Analyze the structures of plant (parenchyma, collenchyma, sclerenchyma, xylem, and phloem) and animal (epithelial, cardiac, areolar, fibrous, and skeletal) tissues to assess their roles in physiological processes, disease diagnosis, and levels of organization. (u, s, v/a, gs).

PLANT TISSUES

CLASSIFICATION OF PLANT TISSUES

Simple plant tissues each consist of only one type of cell. They are normally grouped according to the degree of thickening.

The simplest plant tissue is meristematic tissue. This occurs at the apical growing points of a plant, for example the tip of the stem and root.

Meristematic cells are small, thin walled, and lack sap vacuoles and chloroplasts. But they contain undifferentiated plastids whose membranes are the site of intense synthetic activity. They divide and differentiate into specialized cells.

Meristem.

A meristem is a group of plant cells which remain with the ability to divide by mitosis producing daughter cells which grow to form the rest of the plant body.

Types of meristems.

Apical meristems :- They are found at the shoot tip and root tip.

They divide continuously by mitosis leading to primary growth of the plant body that is increase in length of the shoot or root.

Lateral meristems (cambium) :- These are found in a cylinder towards the outside of stems and roots. They are responsible for secondary growth and cause an increase in girth.

They include the vascular cambium which gives rise to secondary vascular tissue including secondary xylem and phloem. They also include the cork cambium (phelogen) which gives rise to periderm which replaces the epidermis and includes the cork.

Intercalary meristems :- These are found at the nodes in monocotyledonous plants. They allow an increase in length in positions other than the tip. Ensures continued growth where tissues are damaged such as when eaten by herbivores in grasses.

PARENCHYMA CELLS

Parenchyma cells are one of the simplest and most common types of plant cells, and they play a key role in various plant function.

Structural Characteristics:

1. **Cell Wall**: Parenchyma cells have thin primary cell walls that are flexible, allowing the cells to remain alive at maturity. This enables them to take on various shapes and to carry out different functions.
2. **Shape**: They are usually isodiametric (about the same dimensions in all directions) and can be spherical, elongated, or lobed.
3. **Intercellular Spaces**: These cells are loosely packed with large intercellular spaces, allowing for gas exchange and storage.
4. **Large Vacuole**: Parenchyma cells contain a large central vacuole that stores water, nutrients, and waste products.
5. **Cytoplasm and Organelles**: They have a dense cytoplasm that contains various organelles like chloroplasts (in photosynthetic parenchyma cells), mitochondria, and the nucleus.

Functional Characteristics:

1. **Photosynthesis**: In leaves, parenchyma cells containing chloroplasts (known as chlorenchyma) carry out photosynthesis.
2. **Storage**: These cells store starch, proteins, oils, and water. They are found in the roots, tubers, and seeds.
3. **Secretion**: They can also be involved in the secretion of substances.
4. **Regeneration and Healing**: Parenchyma cells can divide and differentiate into other types of cells, playing a key role in wound healing and regeneration.
5. **Support**: Although they are primarily involved in metabolic activities, their turgid state also provides structural support to the plant.

location of parenchyma cells

1. Leaves

- **Mesophyll:** Parenchyma cells are the main component of the mesophyll, which is divided into two parts:
    - **Palisade Parenchyma:** Located just below the upper epidermis, these cells are elongated and contain many chloroplasts, making them the primary site of photosynthesis.
    - **Spongy Parenchyma:** Found below the palisade layer, these cells have more intercellular spaces to facilitate gas exchange.

2. Stems

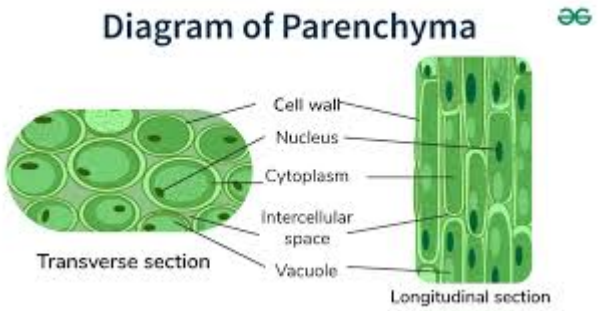
- **Cortex:** The outer layer of the stem, just beneath the epidermis, contains parenchyma cells that store food and water.
- **Pith:** Located at the center of the stem, pith parenchyma cells store and sometimes transport nutrients.

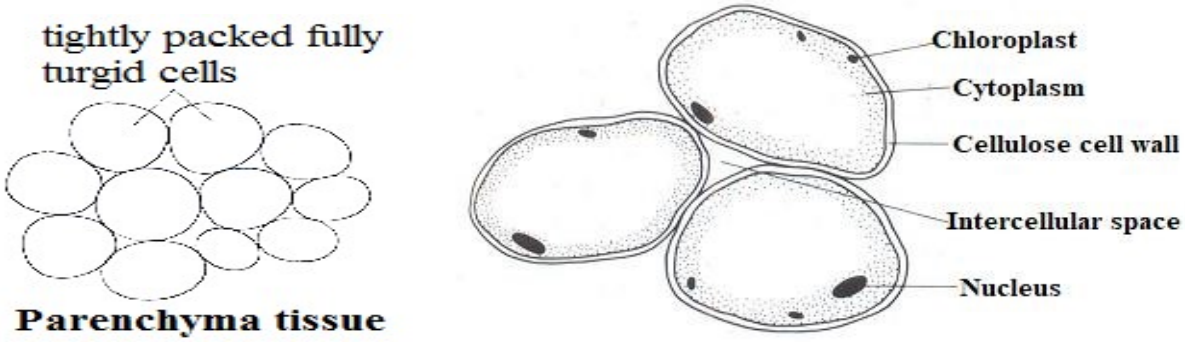
3. Roots

- **Cortex:** Similar to stems, the root cortex contains parenchyma cells that store food and water.
- **Root Cap:** The root cap, which protects the growing tip, also consists of parenchyma cells.

4. Fruits and Seeds

- **Fruits:** Parenchyma cells in fruits are responsible for storing sugars, acids, and other substances, contributing to the fruit's taste and nutritional value.
- **Seeds:** These cells store food reserves in seeds, which provide energy for the developing embryo.





COLLENCHYMA CELLS

Collenchyma consists of living cells modified to give support and mechanical strength. The collenchyma is the first mechanical tissue to develop in the primary plant body.

The cells are closely packed without air spaces between them.

The cells are elongated and polygonal with tapering ends. The cell walls consist of cellulose, pectins and hemicelluloses. The cells have extra deposits of cellulose at the corners of the cells causing uneven thickening of the cell walls. Cells are elongated, parallel to the longitudinal axis of the in which they are found.

They are elongated and important in growing stems since they are able to stretch.

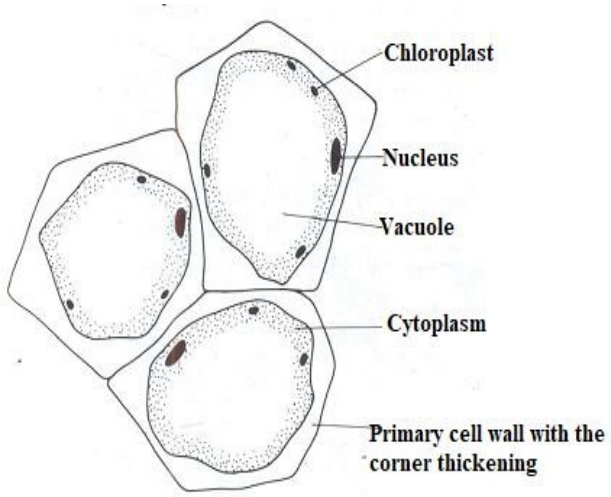
Functional Characteristics:

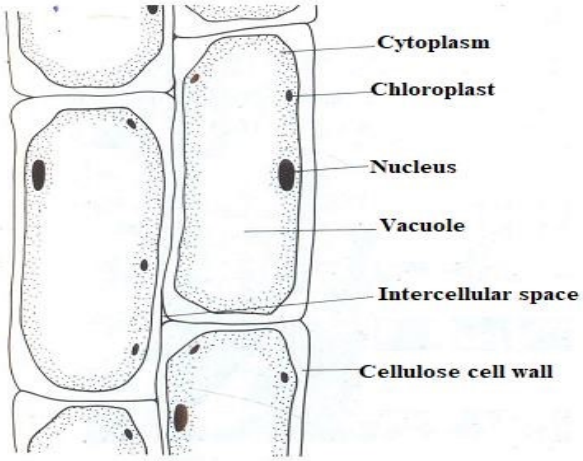
1. **Support**: Collenchyma cells provide mechanical support to the plant, especially in regions of primary growth such as young stems and leaves. They allow the plant to withstand bending and stretching.
2. **Flexibility**: The cell wall's uneven thickening allows collenchyma cells to stretch and grow with the plant, providing support without restricting growth.
3. **Photosynthesis**: In some cases, collenchyma cells can contain chloroplasts and contribute to photosynthesis, although this is not their primary function.
4. **Repair and Regeneration**: Collenchyma cells can also participate in wound healing and tissue regeneration due to their ability to grow and divide.

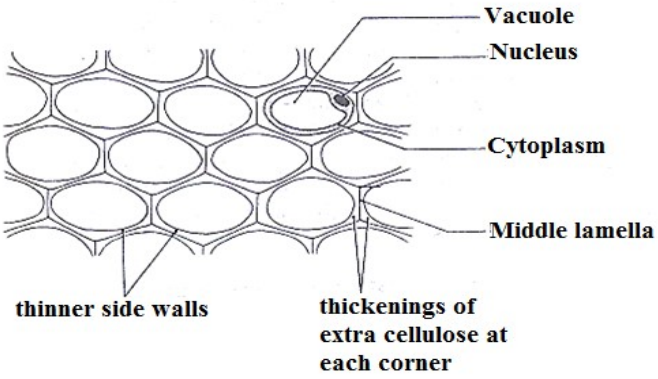
Locations in Plants:

- **Stems**: Collenchyma cells are commonly found just below the epidermis in young stems, providing support during growth.
- **Leaves**: They are often located along the veins and at the margins of leaves, providing structural support to prevent tearing and bending.
- **Petioles**: In petioles (the stalk that attaches the leaf blade to the stem), collenchyma cells help support the leaf blade.

Collenchyma cells play a crucial role in supporting the plant's structure while allowing for flexibility and growth. They are particularly important in parts of the plant that are still elongating and maturing.







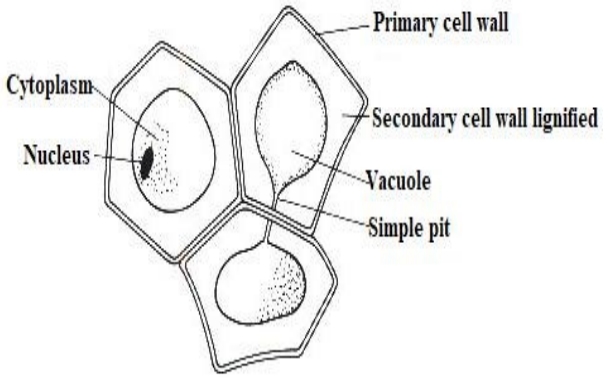
SCLERENCHYMA CELLS

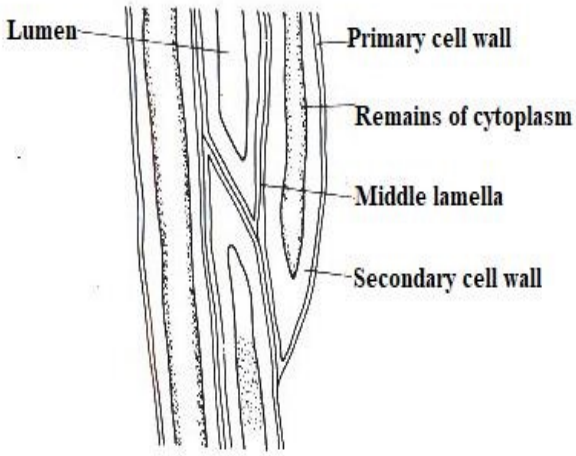
Mature sclerenchyma cells are dead and therefore incapable of growth. They develop fully when the growth of surrounding tissues is complete.

Sclerenchyma cells have large deposits of lignin on the primary cell wall and the cell contents are lost. In places, lignin is not deposited due to the presence of plasmodesmata in the primary cell wall; such regions are called pits.

Some sclerenchyma cells are roughly spherical and are known as **sclereids.** These are usually found in small groups in fruits and seeds, cortex, pith and phloem. They toughen the structures in which they are found.

Elongated sclerenchyma cells are called **fibres** and they provide the main supporting tissue of many mature stems. They may form a cylinder below the epidermis, are found in xylem and phloem and sometimes as masses associated with vascular bundles.





Function and distribution: Individual sclerenchyma fibres are strong owing to their lignified walls. Collectively their strength is enhanced by their arrangement into strands or sheets of tissue that extend for considerable distances in a longitudinal direction. The ends of the cells **interlock** with one another, increasing their combined strength.

They are found in the pericycle of stems, forming a solid rod of tissue tapping the vascular bundles of dicotyledons. They form a layer in the **cortex** below the **epidermis** of stems or roots, in the same way as collenchyma, producing a hollow cylinder that contains the rest of the cortex and vascular tissues. Fibres also occur in both xylem and phloem, either individually or in groups.

Sclereids are generally scattered singly or in groups anywhere in the plant body common in the cortex, pith, phloem and in fruits and seeds. They confer **firmnes**s or **rigidity** on those structures in which they are found. In the flesh of pear fruits they occur in small groups and are responsible for the 'grittiness' of these fruits when eaten. In some cases, they form very resilient, solid layers, as in the shells of nuts and the stones (endocarp) of stone fruits.

In seeds they commonly toughen the testa (seed coat).

Reference; https://www.youtube.com/watch?v=abdYal9NoEs.

PRACTICAL 1

Prepare slides of 3 ground tissues and observe them under microscope .

Describe their structure, adaptation and function.

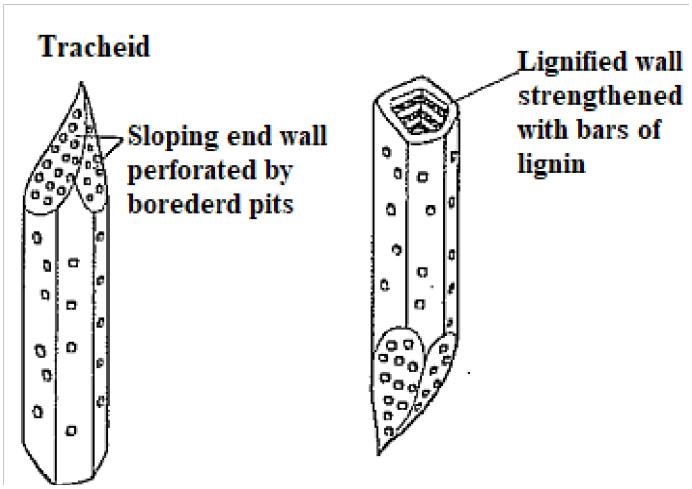
COMPOUND PLANT TISSUES:

These are the vascular tissue: xylem and phloem, made up of more than one type of cell, some living and some dead.

XYLEM:

It consists of parenchyma cells and fibres together with two specialized types of cells: vessels and tracheids. These tissues are both dead and serve the dual role of support and water transport. The types of **vessel** found depend upon the degree and nature of the cell wall thickening.

Tracheids



These are made up of secondary cellulose cell wall thickened with lignin and consist of single elongated cells with pointed ends.

Their walls contain numerous pits but have no perforations in the primary cell wall.

They lack living protoplasm at maturity and their tubular shape at maturity allows vertical transportation of water and mineral salts. The vertical upward movement of substances in the xylem is by conduction. The lignin helps in strengthening the cell walls to make them rigid.

Xylem fibres

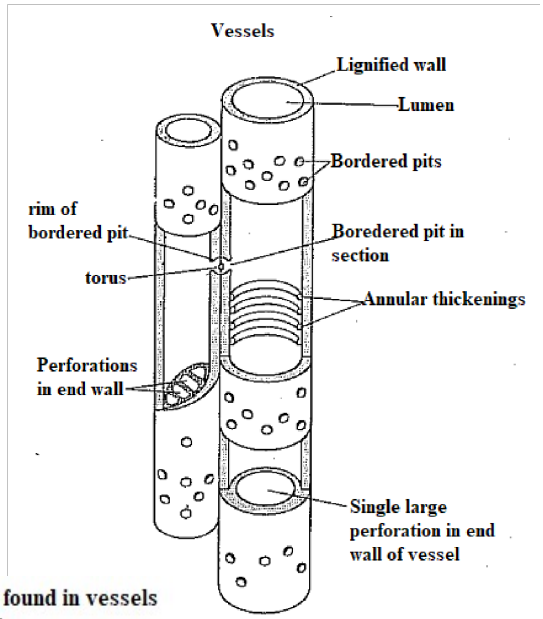
The xylem fibres are shorter and narrower than tracheids and have much thicker and overlapping end walls. These overlapping end walls have pits but they do not conduct water. They are stronger and provide additional mechanical strength to the xylem.

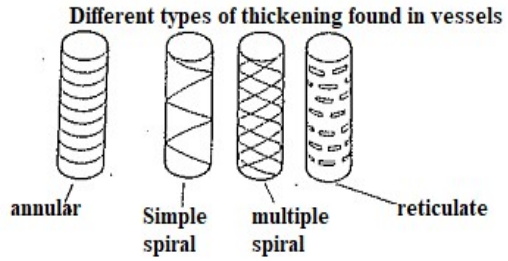
Vessel elements.

vessel elements are tubular xylem structures which allow vertical transportation of water and mineral salts (upward the plant). Each vessel has a typical length of 10 cm. The walls are made up of cellulose and lignin, which provide structural support to the vessel elements.

They are connected together into long tubes which enables easier transportation of water and mineral salts. They possess perforation plates in their end walls which are not found in tracheids.

These perforations help to adjoin other vessel elements. Furthermore, the vessel elements have no cytoplasm and nuclei at maturity. These features enable them to transport large volumes of water and mineral salts.





Xylem parenchyma

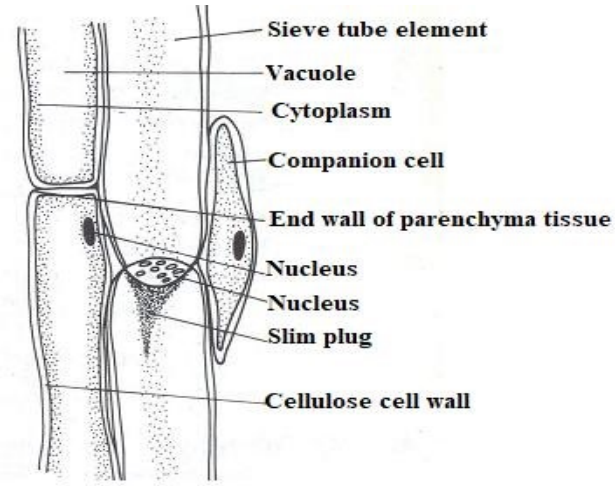
The xylem parenchyma is present in both primary and secondary xylem. It has a cellulose cell wall and a living protoplasm. Its function is to store food and conduct water sideways. In some cases, the xylem parenchyma cells serve as storage devices for starch.

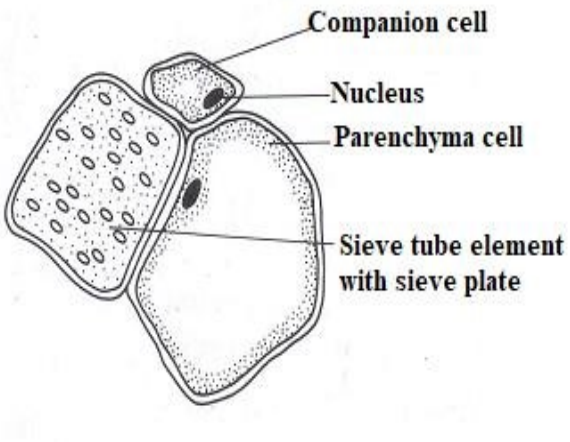
ASSIGNMENT; **Adaptation of the xylem to its functions.**

PHLOEM.

The phloem forms the primary food conducting tissue in vascular plants. It possesses tubular structures that are modified for translocation.

It is composed of living cells with cytoplasm, some of which have mechanical functions. It consists four types of cells, namely: sieve elements, phloem parenchyma cells, companion cells, and fibres.





Sieve tube elements.

These are conducting cells responsible for transporting food substances. They also constitute sieve tubes. Each sieve element is separated from the other by a sieve plate, which contains pores that allow the flow of fluid from one element to the other.

The pores occur when the plasmodesmata of the end walls enlarge greatly or expand. The pores are open channels for transportation in sieve plate between sieve elements. Each sieve element is associated with one or more companion cells.

Companion cells.

The companion cells have dense cytoplasm with small vacuoles and other cell organelles. They are very crucial for regulating the activities of sieve elements.

The companion cells are metabolically active since they contain many mitochondria for cellular respiration, which produce the energy needed for active transport.

There are also numerous ribosomes which are responsible for the active and constant production of respiratory enzymes.

Companion cells and sieve tube elements are connected by strands of cytoplasm called plasmodesmata.

Phloem fibres

The phloem fibres are slender, flexible and elongated sclerenchyma cells with tapering ends. They are found in the inner bark of the stem.

Their main role is to provide strength or mechanical support to mature plant stems.

Phloem parenchyma.

The phloem parenchyma cells are generally, living and elongated cells.

They are mainly for storage and consist of stored carbohydrates and accumulated tannins and resins. When tightly packed together, they provide mechanical support to the plant.

ASSIGNMENT ; **Adaptations of phloem tissues to their functions.**

Reference ;

PRACTICAL 2

Prepare slides of vascular bundles tissues and observe them under microscope .

Describe their structure, adaptation and function.

PREPARED BY BYARUHANGA BENSON

0782543367/0744475309.