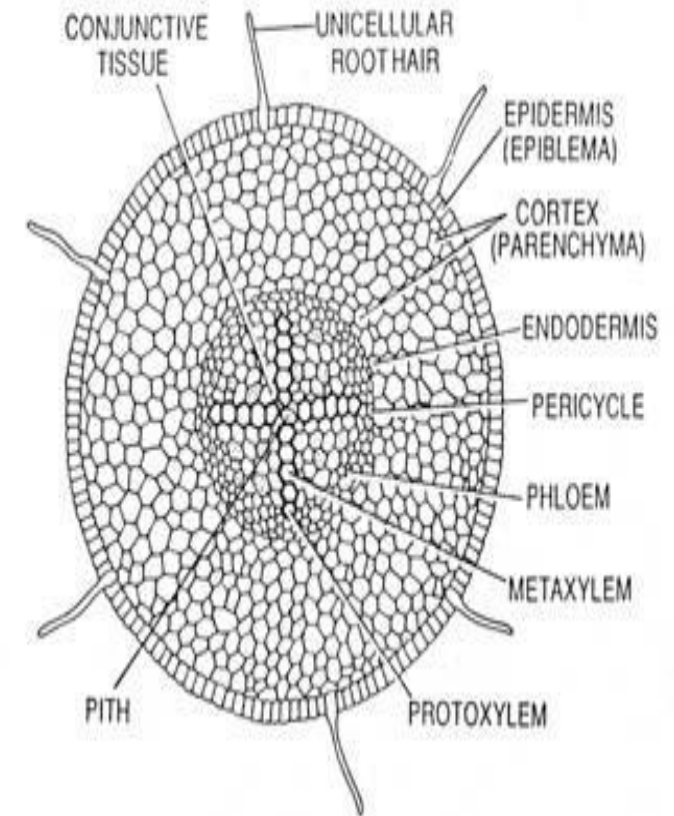


Fig. 42.13. Anatomy of dicot root. T.S. of young root of *Phaseolus radiatus* prior to cambium formation.

Internal Structure Of Typical Dicot Root

2. Cortex:

- It is made up of parenchymatous cells.
- Chloroplast is absent so they are non-photosynthetic but chloroplast is present in roots of *Tinospora* and *Trapa* so they are photosynthetic.

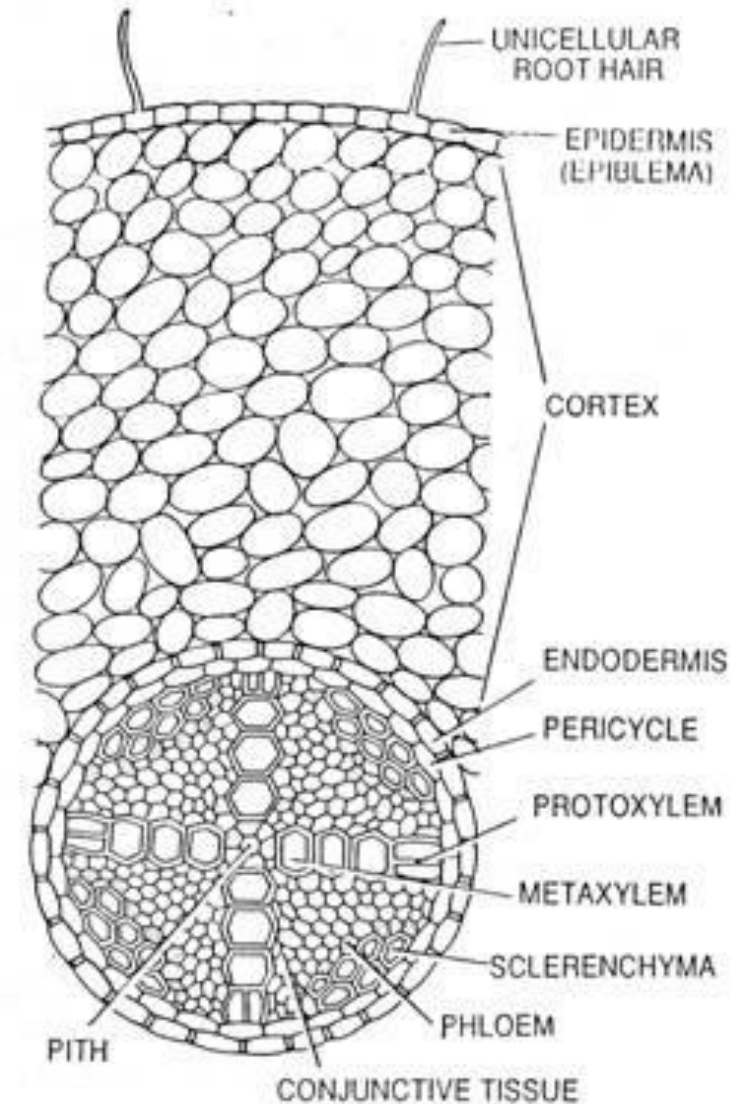


Fig. 42.11. Dicot root—T.S. of gram root.

Internal Structure Of Typical Dicot Root

3 Endodermis:

- This layer is situated between the pericycle and cortex.
- Casparian strips are present on radial and tangential wall of endodermis. These strips are made up of ligno suberin (mainly suberin). Casparian strips are discovered by Caspari.
- The cells of endodermis which are situated in front of protoxylem cells lack of casparian strips. These are called passage cells/ transfusion cells.
- The number of passage cells is equivalent to the protoxylem cells. Passage cells provide path to absorbed water from cortex to pericycle.

4. Pericycle:

It is single layered. It is composed prosenchyma.

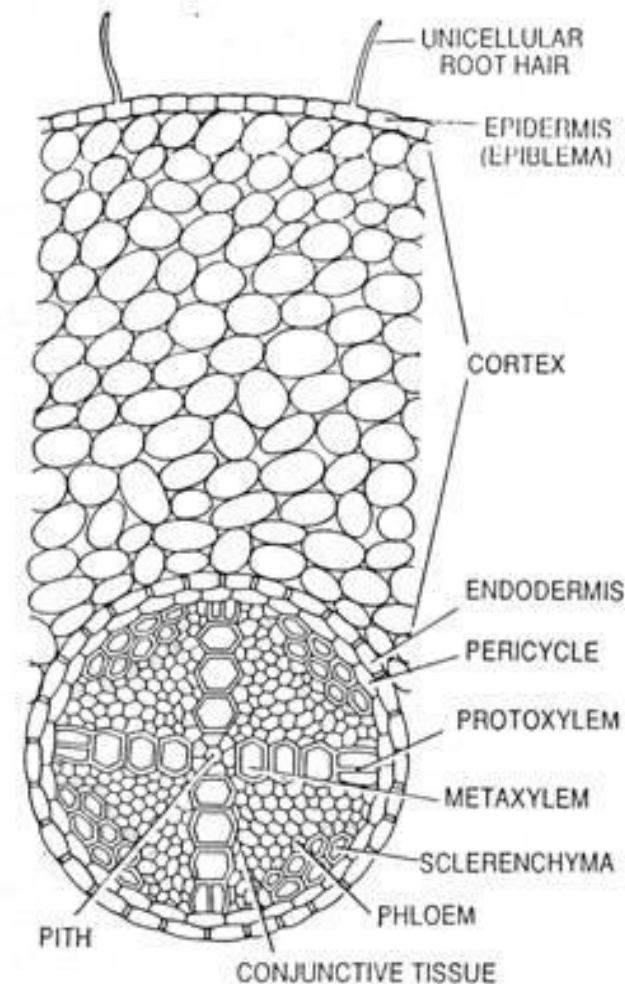


Fig. 42.11. Dicot root—T.S. of gram root.

Internal Structure Of Typical Dicot Root

5. Vascular Bundles:

- Vascular bundles are radial and exarch, xylem and phloems are separate and equal in number.
- The number of xylem bundles are two to six (diarch to hexarch).
- But exceptionally, Ficus (Banyan tree) root is polyarch.
- Parenchyma which is found between xylem and phloem is called conjunctive tissue.

6. Pith:

In dicot root pith is less developed or absent.

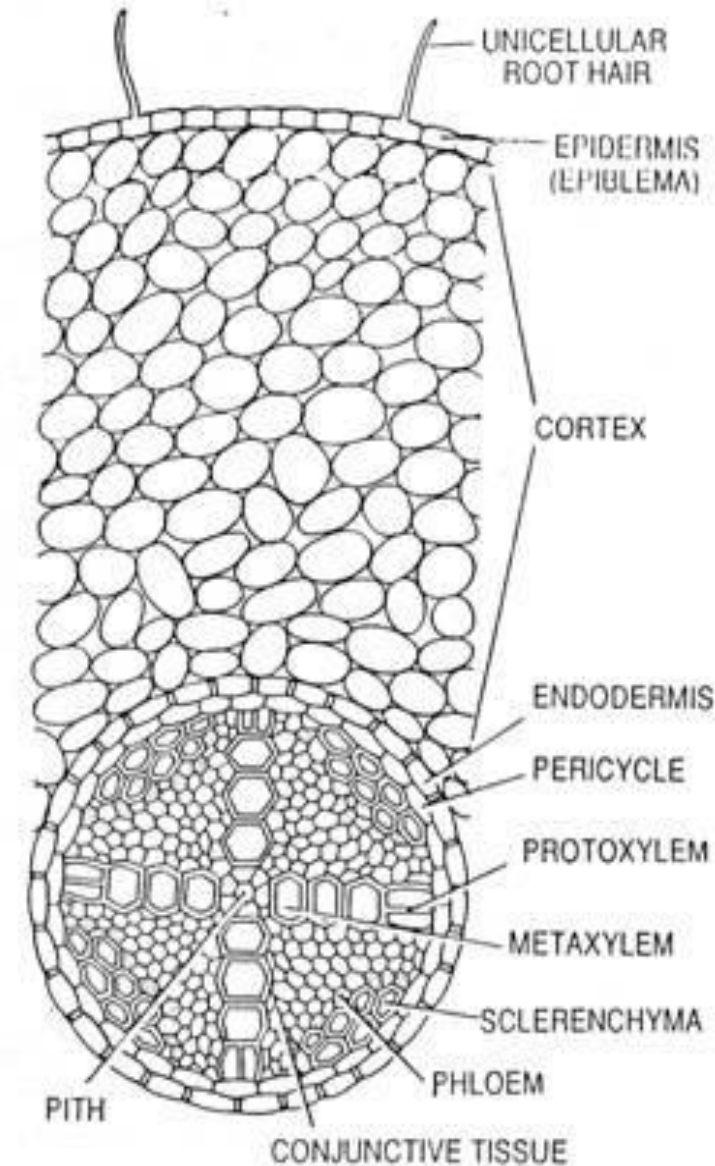


Fig. 42.11. Dicot root—T.S. of gram root.

Internal Structure Of Typical Monocot Root

Epiblema:

It is an outermost, thin-walled, compactly arranged layer of cells out of which some cells give rise to the root hairs. The root hair is a unicellular and lie in contact with soil water. It helps in the absorption of water and minerals.

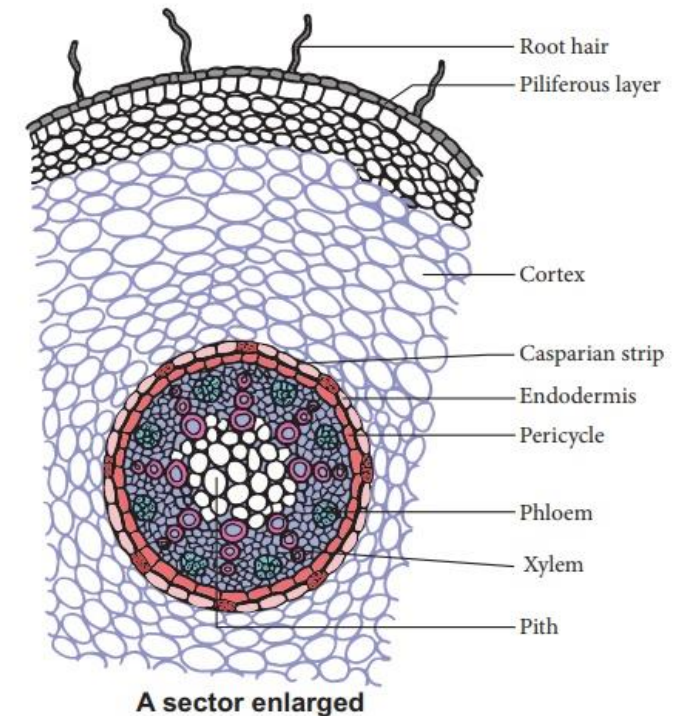
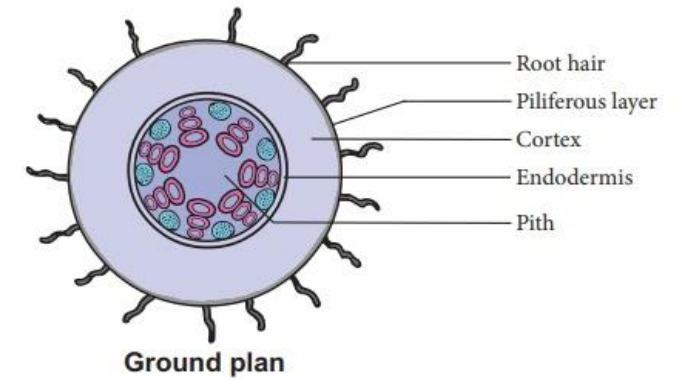


Figure 12.3 Transverse section of Monocot root

Internal Structure Of Typical Monocot Root

Cortex:

It is a broad zone of parenchyma cells. They store food. It provides radial movement of water and minerals from epiblema to the root interior.

Endodermis:

A single layered structure made up of barrel-shaped cells which does not enclose intercellular spaces. The young endodermal cell possesses an internal strip of suberin and lignin called casparian strip.

The unthickened endodermal cells are called **passage cells** transfusion cells. They help in the conduction of minerals and fluids from cortex into the xylem.

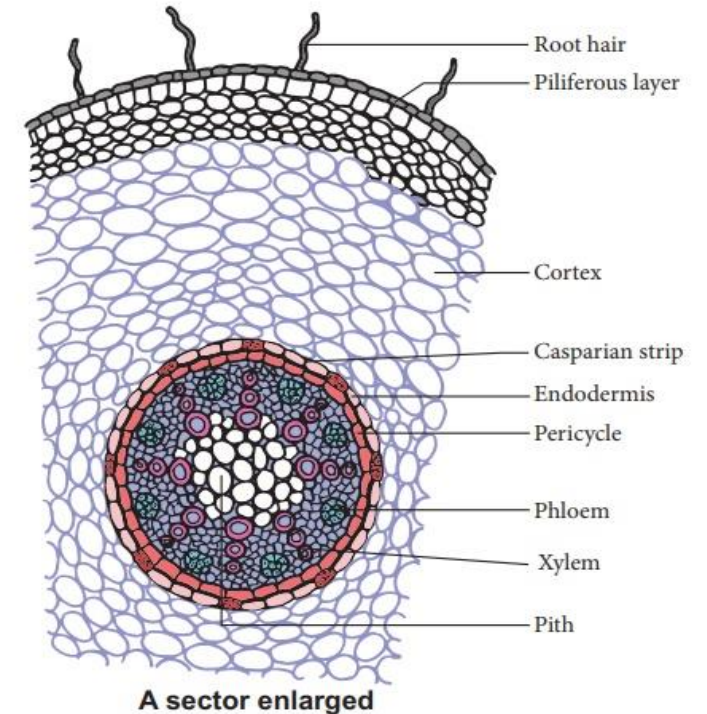
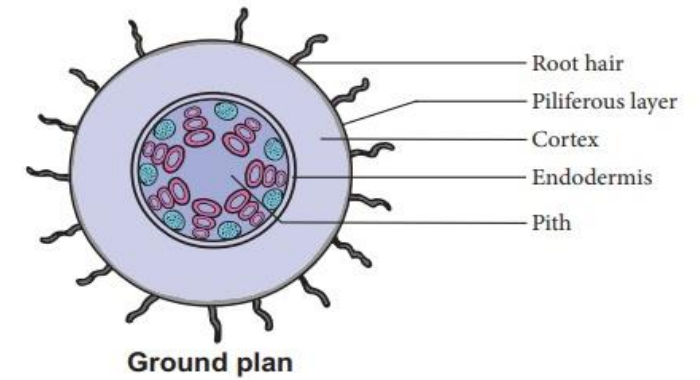


Figure 12.3 Transverse section of Monocot root

Internal Structure Of Typical Monocot Root

Stele: It is constituted of pericycle, vascular bundles and pith.

(a) Pericycle:

It forms the outer boundary of stele. It may be either single or multi-layered. It does not form cambium.

(b) Vascular bundles:

It is present in the form of several alternate and radial xylem and phloem bundles. The xylem bundles are **exarch and polyarch**

(c) Pith:

It is large and well developed. It is large and made up of parenchymatous cells with intercellular spaces. These cells contain starch.

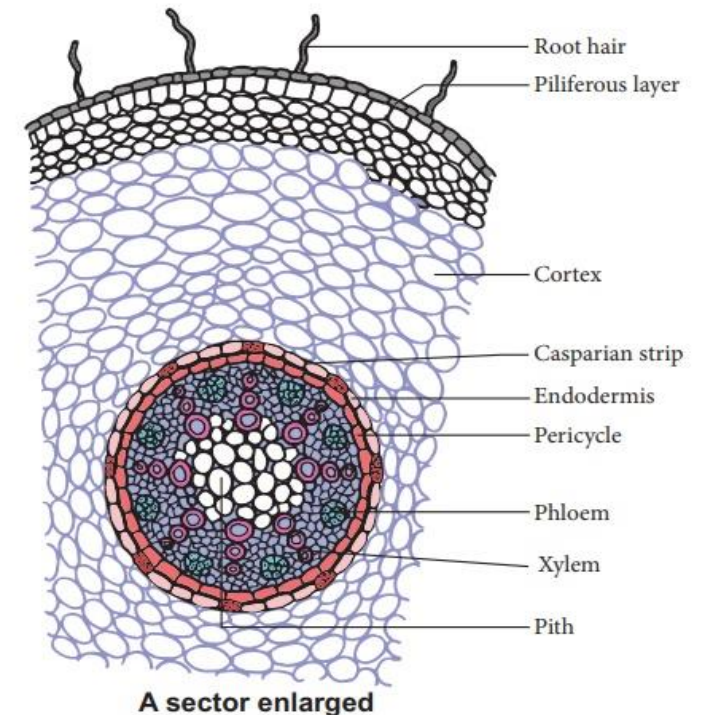
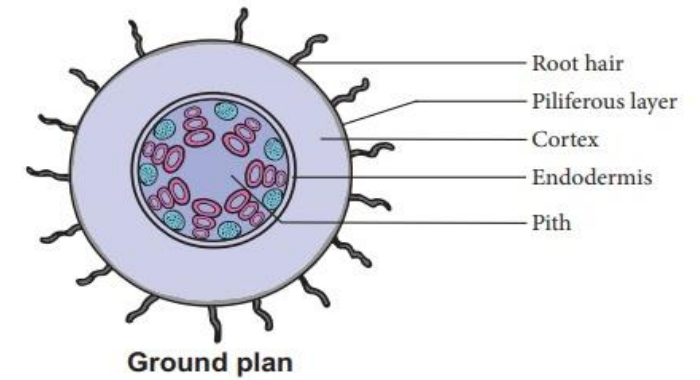
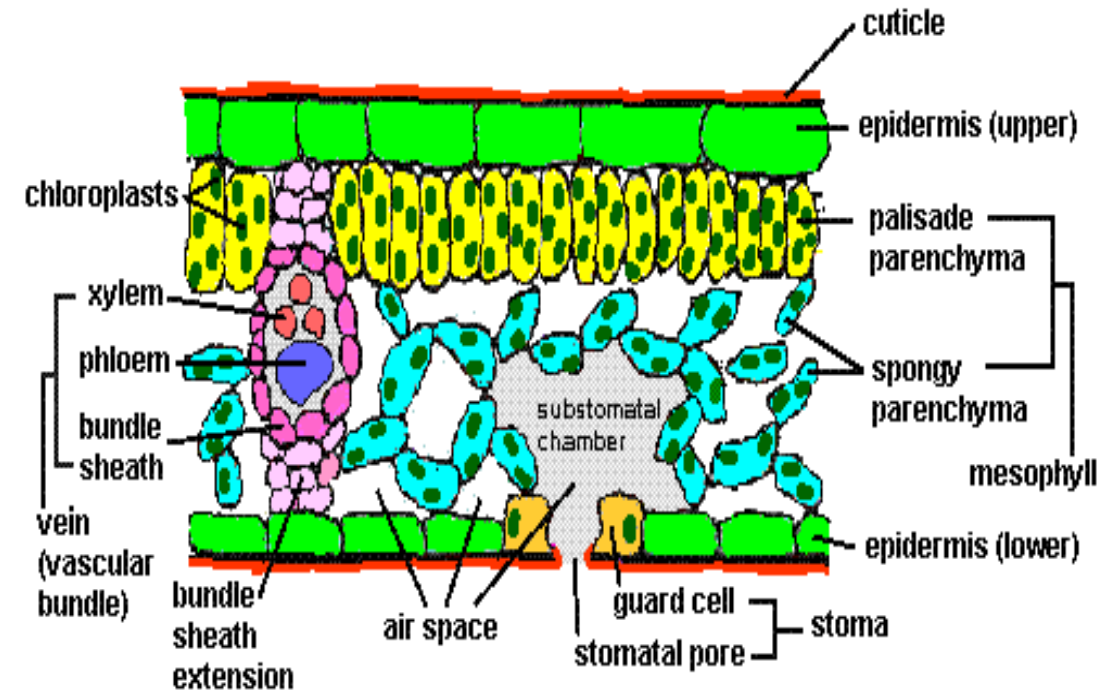


Figure 12.3 Transverse section of Monocot root

Anatomy of a typical Dicot leaf

Epidermis:

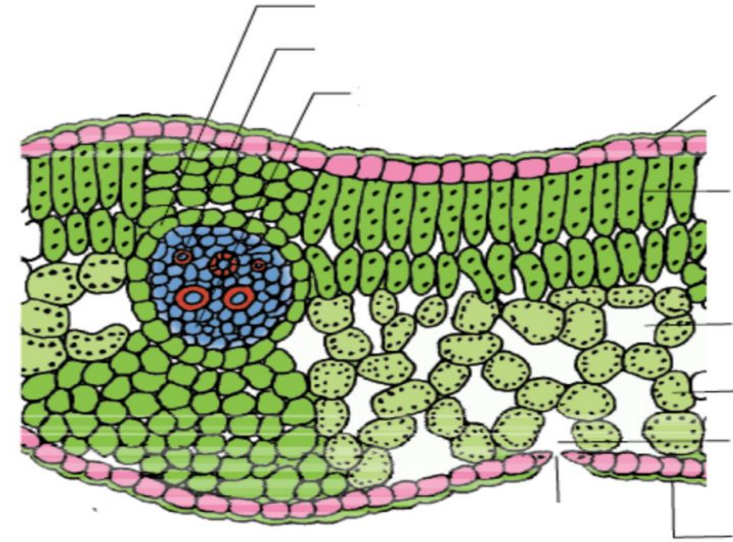
- It is the outermost layer and secretes a waxy substance called the *cuticle*.
- The cuticle helps retain water inside the leaf cells.
- The epidermis houses the guard cells which regulate the movement of water into and outside the cell.
- Guard cells do so by controlling the size of the pores also called *stomata*.



Anatomy of a typical Dicot leaf

Mesophyll:

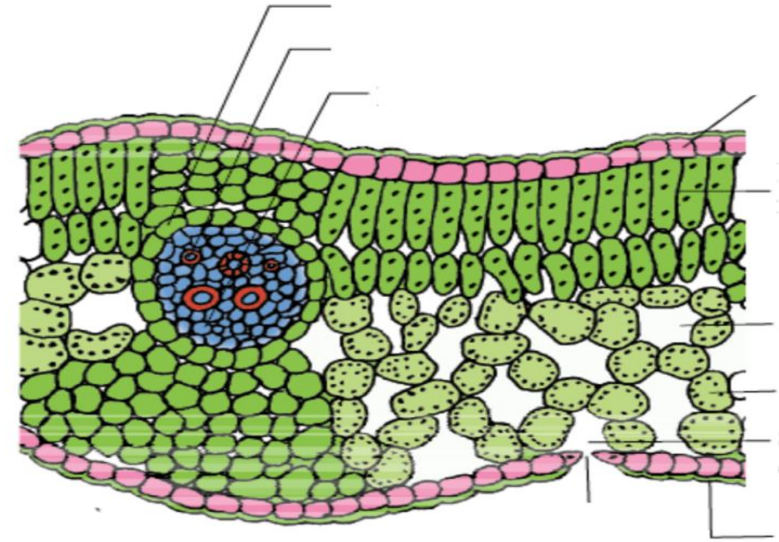
- This forms the middle layer of the leaf.
- It is differentiated into two layers depending on the type of cells found: palisade and spongy mesophyll layers.
- It is in this layer that the chloroplasts are found.
- The vascular tissues of the leaf are contained in the irregularly arranged spongy mesophyll cells.



Anatomy of a typical Dicot leaf

Vascular Tissue:

- The vascular tissue is actually found in the veins of the leaf.
- The vascular tissues are composed of xylem and phloem which are responsible for the transport of water and food.

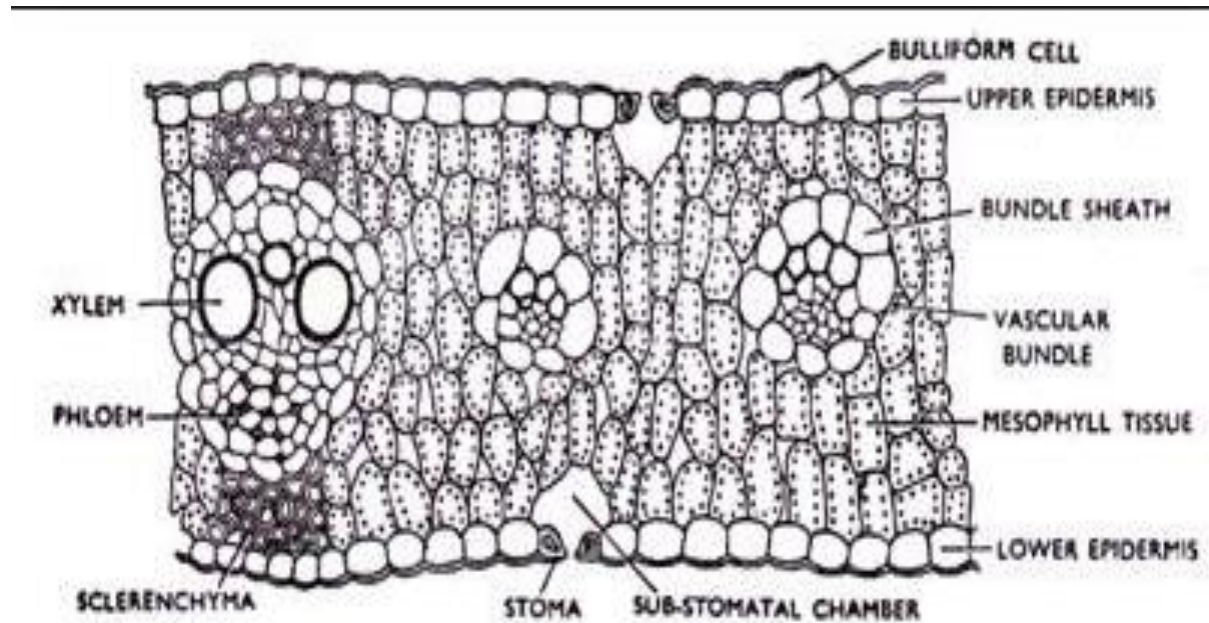


Anatomy of a typical Monocot leaf

Monocot leaves are generally isobilateral in origin but in some plants these are dorsiventral in nature. The leaves usually show parallel venation.

Epidermis:

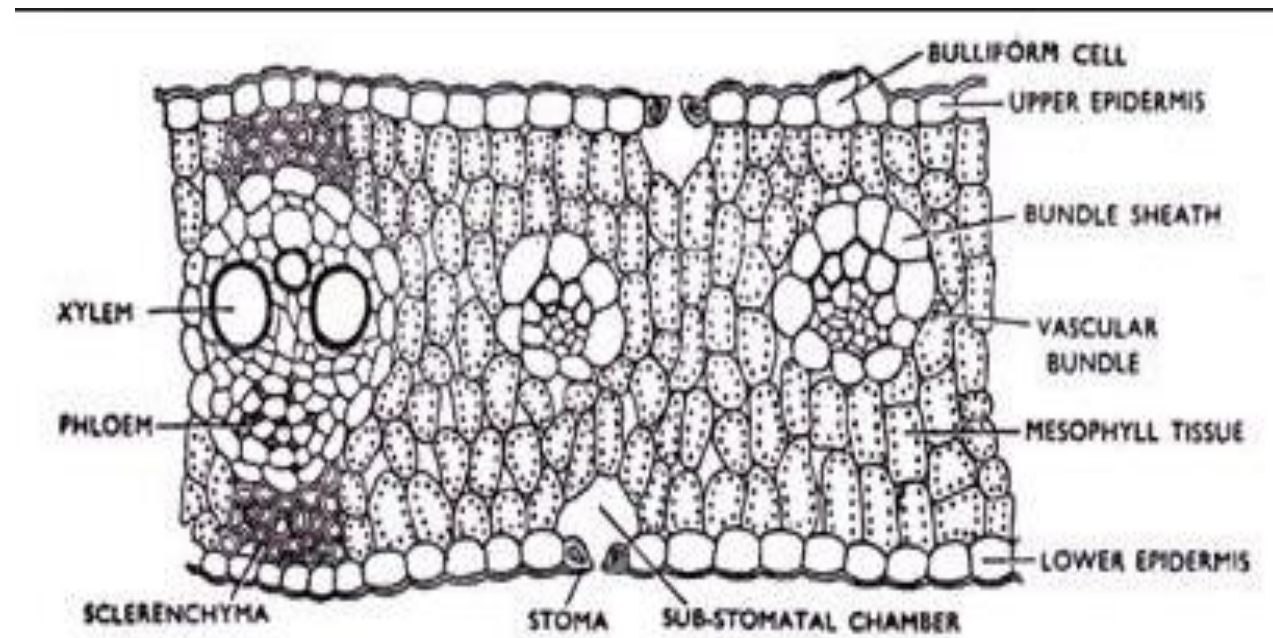
Monocot leaf has upper and lower epidermis made up of single layered, compactly arranged cells. The upper layer is covered with cuticle. Both upper and lower layers of epidermis contain stomata. At some places the



Anatomy of a typical Monocot leaf

Mesophyll:

It is made up of chlorenchymatous ground tissue of leaves. The mesophyll is not differentiated between palisade and spongy parenchyma. The intercellular spaces are connected with the two substomatal cavities.



Anatomy of a typical Monocot leaf

Vascular bundle:

These are present in large number, out of which some are small while the other are big.

The patches of sclerenchymatous cells are present below and above the larger bundle. The vascular bundles are conjoint, collateral, endarch and closed. Xylem and phloem are found towards the upper and lower epidermis respectively.

