PUC I YEAR SEMESTER-II

UNIT–IV. INTERNAL ORGANIZATION IN PLANTS

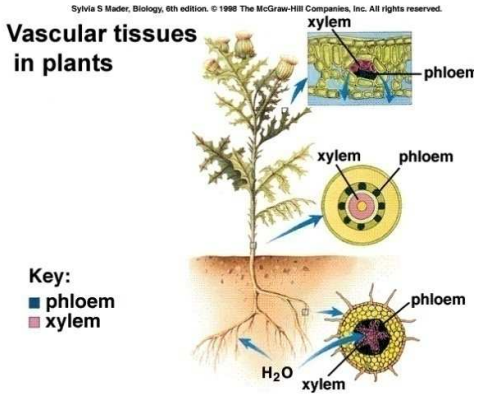
Module 19: COMPLEX TISSUES

COMPLEX TISSUES

The complex tissues are made of more than one type of cells. Xylem and phloem constitute the complex tissues in plants. They are distributed in plant organs in the form of definite strands known as vascular bundles. Hence, they are called vascular tissues. These are arranged variously according to the type of the organ and plant.

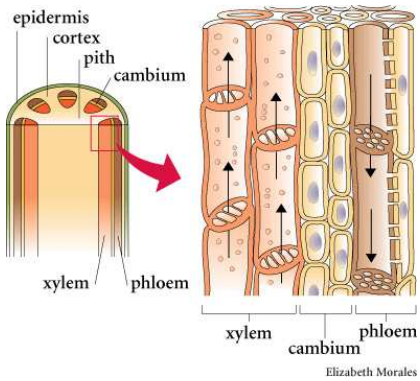
The complex tissues are produced from apical meristems, but in most of the woody plants they are produced by the lateral meristems (cambium).

Complex tissues consist of many cellular elements.
Two types of complex tissues:
Xylem
Phloem



The vascular tissues help in conduction of water, minerals and soluble organic substances throughout the plant. Therefore, they are known as conducting tissues. The complex tissues are of two types: 1. Xylem and 2. Phloem

Longitudinal section of dicot stems showing the Vascular tissues



XYLEM

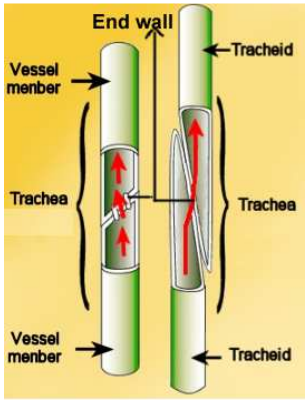
The xylem is composed of four types of different cell elements: tracheids, vessels, fibers and parenchyma.

Only the xylem parenchyma is living while all other components of xylem are dead at maturity. Tracheids and vessels together are called tracheary elements.

Tracheary elements:

Tracheids

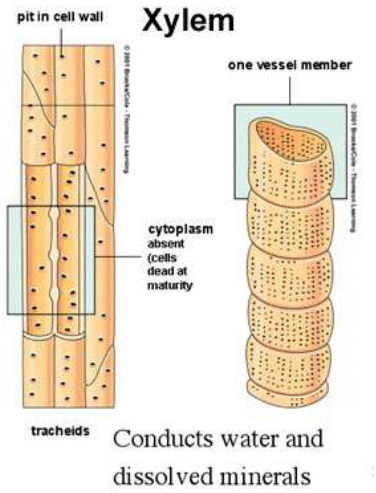
These are least specialized xylem cells. Therefore, they are considered as most primitive. Tracheids are only water conducting tissues in most woody non-flowering plants and gymnosperms like pines. Besides, they also offer mechanical support. These are elongated tube like cells with thick lignified walls and tapering ends. The different types of tracheids include annular, spiral, reticulate, scalariform and pitted tracheids.



Water moves upward in roots and stems from tracheid to tracheid through thin areas of cell walls called pits. The walls of tracheids are opened by numerous pits. The pit pairs allow water to pass from cell to cell.

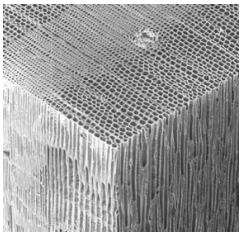
Vessels:

They are more advanced than tracheids. They occur in angiosperms along with tracheids with few exceptions and rarely in gymnosperms. Vessels are shorter and wider than tracheids. The cell walls are thick and lignified like tracheids. They are arranged end to end. Their end walls are partially or completely dissolved forming long hollow tube-like structures through which water and minerals move. The end walls have perforations. The wall area may show single perforation and is known as simple perforation plate or it may show several perforations and is known as multiple perforation plate. The evolution of vessels in angiosperms with greater transport facility is the major reason why angiosperms dominate today's landscapes.



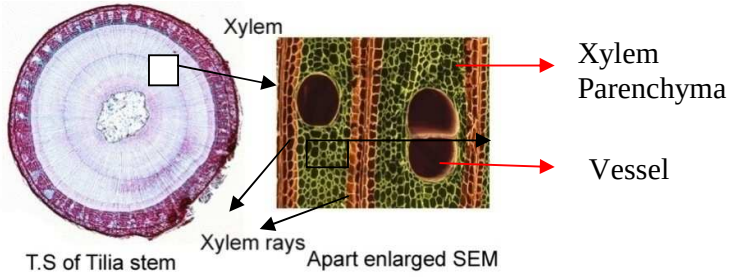
Fibers

Xylem fibers have thickened walls and reduced central lumen. They are septate or aseptate. They give strength to plants.



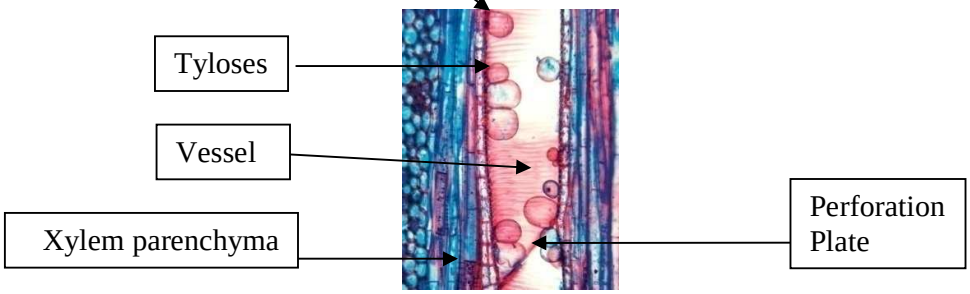
Xylem parenchyma

Xylem parenchyma, the only living component of xylem has cells with thin walls made up of cellulose. They store food material in the form of starch, fats or tannins. They are arranged in vertical rows (axial parenchyma) and horizontal rows (ray parenchyma). The latter are meant for radial conduction of water.



The Xylem parenchyma when protrudes into lumen of xylem through pits develops into bulged structures called tyloses. The xylem produced by the apical meristems is known as primary xylem. It is of two types. The first formed primary xylem elements are called protoxylem and later formed ones as metaxylem. The xylem produced from lateral meristem is called secondary xylem.

Tyloses in grape stem in L.S.



PHLOEM

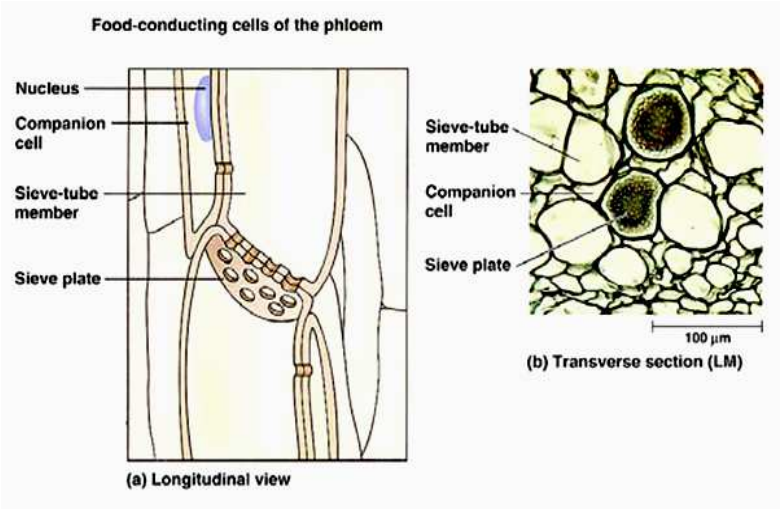
It is a food conducting tissue. It conducts dissolved food materials throughout the plant. It is composed of sieve elements, companion cells, phloem parenchyma and phloem fibers. Gymnosperms have sieve cells and albuminous cells. They lack sieve tubes and companion cells.

Sieve elements

These have characteristic sieve areas (wall area with a cluster of pores). These are recognized into two types: sieve cells and sieve tubes. Sieve cells are least specialized and present in lower vascular plants. The sieve areas are present all over the cell wall. They are usually associated with albuminous cells.

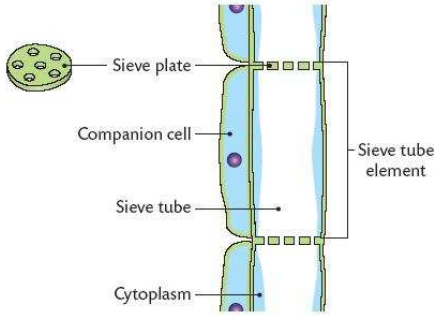
The sieve tubes are long tube like structures arranged longitudinally with end walls perforated like a sieve. These are called sieve plates. The minute pores in sieve areas are known as sieve pores. A mature sieve tube

has only peripheral cytoplasm and large vacuole but lacks nucleus. The walls of the sieve tube are cellulosic and non-lignified, and the wall of sieve plate is thin and most delicate. The sieve tubes contain proteins which accumulate on sieve areas forming slime plug.



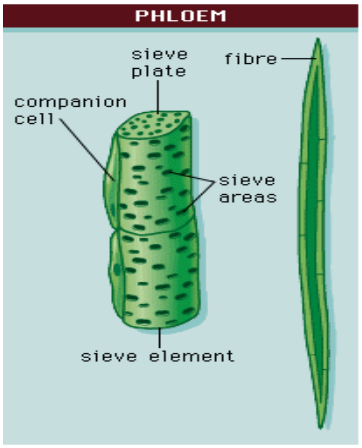
Companion cells

The companion cells are specialized parenchymatous cells, which are closely associated with sieve tube elements ontogenetically (derived from the same mother cell). The sieve tube elements and companion cells are connected by pit fields present between their common longitudinal walls. The companion cells help in maintaining the pressure gradient in the sieve tubes.



Phloem fibers (bast fibers)

These are made up of sclerenchymatous cells. These are much elongated, unbranched and have pointed, needle like apices. The cell wall of phloem fibers is quite thick. At maturity, the fibers lose their protoplasm and become dead. The phloem fibers are called bast fibers. The natural bast fibers are strong. The cellulosic fibers obtained from the phloem or outer bark of jute, flax and hemp plants is used commercially.

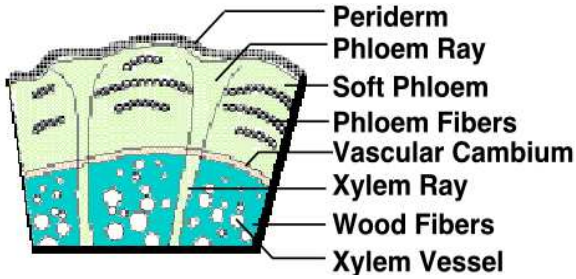


Phloem parenchyma

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 exist between the cells. The phloem parenchyma stores food material and other substances like resins, latex and mucilage. Phloem parenchyma is absent in most of the monocotyledons. When present it is arranged in vertical rows (axial parenchyma) and horizontal rows (ray parenchyma).

The primary phloem originates from apical meristem, whereas secondary phloem from lateral meristem (cambium). The first formed primary phloem consists of narrow sieve tubes and is referred to as protophloem and the later formed phloem has bigger sieve tubes and is

referred to as metaphloem. The primary phloem generally does not have phloem fibers.



Part of T. S of stem Cotton

Check points

- Complex tissues are made of more than one type of cell.
- The two types include the xylem and phloem.
- The secretory structures are specialized tissues present in many plants.
- Xylem is composed of parenchyma, fibers, vessels and/or tracheids, and ray cells.
- Tracheary elements are made up of vessels and tracheids.
- Vessels are joined end to end like a series of tubes. They are dead at maturity.
- Tracheids possess tapered unopened ends and they are also dead at maturity.
- Phloem is other type of complex tissue consists of sieve elements, companion cells, phloem fibers and phloem parenchyma.
- Sieve elements are made of sieve cells or sieve tubes. The sieve tubes are like vessels in xylem, have end to end openings through perforated sieve plate and are meant for transportation of organic solutes of the plant.

- Companion cells are parenchyma cells associated with sieve elements. They help to maintain the pressure gradient in sieve elements.
- Phloem fibers are made up of thick walled sclerenchymatous cells. The fibers lose their protoplasm and become dead.
- Phloem fibers of jute, flax and hemp are used commercially. Phloem parenchyma cells store food materials are of ray and axial type.

Short answer Questions:

1) What are Complex Tissues? What is their function?
2) Give an account on xylem tracheids.
3) Describe the structure and function of Xylem vessel.
4) Distinguish between Xylem fibres and phloem fibers.
5) What are the elements and functions of phloem tissue?
6) Write in brief about sieve cells and sieve tubes.
7) Explain the structure of sieve tubes.
8) What are companion cells? Give their function.
9) What are bast fibers? Give their economic importance.
10) Name the living elements of Xylem and dead element of Phloem? What is their function?

Long answer Questions:

1. What is a complex tissue? Give an account of the complex tissue that conducts water and mineral salts.
2. Describe in detail the different components of Phloem.

MCQS

1. Parenchyma: Simple:: Phloem:_____.
   A. Simple
   B. Collenchyma
   C. Complex
   D. Xylem
2. Vascular plant tissue includes all of the following cell types EXCEPT
   A. Vessels
   B. Sieve cells
   C. Tracheids
   D. Cambium cells
3. Which functional plant cells lack a nucleus?
   A. Phloem Parenchyma
   B. Sieve tube cells
   C. Companion cells
   D. Both companion and parenchyma cells
4. The fiber cells of plants are a type of
   A. Meristematic cell
   B. Collenchyma
   C. Sclerenchyma
   D. Parenchyma
5. Cells present typically in xylem but not in other plant tissues are:
   A. Cambial cells
   B. Both tracheids and vessel elements
   C. Companion cells
   D. Sieve cells
6. Mature sieve-tube members lack:

A. Cell walls

B. Cytoplasm

C. Nuclei

D. Sieve plates

7. Which of the following tissue is composed of mainly dead cells?

A. Endodermis

B. Xylem

C. Epidermis

D. Phloem

8. Phloem in the plants performs the function of _____.

A. Conduction of food

B. Conduction of water

C. Providing photosynthetic tissue

D. Secondary growth