

Tissue

A tissue is defined as group of cells of same origin and same methods of development performing a particular function in a harmonious way.

PERMANENT TISSUE: CHARACTERISTICS, TYPES AND FUNCTIONS

- Cells may be living or dead
- Metabolic activities are relatively slow
- Metabolic activities are relatively slow
- Intercellular spaces may be present or absent
- Permanent tissues are derivatives of meristematic tissue.
- They are mature tissue and the cells have lost the capacity of cell division.

Types of permanent tissue

- A. Simple permanent tissue.
- B. Complex permanent tissue and
- C. Secretory tissue.

A. **Simple permanent tissue:** - Simple permanent tissue is composed of single type of cells which have similar origin, structure and function.

Types of simple permanent tissue

I. PARENCHYMA

Characteristics

1. Living tissue
2. **Shape:** each cell is spherical, oval, rectangular, polygonal, elongated or irregular in shape.
3. **Cell wall:** thin walled made up of cellulose, hemicelluloses and pectin
4. **Origin:** In the primary plant body, i.e. pith and cortex, originates from the ground meristem. Xylem & phloem parenchyma from Procambium & cambium.
5. **Distribution:** Pith, cortex, pericycle (root & stem), mesophyll tissue (leaves), xylem & phloem, fruits & endosperm.
6. Young Parenchymatous cells are loosely arranged.
7. Intercellular space : present
8. Food storage: cell store reserve food material.
9. Parenchyma is found in all parts of plant such as cortex, pith, palisade, mesophyll, flower, seed etc.
10. It is also found in vascular tissues.

Types

1. **Prosenchyma:** It is long and tapering parenchymatous cell present in some plants. E.g. pericycle
2. **Aerenchyma:** It is a type of parenchyma cell having large intercellular air space. E.g. present in cortex of hydrophytes.
3. **Chlorenchyma:** It is a parenchyma cell containing chloroplasts. E.g. present in palisade of leaves and helps in photosynthesis.

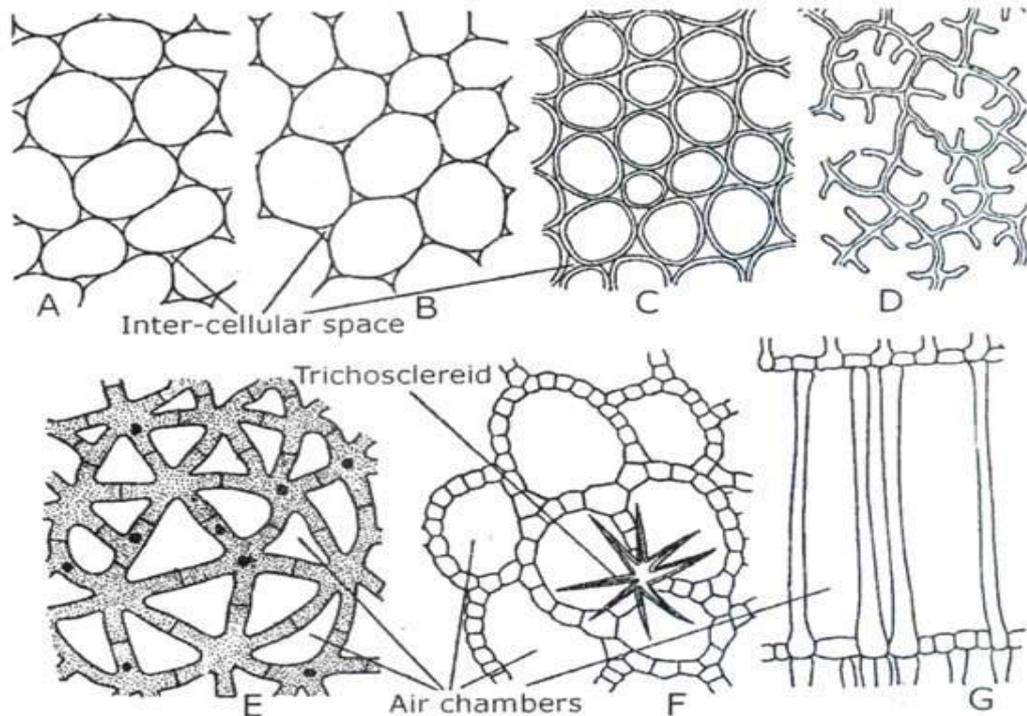


Figure 8.1

Parenchyma. A. Thin-walled parenchyma from cortex of *Helianthus*. B. Same from pith. C. Thick-walled parenchyma from pith of *Clematis*. D. From leaf of *Pinus*. E. Aerenchyma from petiole of *Musa*. F. Same from petiole of *Nymphaea* with trichosclereid. G. Same from stem of *Jussiaea*.

Function of parenchyma tissue:-

1. **Photosynthesis:** chlorenchyma contains chloroplast which helps in photosynthesis.
2. **Storage:** - parenchyma cell stores food in the form of starch, proteins, oils and fats.
3. **Buoyancy:** - helps in floating of aquatic plants due to presence of aerenchyma tissue
4. **Secretion:**-Idioblastic cell secretes resins, latex, tannin, oils etc
5. **Transport:** - parenchyma of xylem and phloem helps in transport of nutrition and water.
6. **Mechanical support:** - Prosenchyma tissue provides mechanical support.

II. COLLENCHYMA

Characteristics

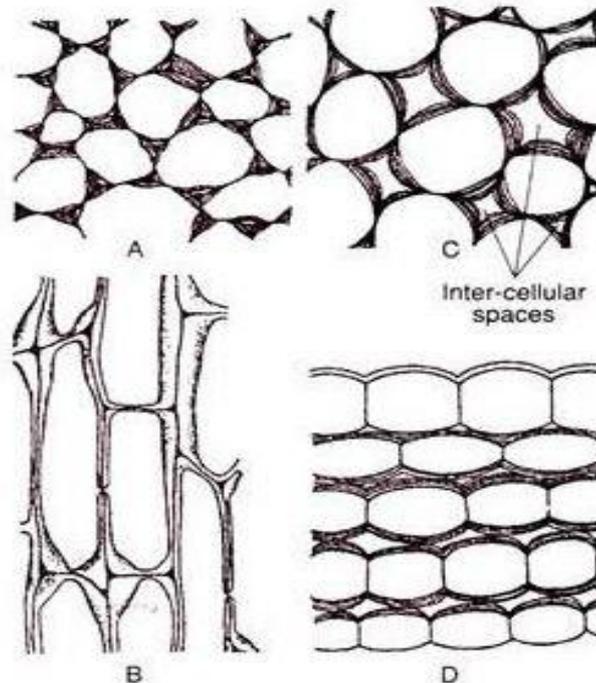
1. Living tissue.
2. **Shape:** - Isolated collenchyma ranges from round, elliptical to elongated cell.
3. **Cell wall:** - thick walled due to deposition of hemicellulose and pectin in intercellular space. Primary pit fields can be distinguished in the walls.
4. **Origin:** - Intercellular space: present or absent

Types

1. **Angular:** -The thickening materials deposit at the angles or corners of the cells.
2. **Lacunar:** - thick wall at boarder of cell; large intercellular space.
3. **Plate or lamellar:** - thick wall at tangential wall; without intercellular space.

Functions

1. **Mechanical support:** It is living mechanical tissue
2. **Photosynthesis:** It contains chloroplast and carries out photosynthesis.



Different forms of collenchyma: (A) Angular in T.S. (B) Same in L.S. (C) Lacunar in T.S. (D) Lamellar in T.S.

III. SCLERENCHYMA

Characteristics: -

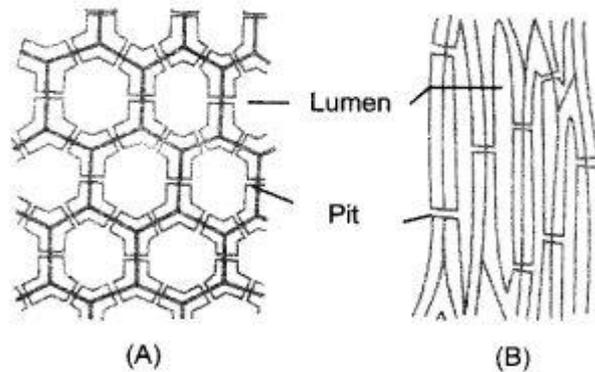
1. Dead tissue.
2. Shape: elongated and pointed at both end.
3. Cell wall: thick and lignified.
4. Cell lack protoplasm.
5. It gives strength and rigidity to the plant body

Types:

1. **Fibres:-**
 - a. It is thick walled, long and pointed dead cell.
 - b. Cell wall contains simple, oblique or bordered pits.
 - c. Present in xylem, covering of fruits.
 - d. Gives mechanical supports.
2. **Sclerosis (stone cell):**
 - a. Extremely thick walled cell with spherical, oval or dumbbell shape.
 - b. Cell wall contains simple pits.
 - c. Present in hard part of plants, pulp of fruits.
 - d. Provide local mechanical supports.

Function:

1. **Mechanical support:** Sclerenchyma is made up of dead and lignified cells which provide support to plants.
2. Provides hardness to stony fruits such as nuts, coconut, almond etc.



Sclerenchyma: (A) Transverse section (B) Longitudinal section

Types of sclereids

1. **Brachysclereids:** Brachysclereids resemble parenchyma cells in shape, but are made almost entirely of secondary cell wall. These non-living cells are also called stone cells because they form the "grit" in pear fruit. The inner portion of a sclereid cell is called the Lumen. The lumen is an empty space in the center of a non-living cell bounded by secondary cell walls.
2. **Macrosclereids:** These are elongated, rod like or columnar in shape. The testa of many leguminous seeds is built entirely of macrosclereids, e.g. seed coat of *Pisum* (pea), *Phaseolus* (bean) etc.
3. **Osteosclereids:** The shapes of osteosclereids are columnar-the end of which may be lobed or branched or simply enlarged like a narrow bone, e.g. the seed coats of *Pisum*, the leaves of *Hakea* etc.
4. **Astrosclereids:** It is stellate cells, i.e. the cell is deeply lobed or branched in such a manner that it resembles stars, e.g. leaves of *Thea* (tea), *Olea* and petiole of *Nymphaea* etc. **Trichosclereids:** It is hair like, very much elongated cells with branches, which extends into the intercellular spaces, e.g. leaves of *Olea*, *Nymphaea* etc.

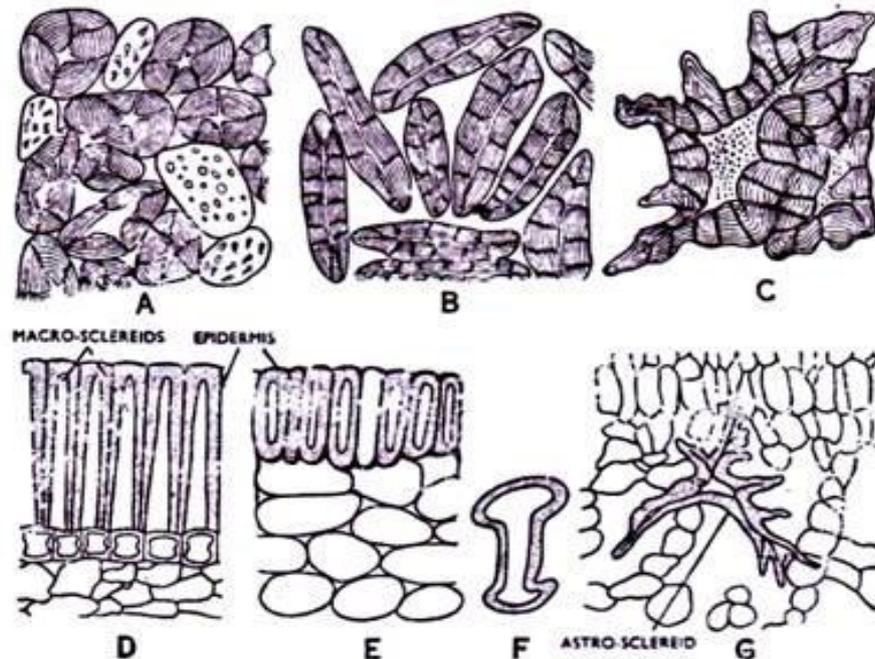


FIG. 537. Scclereids. A. Brachysclereids from flesh of *Pyrus* (pear). B. Same from *Cocos* (coconut). C. Irregular sclereids from *Truga*. D. Macrosclereids from epidermis of *Phaseolus*. E. From epidermis of *Allium sativum*. F. Osteosclereid from seed-coat of *Pisum* (pea). G. Astrosclereid from a leaf.

B. Complex permanent tissue: Complex tissue can be defined as a special types of heterogeneous tissue that is composed of different types of cell having specialised functions like conduction of water and mineral salts, translocation of elaborate food matters and mechanical strength. e.g. xylem and phloem

Types of complex permanent tissue

I. Xylem:

Characters

- The function of xylem is to transport water and minerals from the root to the leaves of plants.
- It also provides support to plants.
- Xylem is also known as wood.
- Xylem may be primary (derived from procambium) or secondary (derived from vascular cambium during secondary growth).
- It is heterogenous tissue made by four basic types of cells.

Types:

1. Trachieds:

- Trachieds are elongated cell with tapering end.
- They are dead cells with lignified thick cell wall.
- Tracheids occur in groups of vascular plants. It is present exclusively in the xylem of **pteridophytes and gymnosperms.**
- Pits are present on lateral and oblique end walls.
- Function: conduction of water and minerals from root to leaves and also provide mechanical support.
- Types: annular, spiral, reticular, scleriform and pitted.

2. Trachea/Vessels:

- Vessels are long, cylindrical, thick walled (due to lignin deposition), tube like dead cells.
- Vessels are occur exclusively present in angiosperm. They also occur in several gymnosperms, e.g. *Ephedra, Gnetum* etc.
- Two ends of vessel unit are perforated.
- Conduction of water and dissolved minerals occur from root to stem and leaves through vessels. Vessels give mechanical rigidity to the organs where they lie due to the presence of hard lignified cell wall.

[# Both trachids and trachea are collectively known as **tracheary elements.**]

Tracheid	Trachea (vessels)
A) It predominates exclusively in xylem elements of pteridophytes and gymnosperms.	A) It predominates xylem elements of angiosperm .
B) The cells are elongated with narrower diametre than trachea.	B) They are elongated tubular and wider in diametre than tracheid.
C) The two end walls may be pointed, obtuse or chisel like.	C) The end walls are transversely of obliquely flat.
D) The end walls are not perforated.	D) The end walls are perforated.
E) Commmunication with adjacent tracheids occurs through the pits presenton the lateral walls.	E) Communication occurs through perforated end walls and lateral walls where pits are present.
F) The cell walls have annular, spiral, reticulate, scalariform and pitted thickening.	F) The cell walls commonly have bordered pits.

3. Xylem Parenchyma:

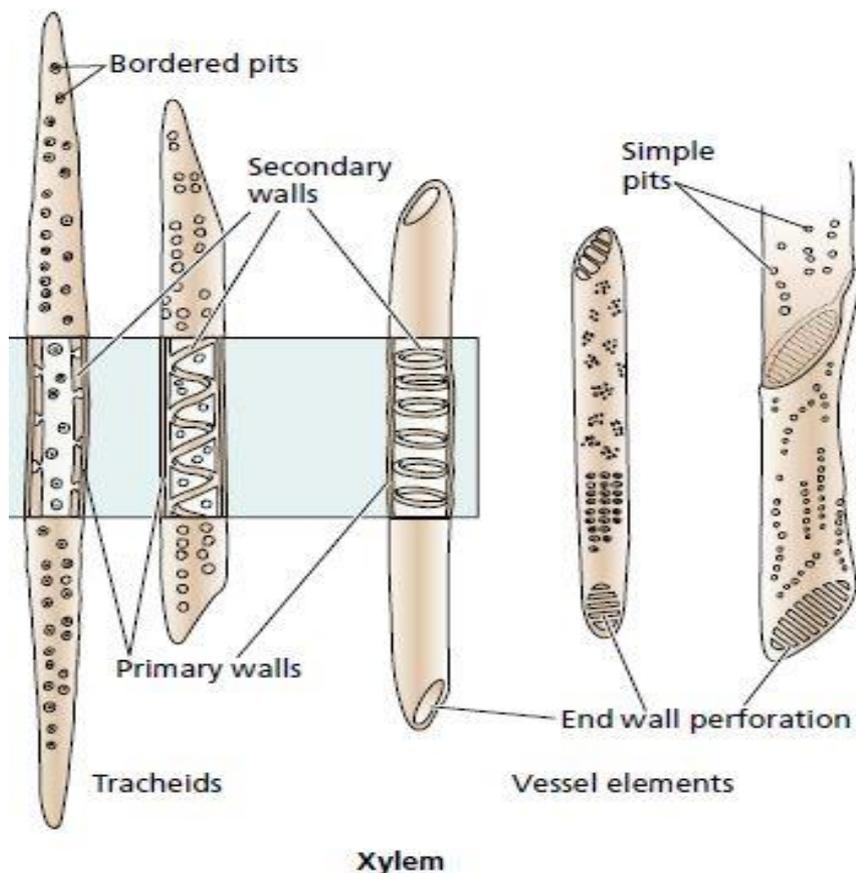
- They are parenchymatous cell.
- They are living cells.
- Function: storage of food in the form of starch or fat.
- It is present in primary and secondary xylem and respectively originates from procambium and cambium.
- It has no definite shape. It may be irregular, rectangular, round, oval and elongated etc.
- The cell wall usually thin when it is composed of cellulose only.

4. Xylem fibres:

- They are sclerenchymatous cell.
- They are dead cells.
- They provide mechanical support.
- They are elongated cells the length of which is many times longer than breadth.
- The cell wall usually thick due to lignin deposition and the lumen of fibre becomes narrow.
- It may occur in primary and secondary xylem but proportionately their occurrence are much less in primary xylem.

Types:-

- Libriform fibre
- Fibre tracheid
- Gelatinous fibre



II. Phloem

Phloem is a complex tissue or heterogenous vascular tissue that store and conducts principally the products of photosynthesis in vascular plants and sometimes adds mechanical strength. Phloem is responsible for the conduction or transport of organic food synthesized by the different parts of plant body.

Types:

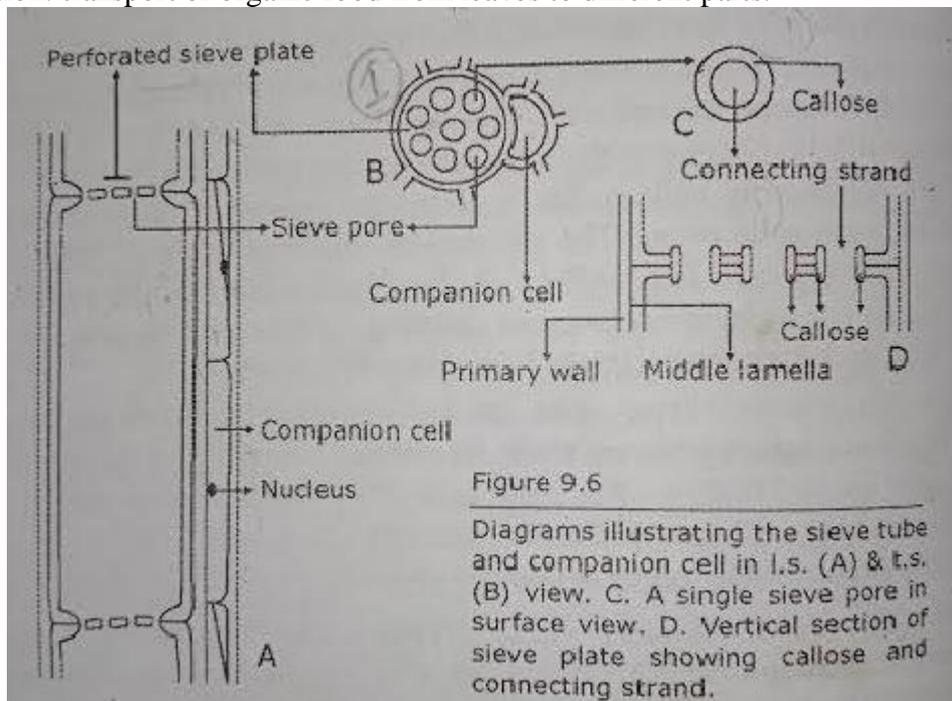
- 1) **Sieve elements:** The conducting elements of the phloem are referred to as sieve areas and absence of nuclei from mature protoplast. Sieve elements are the collective term of sieve cell and sieve tube.

i. Sieve tubes:

- a. They are thin walled, living, enucleated, longitudinally files of tube like cells that are connected to each other through sieve areas and sieve plate on their transverse end walls.

[Sieve plate: sieve plate is the region where the sieve areas occur. The plate lies at the end walls of sieve tube member and is usually horizontal or oblique to the longitudinal axis of them. There may be one or several sieve areas in each sieve plate where and according they termed as: (a) simple plate where there is one sieve area only. (b). Compound sieve plate –where are more than one sieve areas in a sieve plate. The pores in sieve areas may vary in size. Callose is carbohydrate and is composed of β -1, 3-linked glucan].

- b. Function: transport of organic food from leaves to different parts.



- ii. **Sieve cell:**-It is the element of pteridophytes and gymnosperms. It is arranged longitudinally, but the cells are not arranged one above the other the other in a series. The cells single, elongate and tapered at both ends. They often do not have a distinct end wall. When present the end walls are either tapered or many oblique. The cell wall is then and made up of cellulose. Sieve cells are living where nucleus is absent at maturity.

2) **Companion cells:**

- a) They are thin walled, elongated living cells.
- b) Each cell contains large nucleus.
- c) Companion cells are present only in angiosperm.
- d) They are associated with sieve tube elements.
- e) A single meristematic cell gives rise to companion cell and sieve tube.
- f) Function: support sieve cell in conduction of food and active sites of the protein synthesis.

3) **Phloem parenchyma:**

- a) They are living parenchymatous cells.
- b) They occur between primary and secondary phloem.
- c) Function: storage of food in the form of starch or fat. It also store tannin and resins.

4) **Bast/phloem fibres:**

- a) They are elongated cells and two ends of fibre are usually tapering to a wedge shape and interlocked with other fibres.
- b) They are sclerenchymatous cell.
- c) They are dead cells.
- d) Function: mechanical supports.