

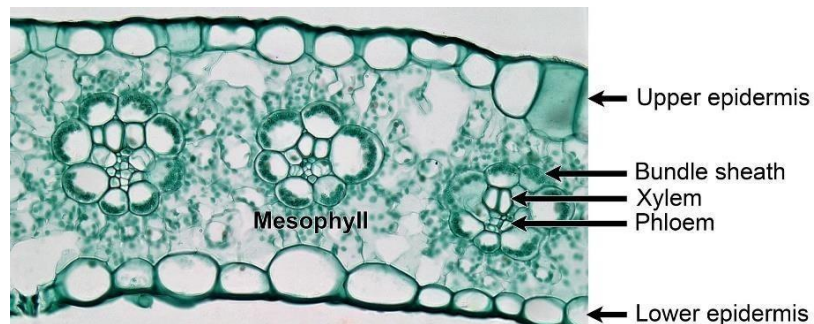
Lab 8:-

Epidermis

Epidermis: - It is the outermost cell layer of the primary plant body and compound tissue. The Cuticle is a complex waxy layer secreted by epidermal cells as it forms a barrier to water loss and the entrance of pathogens.

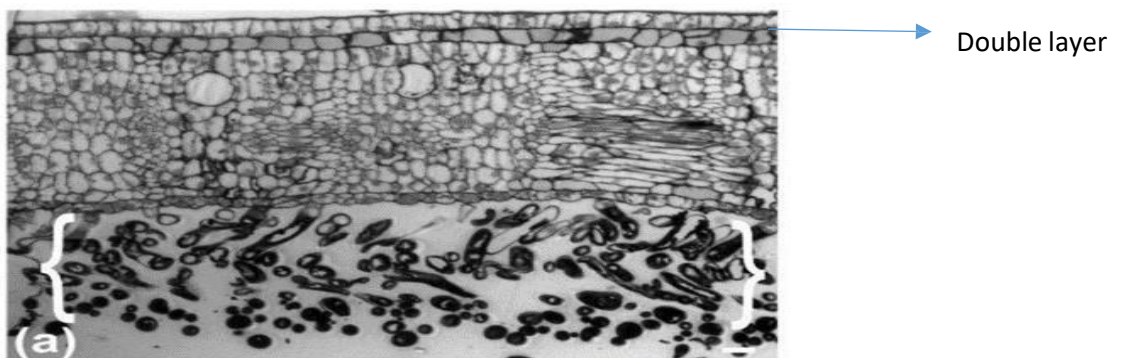
***The epidermis are classified into three types according to the number of epidermis

1- Simple: - It is consisting of one layer as in the leaf of *Zea mays*.

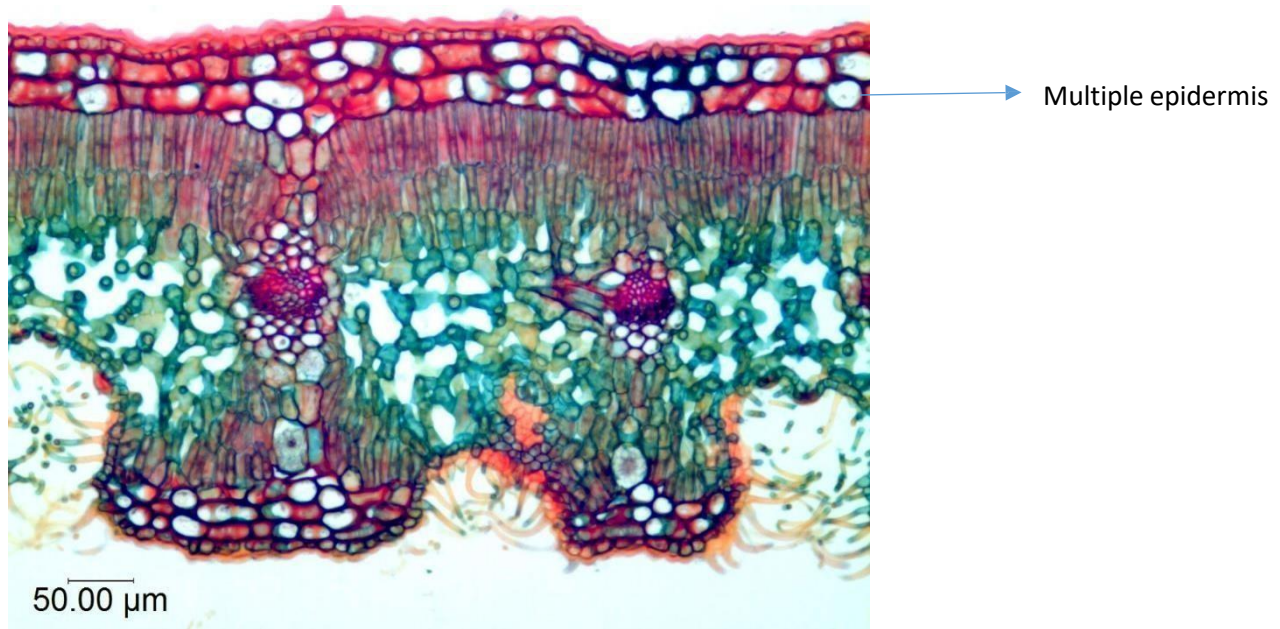


Simple epidermis in the C.S of *Zea mays* leaf

2- Double: - It consists of two layers as in leaf epidermis of *Magnolia grandiflora*.



3- Multiple: - It contains more than two layers as in leaf epidermis of *Ficus elastica* or *Nerium oleander*.



Multiple epidermis in leaf of *Nerium oleander*

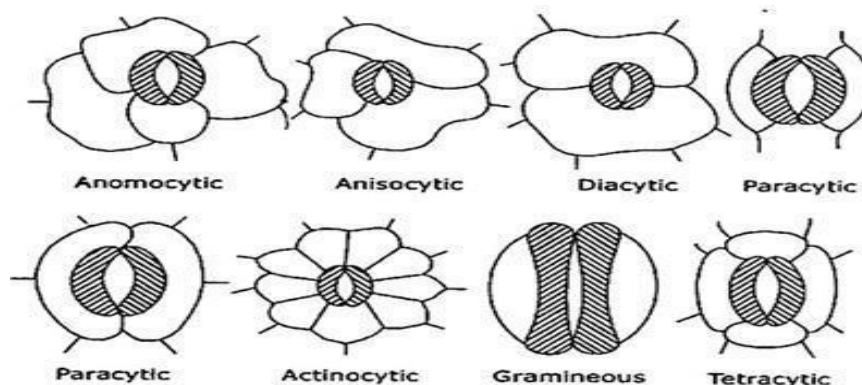
*****Epidermal cell types:-**

- 1- Ordinary or pavement cells:** - They are the most common and vary in shapes from longitudinal to curve.
- 2- Guard cells:** - They are specialized plant cells in the epidermis of leaves, stems and other organs that are used to control gas exchange. They are produced in pairs with a gap between them that forms a stomatal pore.
- 3- Subsidiary cells:** - They are located adjacent to the guard cell in the stoma of a leaf. The function is providing support in the movement of guard cells.
- 4- Stomata:** - There are tiny openings in certain parts in all green plants which are essential in the gas control. They are kidney like shape in dicot and dumbbell shape in monocot.

*****Stomatal complexes.** The arrangement of subsidiary cells and guard cells.

There are several types of stomatal complex as listed below.

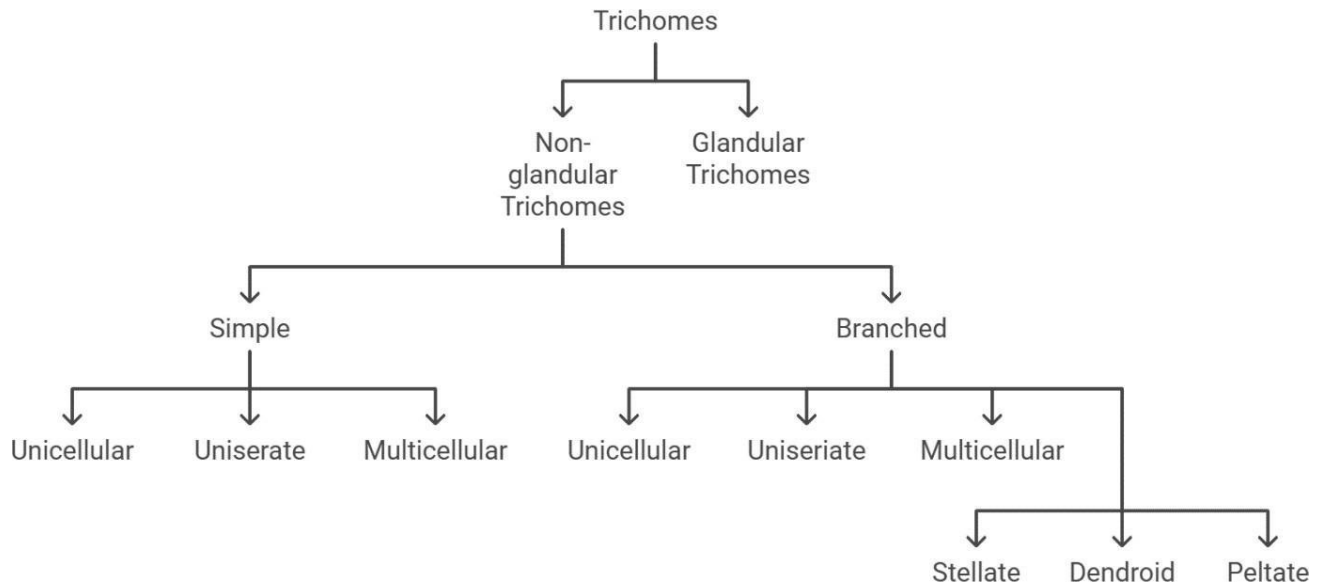
1. **Anomocytic (Irregular celled):** There is no differentiation of the epidermal cells around the guard cells. Ex. *Vicia faba* leaves.
2. **Anisocytic (Unequal celled):** The guard cells are surrounded by three subsidiary cells, where one is distinctly smaller than the other two. This uneven size of surrounding cells is a defining feature. Ex. *Raphanus* leaves
3. **Paracytic (Parallel celled):** 1 or more subsidiary cells are parallel to guard cells. Ex. *Magnolia*, *Graminae* and *Fabaceae* (Bean)
4. **Diacytic (Cross celled):** 2 subsidiary cells with walls perpendicular to guard cells. Ex. *Dianthus* leaf peeling
5. **Actinocytic (radiate celled):** several subsidiary cells radiate from around the guard cells. Ex. *Zea mays* and *Rosa* leaf peeling
6. **Cyclocytic (cyclic celled):** subsidiary cells in 1-2 rings around guard cells.



Types of stomatal complex

The epidermis have several appendages like **trichomes, scales and papillae**

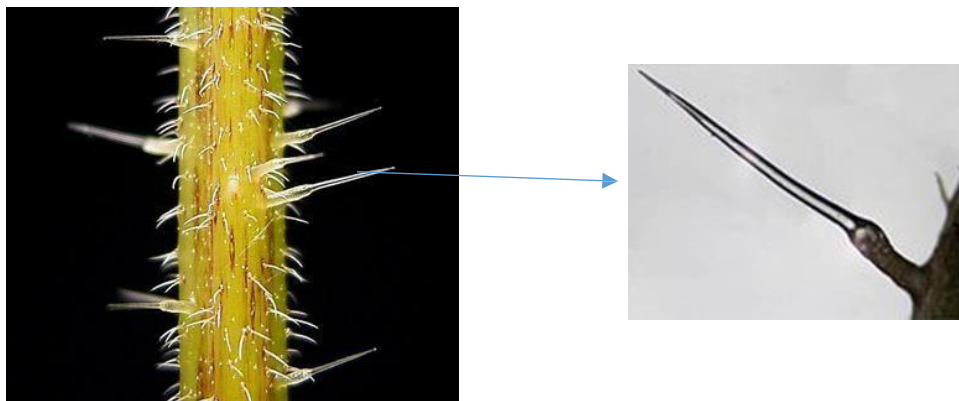
First:-Trichomes: - They are epidermal appendages which take different shapes and functions and can be found in all parts of plants. They are divided into:



****Non-glandular trichomes:** - They are pointed terminal cells, that do not secrete compounds (non-glandular) but serve other functions like preventing herbivory (insects and other animals) and reduce water loss by transpiration from the leaf. They can be divided into simple and branched as mentioned below.

1. Simple

a. Unicellular - e.g. root hair, an extension of the epidermal cells and stinging hair in *Urtica*.



Stinging hair in *Urtica*

b. Uniseriate - one cell layer thick ex. *Malva* leaf.

c. Multicellular - several cell layers thick and divided into

1- Uniseriate: - It can be noticed in *Cucurbita* leaves.



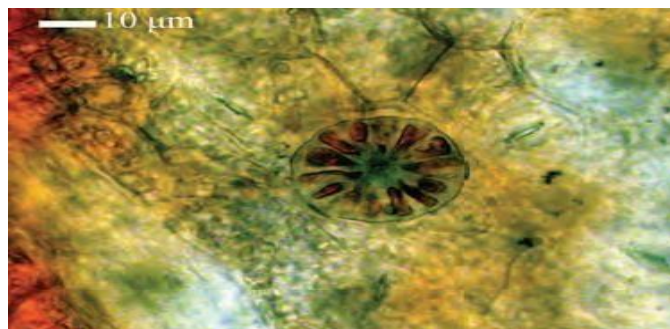
2- Multiseriate: - It can be noticed in *Portulaca oleracea* leaves or petioles.

2. Branched non-glandular trichomes

a. Unicellular. Such as the trichomes of *Arabidopsis* (usually has three branches).

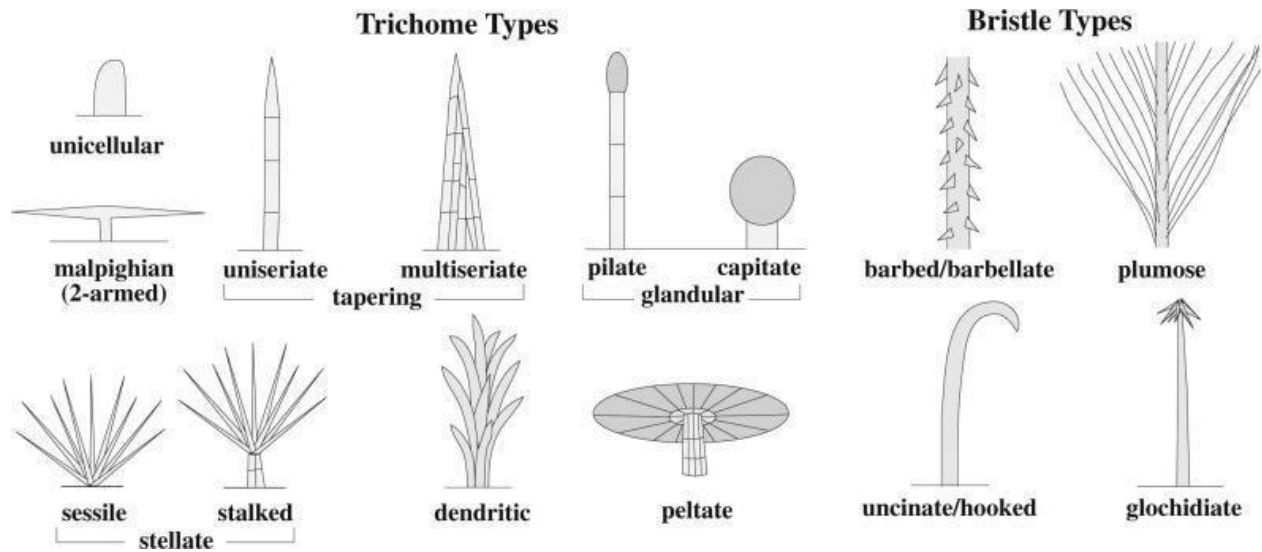
b. Multicellular

- Stellate - star shaped. Some have stalks, such as this *Solanum quitoense*. Some don't have a stalk, like *Hibiscus rosa-sinensis*.
- Dendroid - tree-like, such as trichome of *Verbascum*.
- Peltate (umbrella shaped):- e.g. *Olea europaea* (olive).

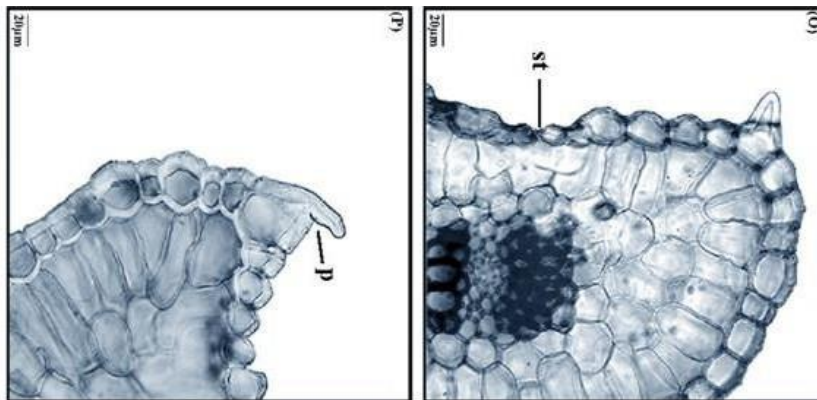


Peltate trichomes on leaf of the aluminum plant (*Pilea cadierei*)

*** **Glandular hairs:** - They are large stalk and multicellular secreting head and found on the surface of about 30% of all vascular plants and are responsible for secreting of some secondary metabolites like essential oils.



Second: - Papillae: - ex. *Rosa* spp. leaf petiole or stem c.s.



Cross sections of the leaf showing the stomata (st), papillae (p) in *Crocus* spp.

Third: - Lithocytes ex. C.S. of *Ficus elastica* leaf

Practical work:-

- 1- Prepare C.S of *Zea mays* leaf to observe simple epidermis.
- 2- Prepare C.S. of *Magnolia grandiflora* (Cultivated in Baghdad) leaf epidermis to observe double layers of epidermis
- 3- Prepare leaf peeling from different plants of monocot and dicot to observe different types of stomatal complex.

- 4- Prepare C.S. of leaf, stems and petioles from plants covered with trichomes to observe different types of epidermal appendages.

Lab 9:- Vascular tissues (Complex tissues)

Vascular tissues are complex conducting tissues in higher plants that are made up of different types of cells and elements. The two main components of vascular tissue in plants are – **Xylem** and **Phloem**. These tissues are responsible for the transport of water and nutrients in the plants.

- 1- **Xylem:** - It is one of the conducting tissues that is responsible for the transport of nutrients and water from roots to the aerial parts of the plant such as stem and leaves. In angiosperm xylem tissue consist of **tracheids, vessel elements, fibers** and **parenchyma cells** but in **gymnosperm** the conduct element is **tracheid** only.

*****Xylem components:-**

A- Tracheary elements: - They are called collectively the tracheid and the vessel element which represent the two chief types of water-conducting cells present in the xylem of vascular plants.

- 1- **Tracheids-** They are the basic cell in the xylem, all plants have tracheids. Tracheids are generally spindle shaped, elongated with tapered ends. Tracheids have a function of support and water conduction. The secondary wall of tracheids is developed in a wide variety of patterns, these include annular, spiral, scalariform, and reticulate thickenings.
- 2- **Vessel elements:-** They are Tubular structure, multicellular, each cell of vessel called **element**, the end of wall of these elements called **perforation**

plates, when these plates have one pore it called **simple perforation plate**
 ex: *Vitis* stem when it have more than one pore it called **compound plate**,
 these plate may be **scalariform, reticulate, forminate or ephedronal plates**
 ex: *Ephedra*. The function of these elements in conduction only.

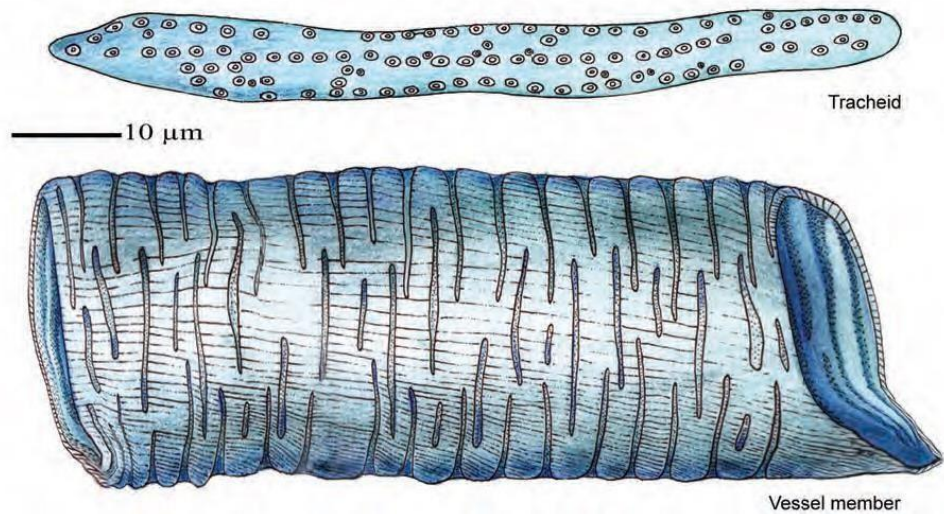
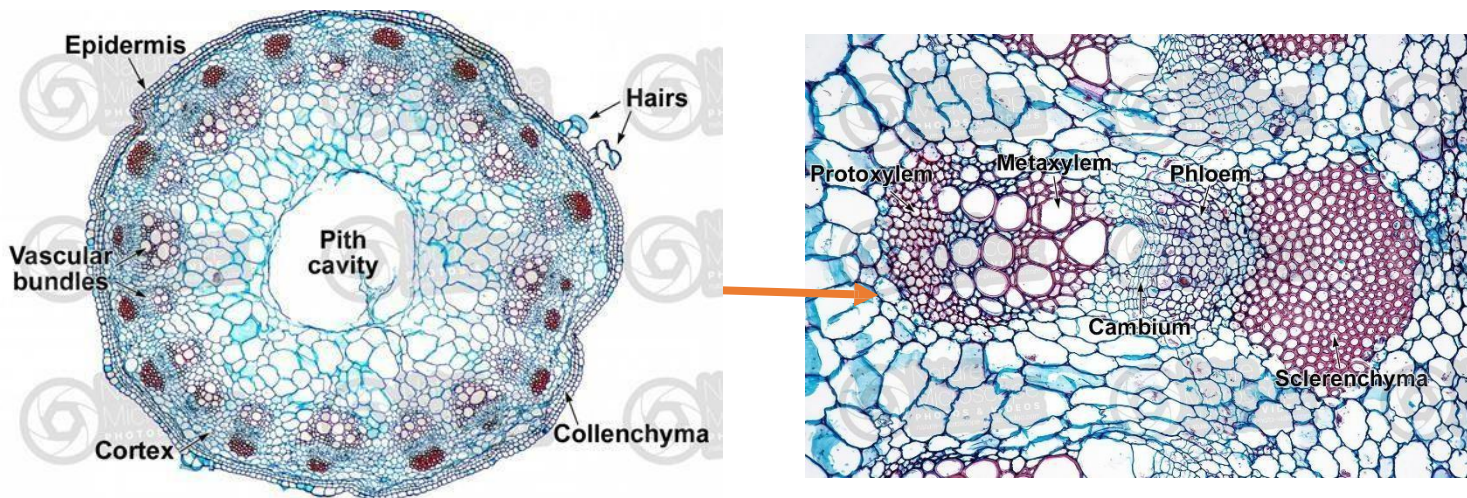
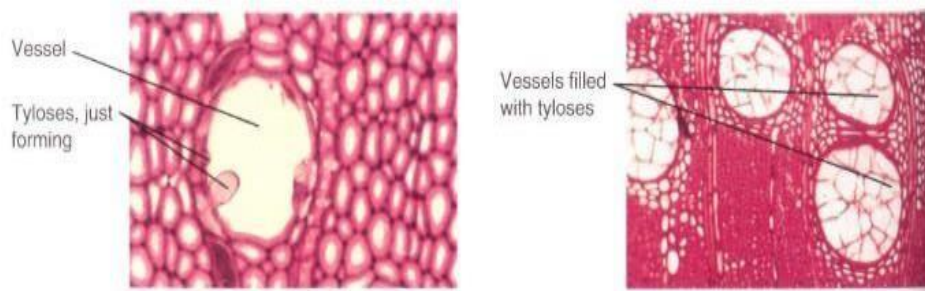


Diagram of tracheids and vessel elements

The xylem tissue undergoes primary and secondary growth. During primary growth, the xylem forms **protoxylem** and **metaxylem** from the **procambium** as illustrated in figure below C.S. of *Helianthus annuus* stem

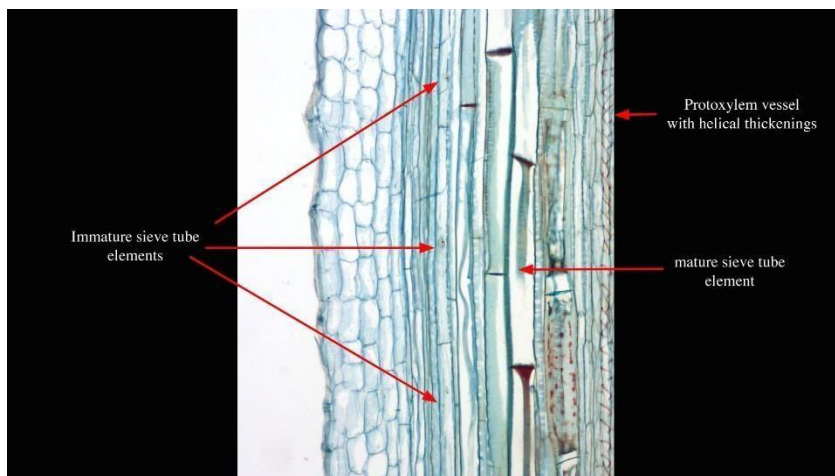


*****Tyloses:** - They are balloon-like swellings or projections that fill the vessels. When a tylosis is fully formed it plugs the vessel. The vessel can no longer conduct water. Tyloses form on some trees, such as white oak.



2. Phloem tissue: - A complex tissue, combine with xylem to form the vascular tissue system, the main function of it is food transportation. The phloem in Angiosperms plants consist of: Sieve tubes, companion cells, parenchyma cells and fibers

A- Sieve tubes: - They are specialized conducting cells. They have sieve plate at the terminal (transverse) walls, these sieve plates have numerous pores that cytoplasmic strands cross through its, these cytoplasmic strands covered with callose (carbohydrate substances).



L.S. of *Cucurbita* stem. The phloem here includes immature sieve tube elements with nuclei, mature sieve tube elements without nuclei, and a protoxylem vessel with helical secondary wall thickenings.

There are two kinds of sieve plate:

1- Simple sieve plate (pores diffuse irregularly) ex: C.S of Cucurbita stem.

2- Compound sieve plate (pores arrange in groups named sieve area) which probably found at lateral walls ex: L.S of *Vitis* stem.

B- Companion cell: - its parenchyma cell with big nucleus and dense cytoplasm, each one of these cells companies one element from sieve tube elements, and both of them derived from same mother cell.

The phloem in Gymnosperms plants consist of: Sieve cells, parenchyma cells (Albuminous cell) and fibers.

The Gymnosperm plants have sieve cells connect by cytoplasmic strands which cross through sieve area on transverse wall only. These plants have albuminous cells instead of companion cells ex: Pinus stem L.S.

There are two kinds of phloem tissue:

1- Primary phloem, derived from procambium, and consist of protophloem (non-functional phloem) and meta-phloem which is the functional phloem at all plant life (in plants don't have secondary growth ex: *Zea mays*).

2- Secondary phloem, derived from vascular cambium (in secondary growth plants) this phloem arrange in two systems:

1. Axial system: consist of (sieve tube elements, companion cells, some axial consist of parenchyma cells and fibers).

2. Radial system: consist of (phloem rays and parenchyma cells).

Practical work:-

1- Exam L.S of *Vitis* stem to observe Xylem.

2- Exam C.S of Helianthus stem to observe protoxylem and phloem.

References:-

1- Crang, R., Lyons-Sobaski, S., & Wise, R. (2018). Plant anatomy: A concept-based approach to the structure of seed plants. Springer.