* Anatomy of Flowering Plants *

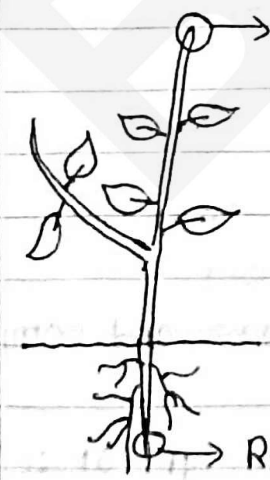
Plant tissue

* Meristematic tissue
→ Cells keep diving
  - 1) Apical meristem
    - Root apical
    - Shoot apical
  - 2) Intercalary meristem
  - 3) lateral meristem

* Permanent tissue
→ Do not divide generally
  - Simple
    - Parenchyma
    - Collenchyma
    - Sclerenchyma
  - Complex
    - xylem
    - Phloem

* Meristematic tissue
→ Dividing cells
→ Polyhedral / isodiametric
→ No intercellular spaces
→ Thin cell wall
→ Prominent nucleus
→ Dense cytoplasm
→ Smaller in size

* Apical meristem

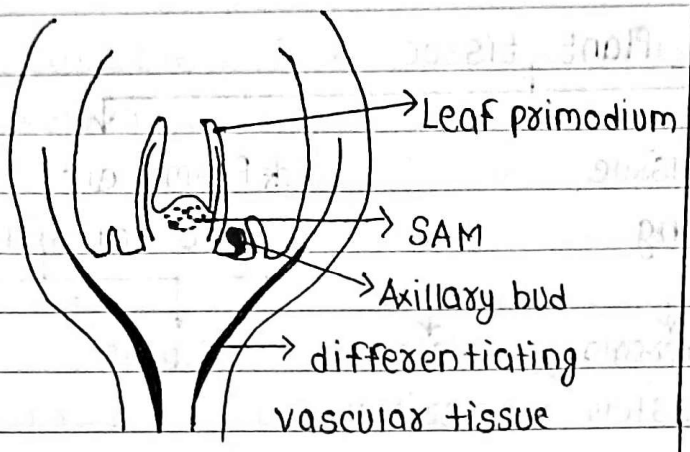


→ Shoot apical meristem

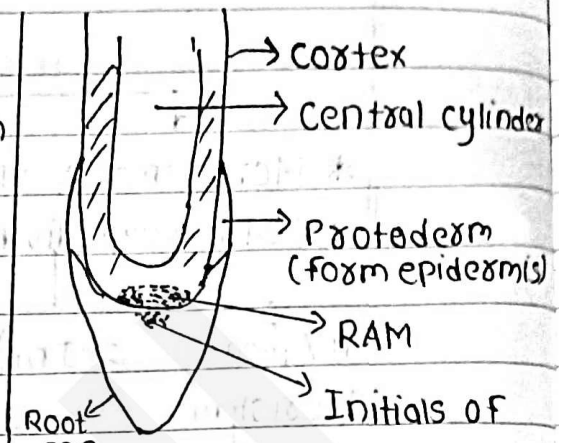
→ Root apical meristem

Functions
→ increase length
→ formation of new organs

→ Subterminal
↓
covered by Root cap

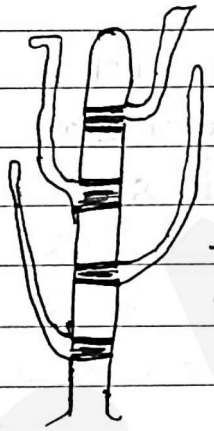


* Shoot apical meristem.



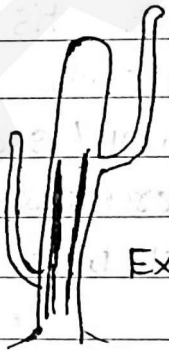
* Root apical meristem.

* Intercalary meristem.



→ mostly in monocots
→ Regenerate the parts removed by grazing herbivores

* Lateral Meristem:



→ Present along the sides
→ Increase the girth of Stem, Root
Ex- Interfascicular cambium
→ Found in Gymnosperm
→ Dicots

* Permanent Tissues

→ The cells of the permanent tissues do not generally divide further
→ It is of two types simple tissues and complex tissues

→ Simple tissue is made of only one type of cells
→ The various simple tissues in plants are parenchyma, collenchyma, and sclerenchyma.

1) Parenchyma

→ cells of parenchyma are isodiametric.

→ spherical, oval, round, polygonal or elongated in shape.

→ walls are thin & made up of cellulose.

→ closely packed or have small intercellular spaces.

→ Photosynthesis, storage, secretion.

2) Collenchyma.

→ occurs in layers below the epidermis in most of dicotyledons plants

→ cells are thick at corners due to a deposition of cellulose, hemicellulose and pectin

→ oval, spherical or polygonal & often contain chloroplast

→ Intercellular spaces are absent

→ Provides mechanical support

3) Sclerenchyma

→ Long, narrow cells with thick and lignified cell walls having a few or numerous pits.

→ Living at the time of production but at maturity they become dead

→ May be either fibres or sclerids

→ Fibres → thick walled, elongated and pointed cells

→ Sclerids → Spherical, oval or cylindrical, highly thickened dead cells with very narrow cavities (lumen).

→ These are commonly found in the fruit walls of nuts; pulp of fruits like guava, pear & sapota; seed coat of legumes and leaves of tea. also provides mechanical support to organs

* Complex permanent tissue (made by more than one type of cells)
Two types xylem and phloem

1) Xylem → Transports water and minerals to stem & leaves

→ It is composed of 4 kinds of elements

i) Tracheids ii) Vessels (non-living) iii) xylem fibres iv) xylem parenchyma (living)

i) Tracheids
→ Elongated, tube like cells with thick and lignified walls and tapering ends.
→ dead and without protoplasm

ii) Vessels → long cylindrical tube like structure
→ made up of many cells called vessel members
→ The presence of vessels is a characteristic feature of angiosperm.

iii) xylem fibres - have highly thickened walls and obliterated central lumens. These may be septate or aseptate.

iv) xylem parenchyma - living cell and thin walled.
→ cell walls are made up of cellulose
→ They store food materials in the form of starch or fat and other substances like tannins
→ conduction of water takes place by ray parenchymatous c

Primary xylem is of two types - protoxylem & metaxylem
→ The first formed primary xylem elements are called protoxylem and later formed is called metaxylem.

→ In stem, the protoxylem lie towards the centre (pith) and the metaxylem lie towards the periphery of the orga This type of primary xylem is called endarch

→ In roots, the protoxylem lie towards periphery and metaxylem lies towards the centre this type is called exarch

2) Phloem

→ It transports food materials from leaves to other parts.
→ In angiosperms phloem is composed of sieve tube elements, companion cells, phloem parenchyma, & phloem fibres
→ Gymnosperms have albuminous cells & sieve cells. They lack sieve tube and companion cells.

→ Sieve tube elements → These are long, tube-like structures, arranged longitudinally and associated with companion cells
→ Their end walls are perforated to form the sieve plates.
→ A mature sieve element has a peripheral cytoplasm and large vacuole. but lacks nucleus.
→ The functions of sieve tubes are controlled by companion cells

* The first formed primary phloem (protophloem) consist of narrow sieve tubes. The later formed phloem (metaphloem) has bigger sieve tubes

→ Companion cells - Specialized parenchymatous cells associated with sieve tube elements.
→ Sieve tube elements & companion cells are connected by pit fields present between their common longitudinal walls
→ Function - Maintain pressure gradient in sieve tubes

→ Phloem parenchyma - It is made up of elongated, tapering, cylindrical cells which have dense cytoplasm and nucleus
→ The cell wall is composed of cellulose and has pits through which plasmodesmatal connections exists betn the cells
→ Phloem paranchyma absent in most of monocots
→ Function - It stores food material and other substances like resins, latex and mucilage.

→ Phloem fibres - Made up of sclerenchymatous cells.
→ Generally absent in primary phloem.
→ These are elongated, unbranched and have pointed, needle like apices. cell wall is quite thick.
→ At maturity these fibres lose protoplasm and become dead. phloem fibres of jute, Flax & hemp are used commercially
→ Function - Mechanical support and protection of soft tissues

* The Vascular Tissue system

* open type vascular bundle.
→ In this, cambium is present between phloem & xylem. So vascular bundles can form secondary xylem & phloem tissues
Ex - dicotyledonous stem

* closed type vascular bundle.
→ In this cambium is absent, hence they do not form secondary tissues. Ex- monocotyledons

→ Based on the arrangement of xylem & phloem vascular bundles are 2 types.
1) Radial type.
→ xylem and phloem are arranged in an alternate manner on different radii, seen in roots.
2) conjoint type.
→ xylem and phloem are jointly situated at the same radius of vascular bundles. seen in stems and leaves
→ Conjoint vascular bundles usually have phloem located only on the outer side of xylem.

* Tissue System

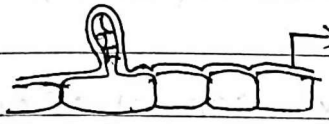
1) Epidermal tissue system.

It includes epidermal cells, stomata, epidermal appendages
Trichomes & Hair

Trichomes present in stem, they are multicellular and prevent loss of water.

Hair present in roots, they are unicellular, Absorb water & minerals

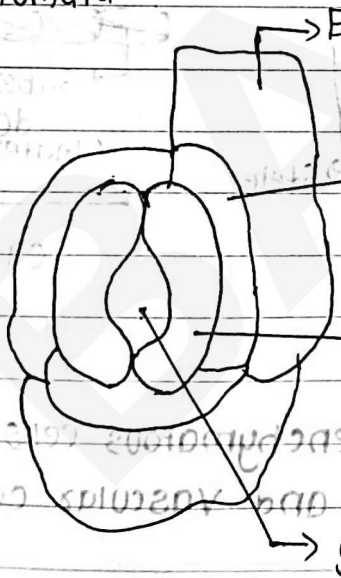
*Epidermis → outermost layer, Single layer.



→ Cuticle (waxy layer which prevents loss of water)

Parenchymatous cells.

* Stomata



→ Epidermal cell

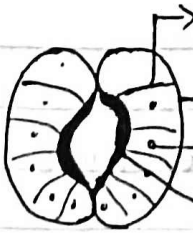
→ Subsidiary cell

→ Guard cell

→ Stomatal aperture

Guard cell is bean shaped in Dicot

Dumbell Shape in monocot



→ Radially oriented microfibrils

→ Outer layer thin

→ Chloroplas

→ inner layer thick.

Open stomata

closed stomata

2) Ground Tissue System:

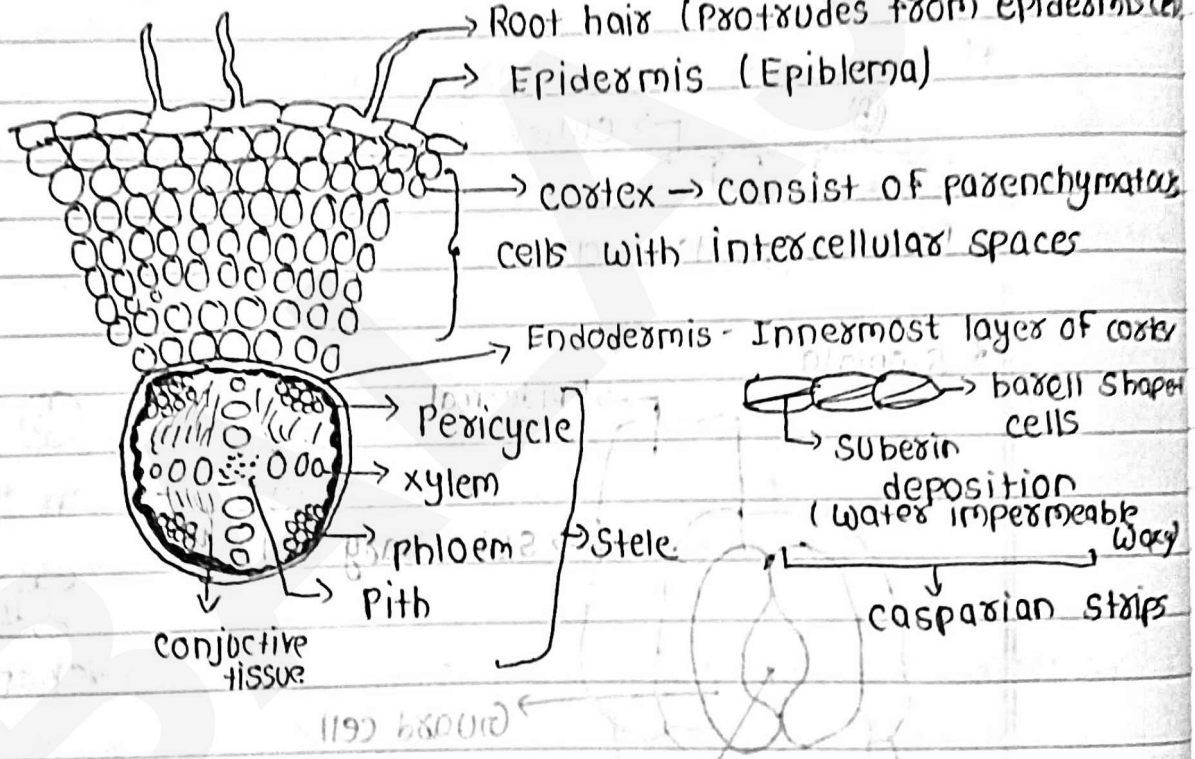
→ All tissue except epidermis and vascular bundles.

→ Made of simple tissue.

→ Parenchymatous cells present in cortex, pericycle, pith and medullary rays.

→ Ground tissue of leaves → mesophyll cells

* Anatomy of Dicot Root:



→ Pericycle - Few layered, parenchymatous cells

→ Lateral Roots arise from and vascular cambium arise from pericycle

Pith - very small

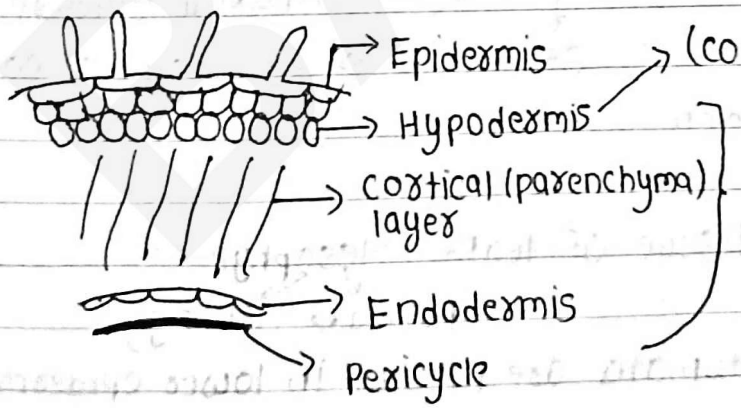
Vascular Bundles - 2-4 not more than 6

Radial

* Anatomy of Monocot Root:
→ Similar to Dicot roots but
→ more than Six xylem bundles & pith is large and well developed
→ No secondary growth

Tissue	Dicot Root	Monocot Root
No. of xylem	2-4 not more than 6	Polyarch (more than 6)
Cambium	Present (during secondary growth)	Absent
Secondary growth	Present	Absent
Pith.	very small	present and large.

* Anatomy of Dicot ~~Root~~ Stem:



DO CTOR
↓
Dicot → collenchyma

Endodermis - Rich in Starch grains
Stele:- pericycle → ◠ → small lunar patches of sclerenchyma
Medullary rays
↳ Radially placed, present betⁿ vascular bundles

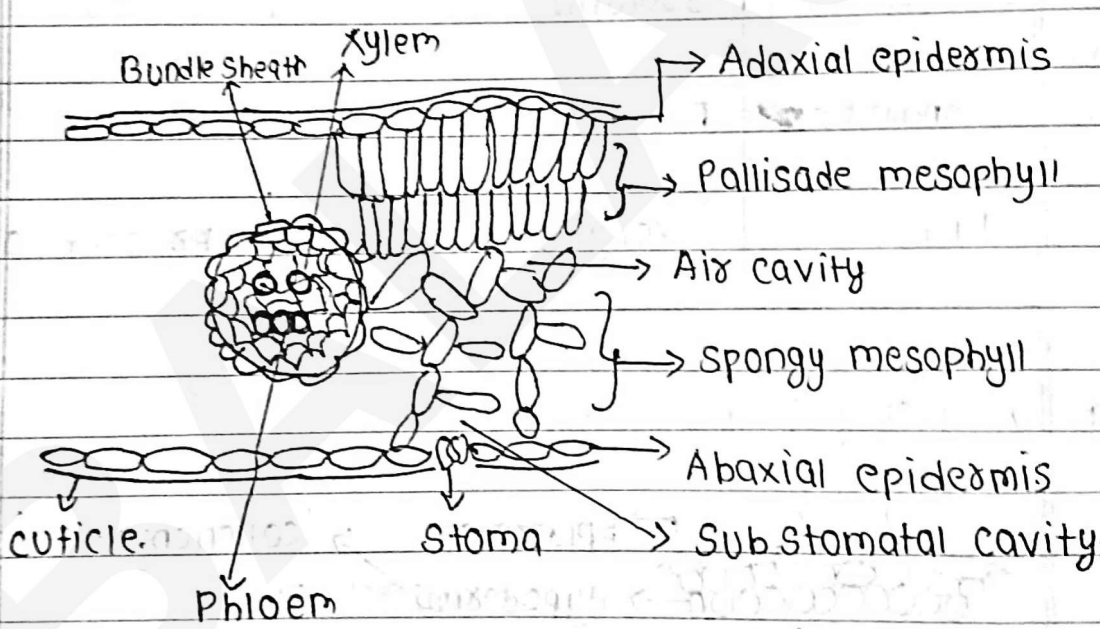
* vascular Bundles
→ large number. Ring arrangement, conjoint & open
→ protoxylem is endarch
→ Pith is large

* Anatomy of monocot stem.

monocot → Sclerenchyma
↑
MSC

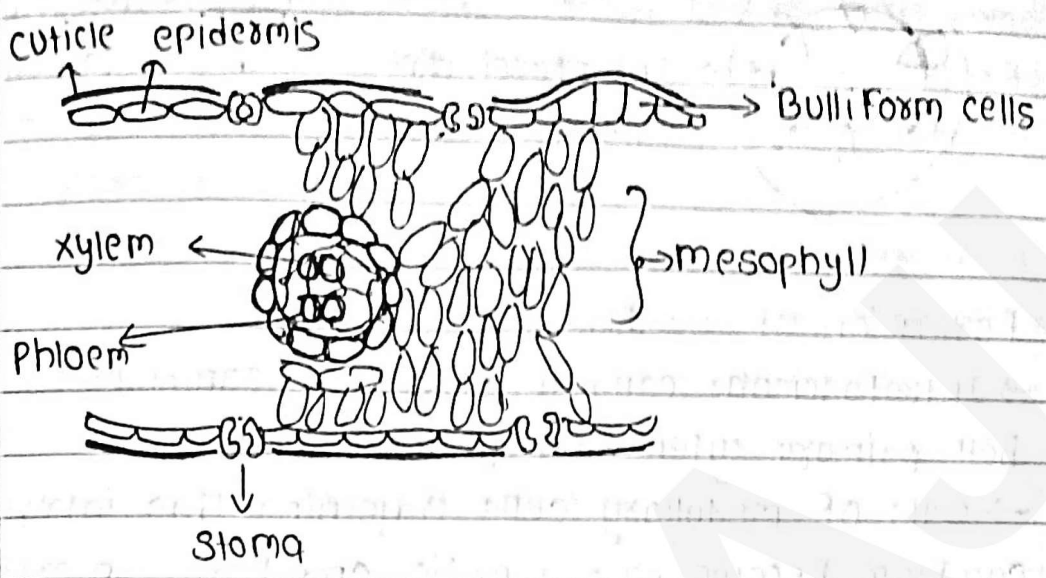
→ Hypodermis → sclerenchyma
→ No differentiation in cortex and pith
→ Vascular bundles scattered
→ Smaller at periphery and large at cortex
→ Conjoint and closed
→ Phloem parenchyma absent
→ Water containing cavities with the vascular bundles

* Anatomy of Dicot leaf (Dorsiventral)



→ Ground tissue of leaf → Mesophyll
Pallisade Spongy
→ Mostly stomata are present in lower epidermis
→ vascular bundles are closed.
→ Reticulate venation

* Anatomy of monocot leaf

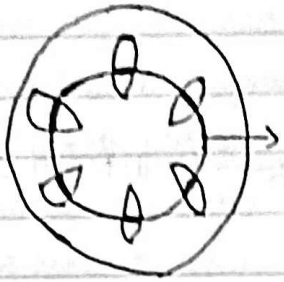


→ Stomata present equally on both surface
→ mesophyll is not differentiated into pallisade and spongy.
→ Bulliform cells - large, empty, colourless cells, ex- grasses
↳ Flaccid → due to water stress
↓ make the leaves curl inwards
↳ minimize loss of water

Parallel venation

* Secondary growth
primary growth → increase in length of roots and stems.
Secondary growth → increase in girth of dicot plants
→ Tissues involved in secondary growth are the two lateral meristem - i) vascular cambium ii) cork cambium.

1) Vascular cambium
→ It is the meristematic layer responsible for cutting off vascular tissues (xylem & phloem)
→ In the young stem, it is present in patches as a single layer between xylem & phloem. Later it forms a complete ring.

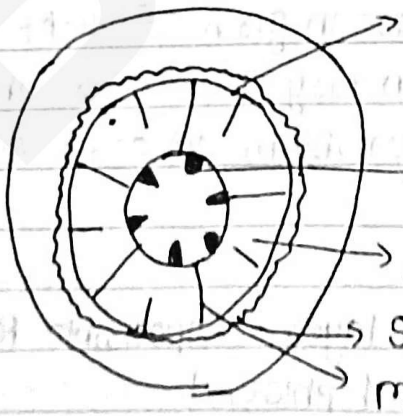


Interfascicular
cambium

Formation of cambial ring:

→ Intrafascicular cambium - cells of cambium present betn primary xylem and primary phloem.

→ cells of medullary cells adjoining this intrafascicular cambium become meristematic and form interfascicular cambium Thus, a continuous ring of cambium is formed



Activity of the cambial ring.

→ The cambial ring becomes active and cut off new cells, both towards the inner and outer sides. The cells cut off towards pith mature into secondary xylem. The cells cut off towards periphery mature into secondary phloem.

→ Cambium is more active on the inner side than on the outer. As a result, more secondary xylem is produced than secondary phloem and soon forms compact mass.

* Spring wood and autumn wood

→ In the spring season, cambium is very active and produces a large number of xylary elements having vessels with wider cavities. The wood formed during this season is called spring wood or early wood.

→ In winter the cambium is less active and forms fewer xylary elements that have narrow vessels and this wood is called autumn wood or late wood.

→ The spring wood is lighter in colour and has a lower density whereas the autumn wood is darker and has higher density.

→ The two kinds of woods that appear as alternate concentric rings, constitute an annual ring.

* Heartwood and Sap wood

→ In old trees the greater part of secondary xylem is dark brown due to deposition of organic compounds like tannins, resins, oils, gums, aromatic substances and essential oils in the central or innermost layers of the stem.

→ These substances make it hard durable and resistant to the attacks of microorganism and insects.

→ This region comprises dead elements with highly lignified walls and is called heartwood.

→ The heartwood does not conduct water but it gives mechanical support to the stem.

→ The peripheral region of the secondary xylem is lighter in colour and is known as the sapwood. It is involved in the conduction of water and minerals from root to leaf.