lecture 4

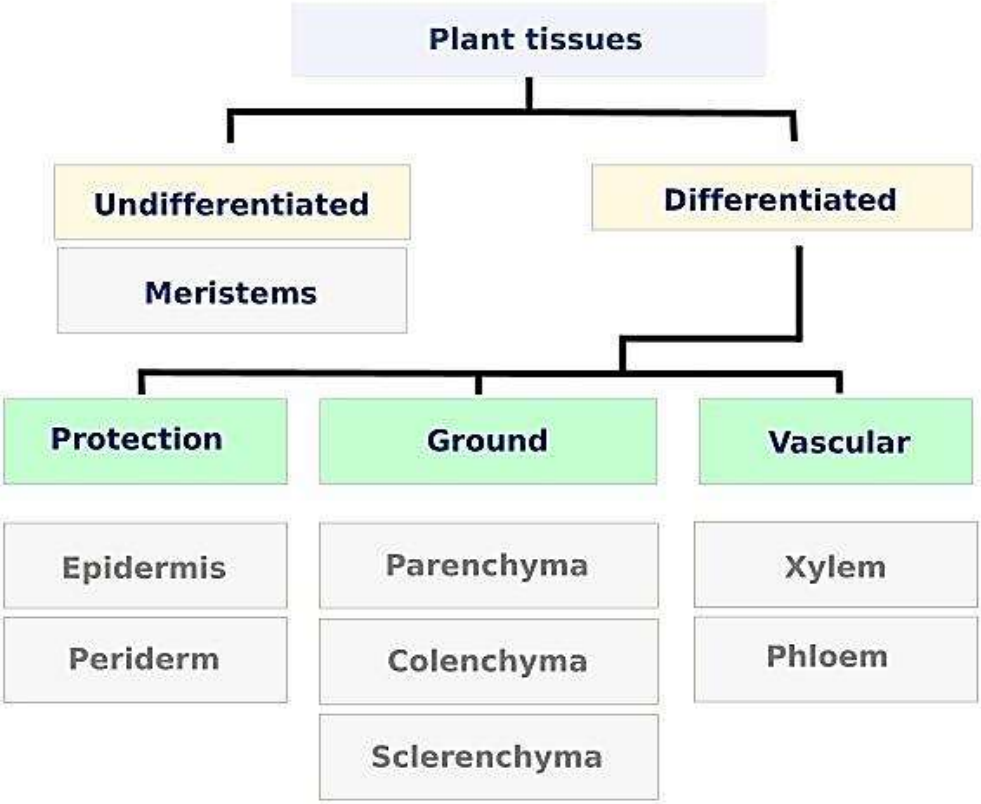
Permanent Tissues

Permanent tissues are a group of living or dead cells which are formed by meristematic tissues that have lost their ability to divide. These tissues have undergone differentiation and are incapable of meristematic activities.

Characteristics of Permanent Tissue

- **Differentiation**:
  - **Defined Structure**: Permanent tissues have differentiated into specific cell types with specialized functions. Unlike meristematic tissues, they do not divide actively.
  - **Specialization**: Each type of permanent tissue has a unique structure tailored to its function, such as support, transport, or storage.
- **Cell Structure**:
  - **Cell Wall Composition:** The cell walls of permanent tissues are often thicker and more rigid compared to those in meristematic tissues. They may contain substances like lignin, cellulose, or pectin, depending on the tissue type.
  - **Vacuole Size:** Permanent tissue cells typically have large central vacuoles that contribute to turgor pressure and storage functions.
- **Functionality**:
  - **Non-Meristematic:** Once cells become part of permanent tissues, they generally cease to divide. Their main role is to perform specific functions such as support, nutrient transport, or storage.
  - **Adaptation to Function:** The cells are adapted to their function, whether it's mechanical support (as in sclerenchyma), flexible support (as in collenchyma), or nutrient storage (as in parenchyma).
- **Types of Permanent Tissues**:

- **Simple Permanent Tissues**: These consist of one type of cell and include:
  - **Parenchyma:** Involved in storage, photosynthesis, and tissue repair.
  - **Collenchyma:** Provides flexible support, mainly in growing parts of the plant.
  - **Sclerenchyma:** Offers mechanical support and strength, with cells often lignified and dead at maturity**.**
  - **Complex Permanent Tissues:** These are made up of multiple cell types working together, including:
    - **Xylem**: Responsible for water and nutrient transport; composed of tracheids, vessels, xylem fibers, and xylem parenchyma.
    - **Phloem**: Transports organic nutrients; consists of sieve tubes, companion cells, phloem fibers, and phloem parenchyma.
- **Location**:
  - **Tissue Distribution**: Permanent tissues are distributed throughout various parts of the plant, including stems, leaves, roots, and flowers. Their location is closely related to their function.
- **Lack of Active Division**:
  - **Non-Active Growth:** Cells in permanent tissues do not actively divide. They are fully differentiated and perform specific roles for the life of the plant.



Types of permanent tissue

Permanent tissues are of two types:

(a) Simple tissue (b) Complex tissue

A. Simple Permanent Tissue

Simple permanent tissues are a category of plant tissues comprised of cells of a single type, which are specialized to perform specific functions. These tissues are also referred to as homogeneous tissues due to their uniform cellular composition. They are classified into three main types: parenchyma, collenchyma, and sclerenchyma. Each type has distinct characteristics and functions essential for plant structure and growth.

Parenchyma

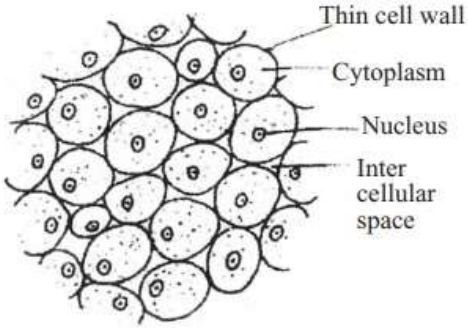
Parenchyma tissue represents a fundamental type of permanent tissue found across all plant species. This tissue is characterized by its composition of unspecialized, living cells, which are crucial for various physiological functions. Derived from the Greek terms “para”

meaning beside and “enchyma” meaning tissue, parenchyma refers to the “beside tissue” that is integral to plant function and structure.

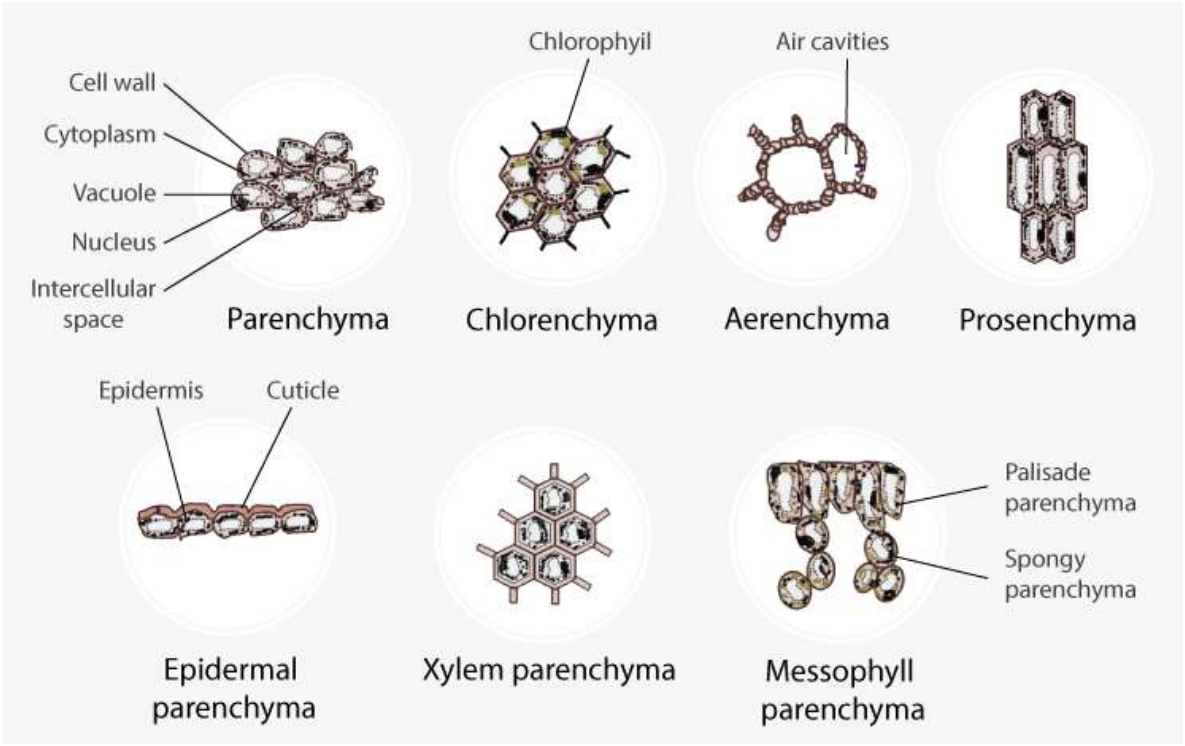
- The cells in the Parenchyma tissue are living.
- The cells have an oval or round shape.
- There are intercellular spaces present between the cells in this tissue.
- The cell wall is made up of hemicellulose or cellulose.
- The cell is thin-walled.
- The cells have vacuoles and very small nucleus.
- It is found in all parts of the plant.
- The protoplasm is living and dense.
- These cells have the ability to multiply after they have matured
- Parenchyma cells retain the ability to divide even when mature, this property is helpful in the regeneration of damaged plant cells.
- They also play an important role in wound recovery and regeneration.

Functions of Parenchyma tissue

- These tissues are suitable for storage due to the large intercellular spaces in between them. These tissues can store water, fats, oil, etc.
- They are capable of transporting nutrition and other chemical products formed in the plant. Some cells are also capable of transporting light through them.
- This tissue is responsible for photosynthesis and thus for the general well-being of the plant.
- They convert to another type of cell when required for some specific function.
- These cells have the ability to multiply after they have matured, this property is helpful in the regeneration of damaged plant cells.



{Totipotent: Parenchyma cells have an ability to transform to the other types of cells and act as a precursor for other types of cells}.



Types of Parenchyma Tissue

1. **Simple Parenchyma**:
    - **Description**: Characterized by thin-walled, isodiametric cells with intercellular spaces.
    - **Location**: Found in the pulp of fruits, cortex, medullary rays, and the pith of plant organs.
    - **Function**: Contributes to storage and general metabolic functions.
2. **Chlorenchyma**:
    - **Description**: A specialized form of parenchyma rich in chloroplasts.
    - **Location**: Present in green plant tissues such as leaves, young stems, and flower sepals.
    - **Function**: photosynthesis, Example: Mesophyll of leaves.
3. **Aerenchyma:**
    - **Description:** Parenchyma which contains air in its intercellular spaces.
    - **Location**: Found in aquatic plants (hydrophytes).
    - **Function** :It helps in aeration and buoyancy. Example: Nymphae and Hydrilla.
4. **Idioblasts**:

- **Description**: Parenchyma cells that contain specialized inclusions like oil droplets or calcium oxalate crystals.
- **Function**: Primarily involved in storage of substances such as oils and tannins.

5. **Prosenchyma**:
    - **Description**: Parenchyma cells with thickened walls and elongated shapes, tapering at the ends.
    - **Location**: Found in the pericycle of some plants.
    - **Function**: Provides mechanical support to plant structures.
6. **Epidermis**:
    - **Description**: The outermost layer of the aerial parts of plants, composed of tightly packed parenchyma cells.
    - **Function**: Protects plant tissues and may feature a cuticle layer to reduce water loss.
7. **Xylem Parenchyma**:
    - **Description**: Parenchyma cells associated with xylem tissue.
    - **Function**: Assists in the storage of nutrients and the lateral conduction of water and minerals.
8. **Phloem Parenchyma**:
    - **Description**: Parenchyma cells associated with phloem tissue.
    - **Function**: Helps in the storage and lateral conduction of organic nutrients.

Special Tissues

They are modified structurally to carry out functions secretory in nature and are of two types:

Laticiferous Tissues

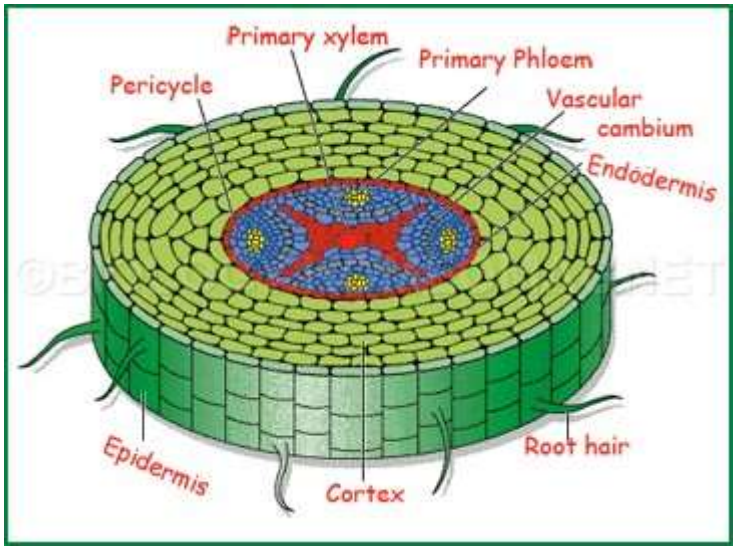
- The plant tissues have latex.
- They originate from the meristematic tissues and mature with other tissues.
- The cells are elongated, thin-walled and multinucleated.
- Observed in a large number of families such as Euphorbiaceae, Apocynaceae, Compositate, etc.

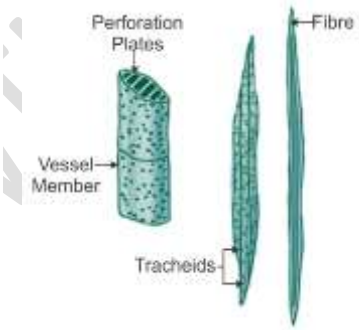
Glandular Tissues

- They possess various glands, that secrete oil, resins, tannin, mucilage, etc.
- The gland is situated on the epidermis.

B. Complex Permanent Tissue

Complex permanent tissues are made up of more than one type of cells. These different types of cells coordinate to perform a function. Xylem and Phloem are complex permanent tissues and are found in the vascular bundles in the plants.





Plants have two main types of vascular tissue: xylem and phloem:

1. Xylem

It is the vascular tissue transporting water and minerals from roots through the shoots to all parts of the plant.

Xylem cells are dead cells forming a hollow cylinder, similar to a pipe that runs entirely from the roots to the leaves. Since xylem cells have thick cell walls, they also support the plant body.

The main conducting vessels of the xylem are the tracheids and the vessels.

Tracheids are long thin tubes found in almost all vascular plants, while vessels are large tubes found primarily on angiosperms. The tracheids and vessels form pipes that

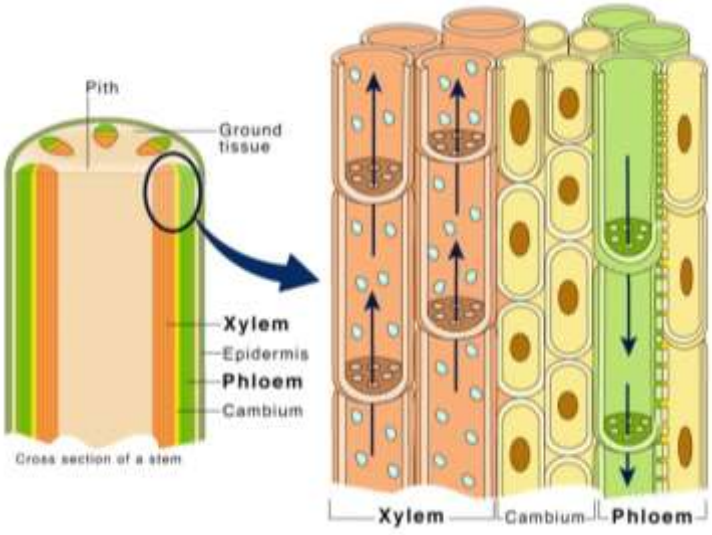
have pores and perforated ends, allowing water and minerals to be transported from one tube to another and out to the surrounding tissues.

2. Phloem

It is the living, permanent tissue transporting sugars from the leaf to the rest of the plant. Phloem also carries various hormones and chemicals necessary for the growth and defense of the plant with the sap.

Unlike the xylem, which transports water and minerals in one direction (from the root to the leaves), the phloem conducts carbohydrates (sugars) in multiple directions. For example, phloem moves sugars from the leaves to the roots for storage and back to the leaves when they need them for cell division.

Phloem contains living tissues except for fibres that are dead tissues.



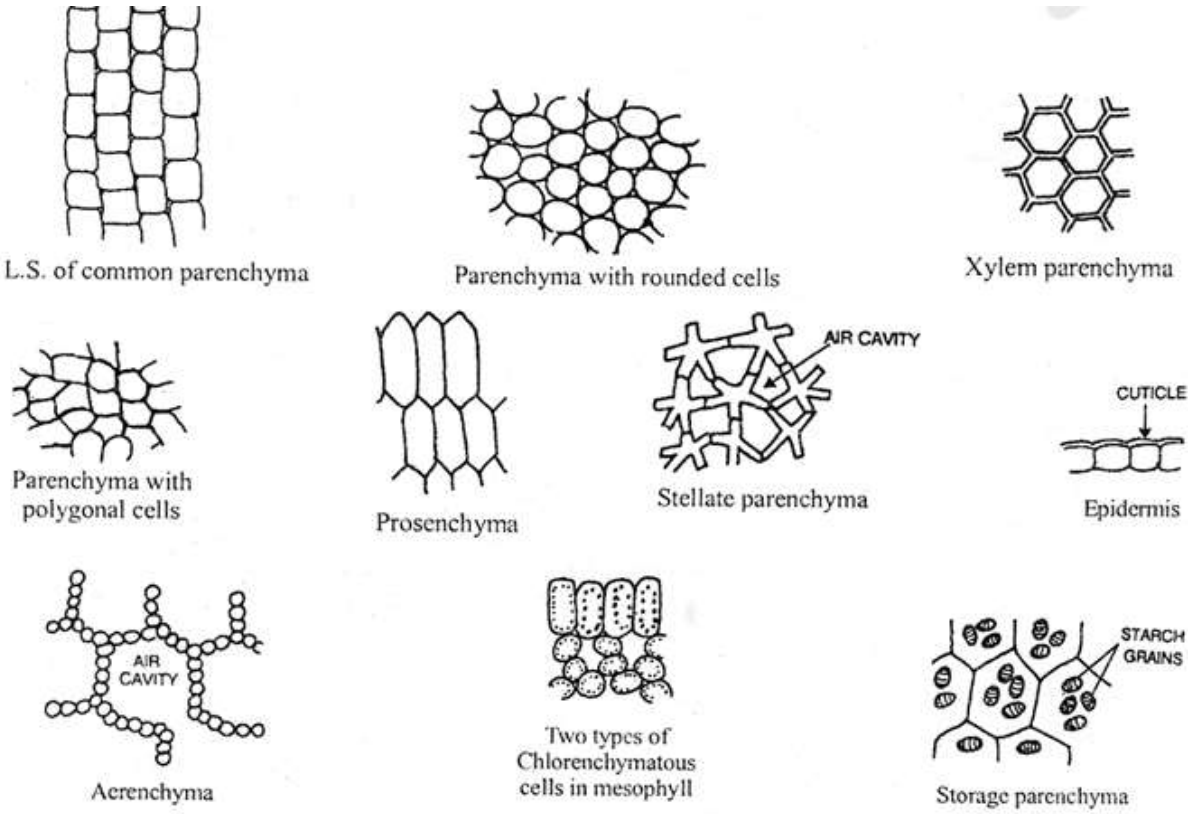


Fig. Types of parenchyma