ANATOMY OF FLOWERING PLANTS

- **Anatomy**: is the branch of biology which deals with the study of internal structure.
- **Cells**: are the basic structural and functional unit of life.
- **Tissue***:* is group of cells perform a function.

Tissue in plants are of two types
- a) Permanent tissue
- b) meristematic tissue

Meristematic tissue (meristem) consists of immature cells which are continuously dividing. They produce new cells which differentiates into permanent cells.

Meristem features:
1. contain immature cells
2. localised at specific regions.
3. composed of immature cells.
4. cells have isodiametric in shape.
5. cells have abundant protoplasm

Classification of meristem

On the basis of their time of origin they can be classified as
1) Primary meristem 2) secondary meristem

1) primary meristem : formed primarily at younger stage of the plant
2) secondary meristem : formed secondarily from permanent tissues

Classification on the basis of position

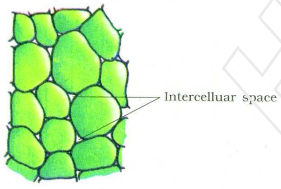
1 .Apical meristem : Meristem seen at the apical region of root and stem

2. Lateral meristem : Laterally placed meristem . eg. cambium

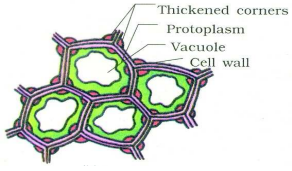
3. Intercalary meristem : this meristem intercalated with permanent cells. Eg. Meristem seen at the base of internode and leaf base.

Permanent tissue: they are classified as simple and complex permanent tissue. Simple tissue consists of same type of cells. Examples are :

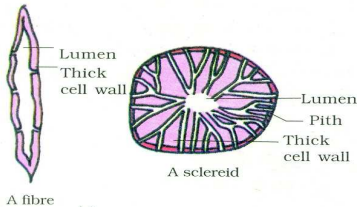
a) Parenchyma: round , oval , or polygonal in out line. Storage, photosynthesis are the functions.



b) Collenchyma: oval in outline, cells have localized thickenings, give mechanical support.



c) Sclerenchyma: thick walled cells . cells are of two types- fibers and sclerieds
Fibers are long cells and sclereids are oval cells and have a narrow lumen. Highly thick walled. Seen in coconut shells , seeds of guava etc.



The complex tissue consists of different type of cells but perform same function. They are:

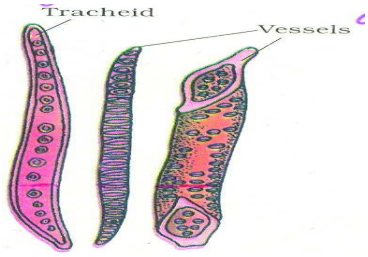
a) **xylem**: conduction of water and mineralas are the function of xylem. It consists of different type of cells or they are called xylem elements. The xylem elements are :

i) xylem tracheid: they are tube like cells with tapering ends. They are thick walled. In gymnosperms tracheid is absent.

ii) xylem Vessel: long, cylindrical tube like cells . lumen is larger than of tracheid.

iii) xylem Fiber: are the sclerechyma cells associated with xylem

iv) xylem Parenchyma: are the parenchyma cells associated with xylem. It is thin walled.



Protoxylem& metaxylem

- Protoxylem: first formed primary xylem. It is small.
- metaxylem : later formed primary xylem. It is large.

Endarch & exarch xylem

✔ Endarch : if protoxylem lies towards the centre. Seen in stem

✔ Exarch : if protoxylem lies towards the periphery. Seen in root

b) **phloem** : transport of prepared food from leaves to other parts of the plant is the function. Phloem has 4 different elements like.

i) Sieve tube: tube like structure. Have no nucleus.

ii) Companion cell: it is associated with the sieve tube. It control the function of sieve tube. They are living.

iii) phloem fiber: are the sclerechyma cells associated with phloem . they are otherwise called as bast fibers. phloem fibers of jute, hemp and flax are commercially important.

iv) phloem Parenchyma: are the parenchyma cells associated with phloem. It is living. It is absent in monocots.

The tissue system

On the basis of their location and function all the tissue of plant can be classified as different tissue systems.

1.epidermal tissue system.: it is the outer tissue system. Consists of epidermis, epidermal hairs, stomata, cuticle, subsidiary cells.

2. ground tissue system: the tissue other than the epidermal tissue and vascular tissue is ground tissue . consists of cortex, pith etc

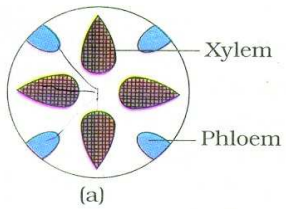
3. vascular tissue system: consists of vascular tissues like xylem and phloem.

The arrangement of xylem and phloem

In roots the xylem and phloem seen in different radii. Such arrangement is called *radial* arrangement.

In stem the xylem and phloem seen on same radius. Such arrangement is called *conjoint* arrangement.

Here they form as a bundle called vascular bundle.

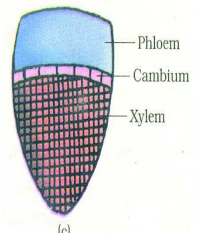


RADIALVASCULAR BUNDLE

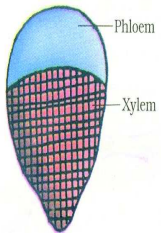
Open and closed vascular bundle

In open vascular bundle cambium (a meristem) is seen in between xylem and phloem. Seen in dicots.

In closed vascular bundle cambium (a meristem) is absent . seen in monocots.



OPEN



CLOSED

Anatomy of stem and root

1.the outer layer of cells are epidermis
2.stele is the central portion, here xylem and phloem are seen.
3.in between epidermis and stele cortex is seen.

Anatomy of dicot root	**Anatomy of monocot root**
1. vascular bundle is radial	*1. vascular bundle is radial*
2. xylem exarch	*2. xylem exarch*
3. cortex homogenous	*3. cortex homogenous*
4. clear endodermis	*4. clear endodermis*
5.xylem and phloem groups are limited in number	5.xylem and phloem groups are numerous
6. xylem polygonal in outline	6. xylem oval in outline
7. Pith is reduced or absent	7. Pith is large
8. secondary growth is seen	8. secondary growth is absent

[compare above two anatomy of root and stem]

- Casparian strips: the radial and inner tangential walls of endodermis have suberin thickenings.it is called Casparian strips
- Endodermis is the last layer of cortex.
- Just below endodermis pericycle is seen

Anatomy of dicot stem
1. vascular bundle is conjoint
2. xylem endarch
3. cortex heterogenous

4.vascular bundles are limited in number
5. xylem polygonal in outline
6. cambium is present
7. bundle cap is seen
8. protoxylem lacuna absent

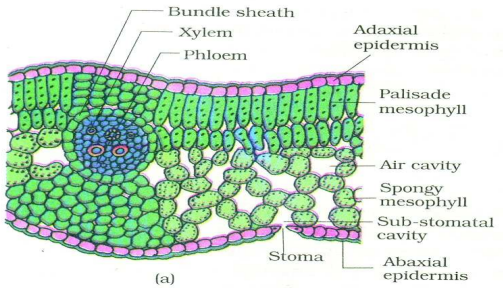
Anatomy of monocot stem
1. vascular bundle is conjoint
2. xylem endarch
3. cortex heterogenous

4.vascular bundles are numerous in number
5. xylem oval in outline
6. cambium is absent
7. bundle sheath is seen
8. protoxylem lacuna present

- Conjunctive tissue: tissue seen in between xylem and phloem.
- Protoxylem lacuna: is the cavity seen below the protoxylem.

Anatomy of dicot leaf.

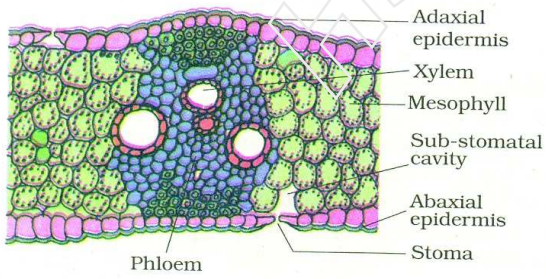
- Upper and lower epidermis is seen.
- Epidermis possess stomata
- The cells in between the upper and lower epidermis is called mesophyll.
- The mesophyll possess two different tissue. The upper palisade and lower spongy tissue.
- In palisade tissue cells are long and compactly arranged, and they have more chloroplast.
- In spongy tissue the cells are oval and loosely arranged. And have less chloroplast.
- Exarch Vascular bundles can be seen in the midrib and veins. Bundles have bundle sheath.
- Dicot leaf is otherwise called dorsiventral leaf. Because it has clear upper and lower surface



Anatomy of monocot leaf

- Upper and lower epidermis is seen.
- Epidermis possess stomata . bulliform cells are seen at upper epidermis.
- The cells in between the upper and lower epidermis is called mesophyll.
- The mesophyll has no palisade and spongy tissue differenciation
- Exarch Vascular bundles can be seen in the veins. Bundles have bundle sheath.
- monocot leaf is otherwise called isobilateral leaf. Because it has no differenciation of upper and lower surface.

- Bulliform cells are special cells which absorb water and become turgid. This time leaf surface is exposed. But if they loose water the cell become flaccid and the leaves curl inwards.



Secondary growth

- Secondary growth is the increase in girth.
- It occurs due to the activity of cambium.
- Cambium produce secondary tissues such as secondary xylem and secondary phloem.
- Periderm is the protective tissue formed during secondary growth.

Secondary growth in dicot stem

- the permanent tissue in between the vascular bundles become meristematic, and form interfasicular cambium.
- The interfasicular cambium grow and fuses with the intra fasicualr cambium seen in the vascular bundle.

- Thus form a continuous ring of vascular cambium.
- This vascular cambium produce secondary xylem inwardly and secondary phloem outwardly.

- Due to the addition of above tissues the epidermis braeks. So new protective tissue is formed below it, called periderm

- During periderm formation some cells of cortex become meristematic and form cork cambium or phellogen.

- The phellogen produce cells both outwardly and inwardly. The outwardly formed cells are phellum and inwardly forme cells are phelloderm.

- These phellum, phellogen and phelloderm constitute the periderm.
- For aeration some pores called lenticels are seen in periderm.
- [Some parenchyma cells are formed from vascular cambium which passes through secondary xylem and secondary phloem.]

Spring wood and autumn wood

The activity of cambium is controlled by many physiological features.
In temperate regions this activity varies with season.
During spring activity of cambium is more, and it produce large amount of xylem with large vessels.
It is called early wood or spring wood.
But in autumn activity of cambium is less, and it produce small amount of xylem with narrow vessels. It is called late wood or autumn wood.

The above two appear as alternate concentric rings called the ***annual rings***. By counting them we can calculate the age of a tree.

Heart wood and sap wood

Heart wood	***Sap wood***
It is seen at centre	*seen at peripheral*
dark coloured	*light coloured*
contain tannins ,resins and oils, gums etc.	*no such compounds*
durable	*less durable*
not functional, dead	*functional, living*

Secondary growth in dicot root

- During the secondary growth small strips of cambium are formed just above the protoxylem (here pericycle cells become meristematic) and just below the phloem.(here conjunctive tissue become meristematic)
- Later these two cambium join togother to form a wavy band of cambium.
- It become circular later.
- This cambium produce secondary xylem inwardly and secondary phloem outwardly.
- Periderm formation is also seen here as in the case of dicot stem. But the phellogen is formed from pericycle.

Bark: is the all tissues seen exterior to vascular cambium.