Tissues

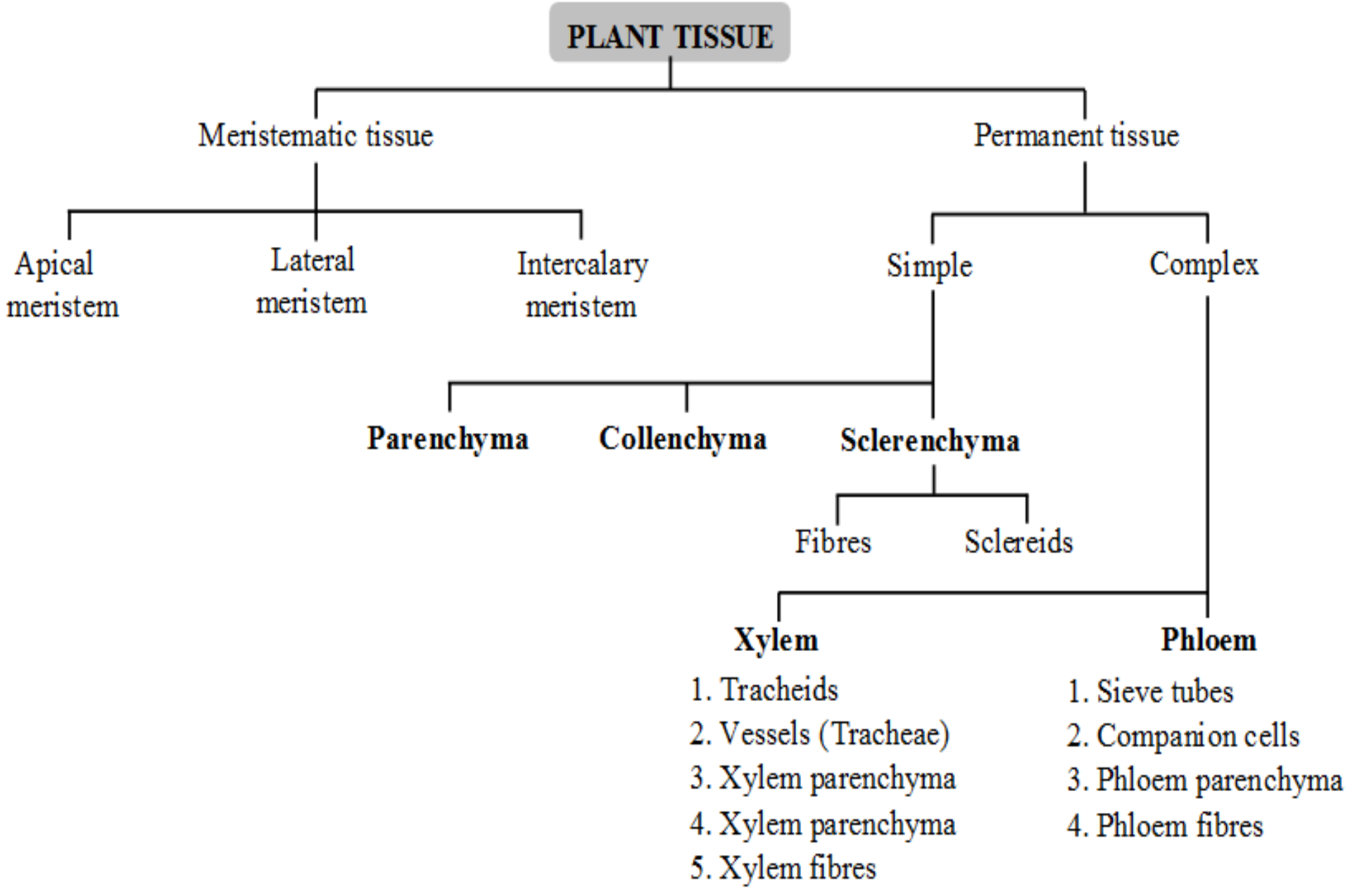
- Tissues are groups of similar cells that work together to perform a specific function within an organism. They are one of the fundamental levels of biological organization, with cells being the smallest unit of life, and tissues being the next level of organization above cells. In multicellular organisms, tissues are essential for carrying out various functions necessary for the organism's survival and functioning.

Plant Tissues

- Plant tissues are of various types, and they are made up of similar types of cells. They are different from animal tissues since there are several differences between animal and plant cells. Meristematic tissues and permanent tissues are the two types of plant tissues.

Animal Tissues

- Animal tissues are made up of animal cells. These tissues are usually not rigid since the cells do not have cell walls.



PLANT TISSUE

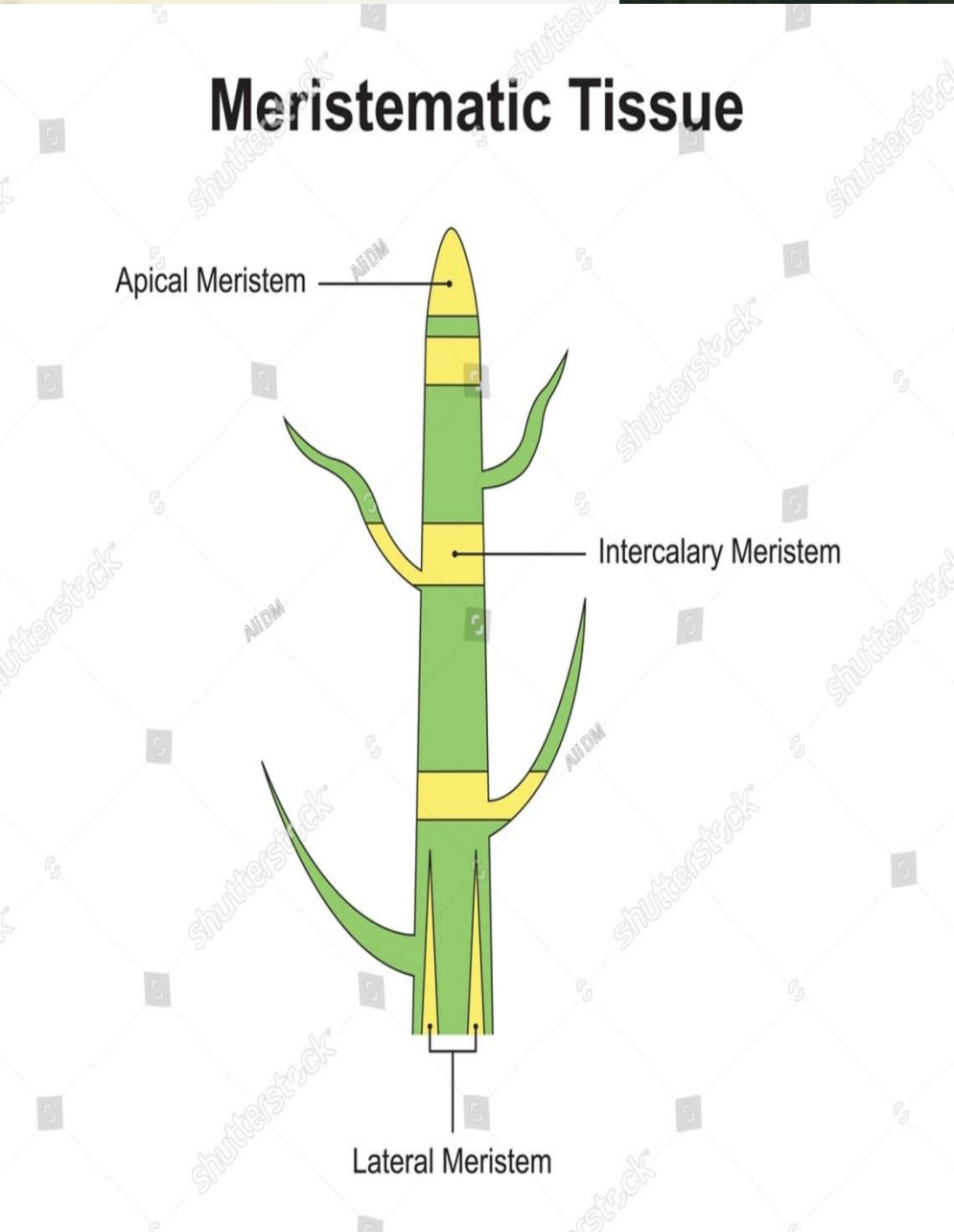
- Plant tissue refers to groups of cells in plants that are structurally and functionally similar and work together to perform specific functions. These tissues are the building blocks of plant organs such as leaves, stems, roots, flowers, and fruits.
- Growth: Meristematic tissues enable the plant to grow in length and width.
- Support: Collenchyma and sclerenchyma tissues provide structural support.
- Photosynthesis: Parenchyma tissues perform photosynthesis to produce energy.
- Storage: Parenchyma cells store water, nutrients, and reserves.
- Transport: Vascular tissues (xylem and phloem) facilitate the movement of water, nutrients, and sugars.
- Protection: Epidermal tissue protects against pathogens and physical damage.
- Healing: Parenchyma cells assist in wound healing.
- Mechanical Defense: Sclerenchyma tissue offers protection against herbivores and pathogens.
- Reproduction: Some tissues are involved in plant reproduction.
- Nutrient Storage: Certain tissues store nutrients and reserves for future growth.

Meristematic Tissue

- Meristematic Tissue:
- Location: Meristematic tissue is primarily found at the growing tips of plant structures, such as the tips of roots and stems, as well as in lateral buds.
- Function: It consists of actively dividing cells and is responsible for the growth and development of the plant. It plays a crucial role in both primary growth (lengthening) and secondary growth (thickening) of plant parts.
- Rapid Division: Meristematic cells divide rapidly, resulting in a continuous supply of new cells for growth.
- Small and Undifferentiated: These cells are small, with thin cell walls and no specialization, allowing them to become any type of plant cell as needed.
- Thin Cell Walls: The cell walls of meristematic cells are thin and primary, lacking secondary cell wall structures like lignin.

Types :

- There are different types of meristematic tissue, including apical meristem (at the tips of shoots and roots), lateral meristem (responsible for lateral growth), and intercalary meristem (found at the base of leaves and internodes).



- **Apical Meristem:**
  - **Location**: Found at the tips of roots (root apical meristem) and shoots (shoot apical meristem).
  - **Function:** Responsible for primary growth, increasing the length of plant structures.
  - **Result:** Growth in height and length of the plant.
- **Lateral Meristem:**
  - **Location:** Present in the lateral (side) regions of plant structures.
  - **Function:** Responsible for secondary growth, increasing the girth or thickness of plant structures, especially in woody plants.
  - **Result:** Increases the diameter of stems and roots, leading to the formation of secondary vascular tissues (secondary xylem and phloem).
- **Intercalary Meristem:**

Location: Found at the base of leaves and internodes (the regions between nodes on a stem)

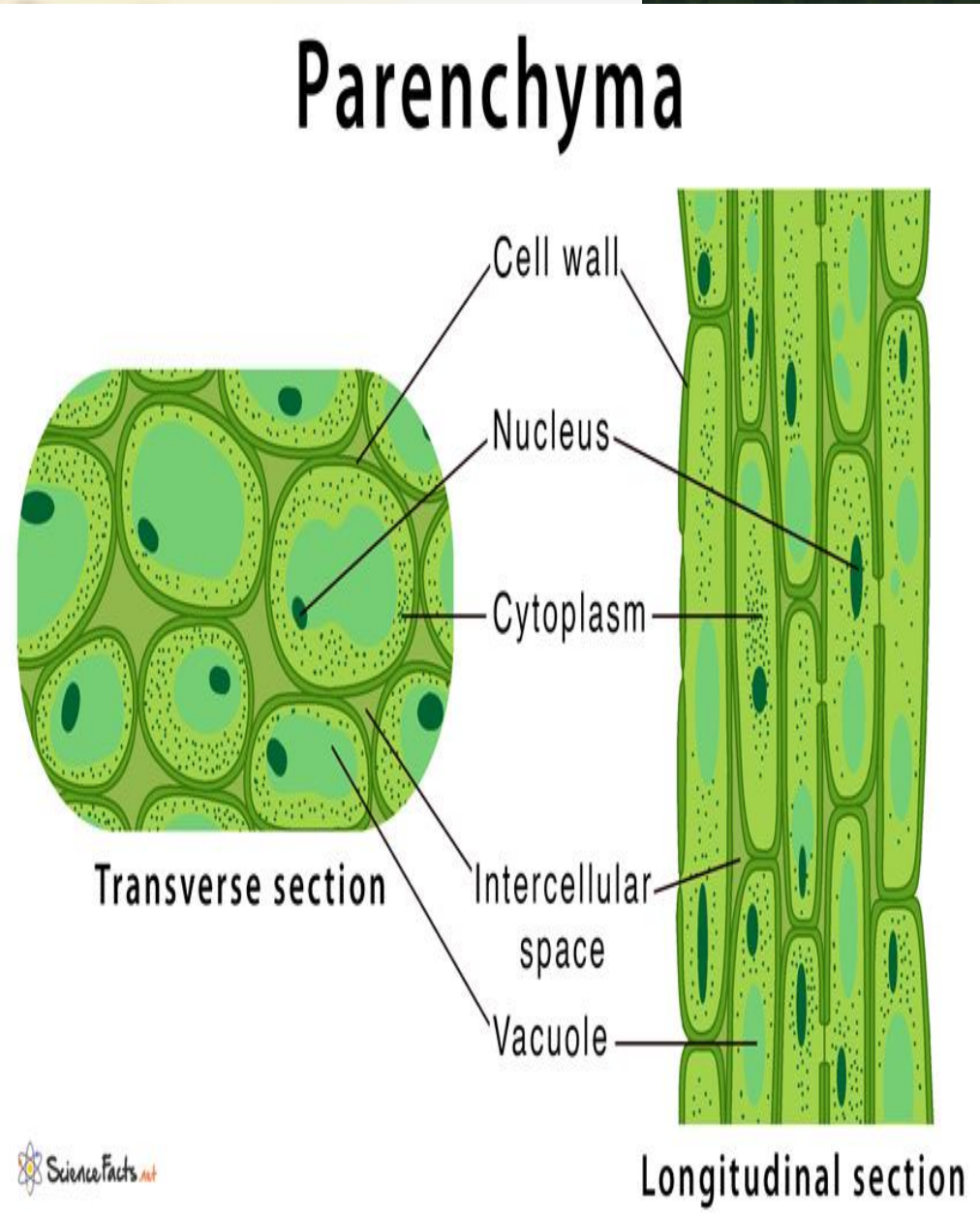
Function: Allows for elongation and growth at specific regions of the plant.

Result: Helps in the lengthening of leaves and stems, particularly in grasses and some other monocots.

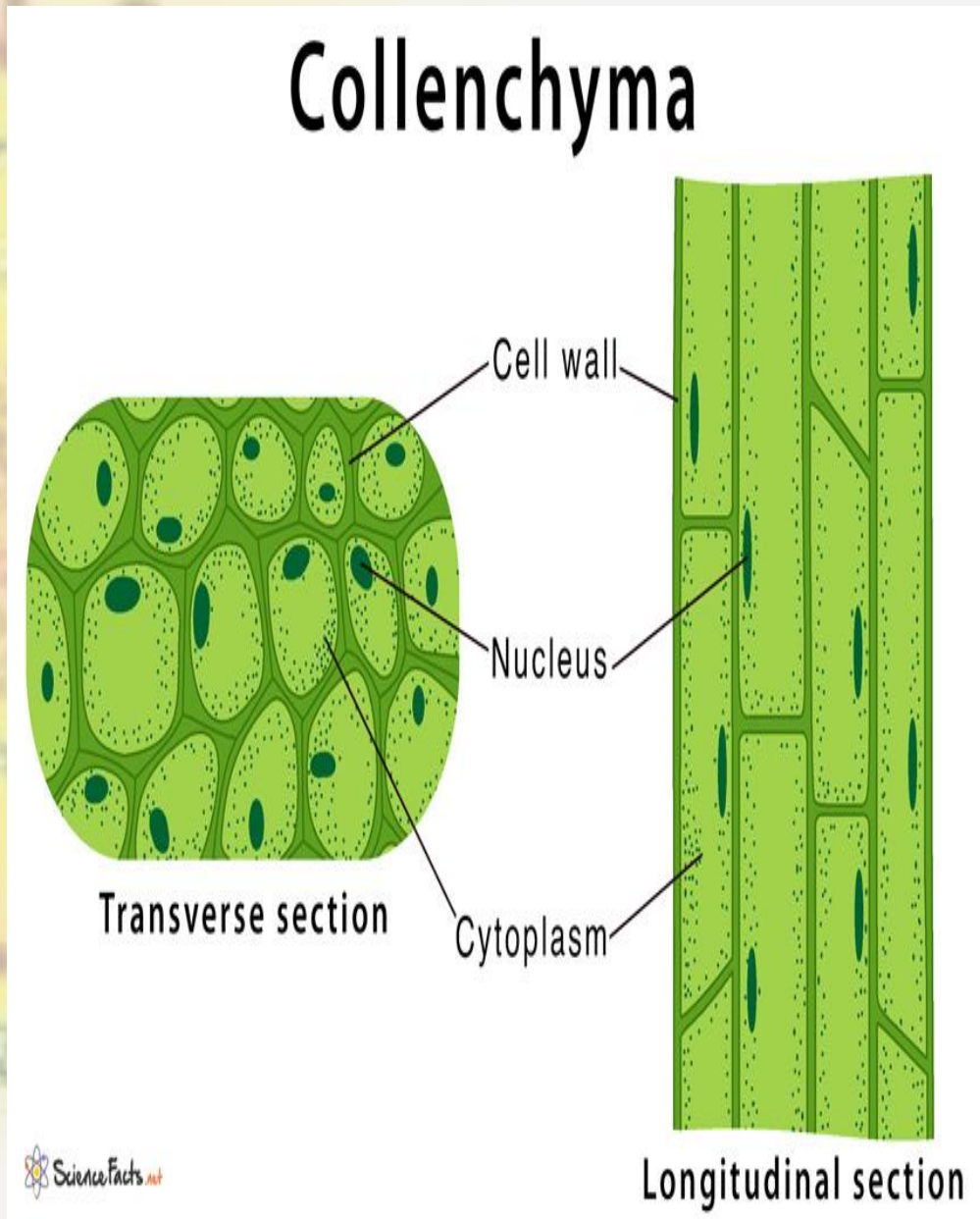
Permanent Tissue

- Permanent tissue is composed of cells that have ceased dividing and have specialized functions.
- The main types of permanent tissue are parenchyma, collenchyma, and sclerenchyma, as well as complex tissues like xylem and phloem.
- **Specialized Functions:**
  - Permanent tissues can have specialized functions in specific plant organs or adapt to particular environmental conditions.
  - For example, xerophytic plants may have specialized parenchyma tissues for water storage.
- **Importance of Permanent Tissues:**
  - Permanent tissues are essential for maintaining plant structure, supporting growth, and facilitating various physiological processes like photosynthesis, nutrient storage, and water transport.

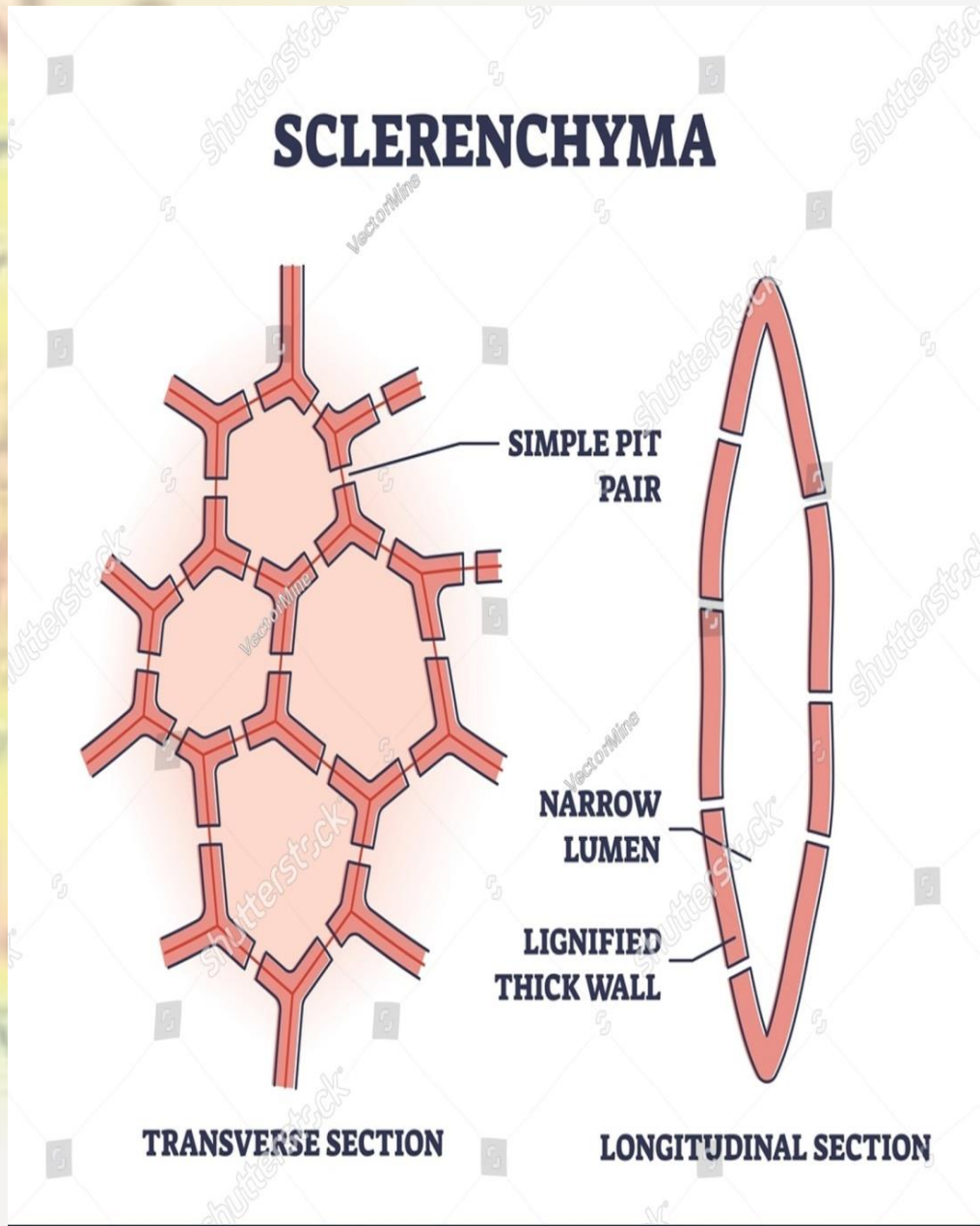
- Parenchyma Tissue:
- Characteristics: Parenchyma cells have thin cell walls and are loosely packed.
- Functions: They are involved in photosynthesis, storage of water and nutrients, and wound healing.
- Locations: Found in leaves (palisade and spongy parenchyma), stems, roots, and fruits.



- Collenchyma Tissue:
- Characteristics: Collenchyma cells have thicker cell walls than parenchyma, but they remain flexible.
- Function: Provides flexible structural support to young and growing plant parts.
- Locations: Typically found just beneath the epidermis in stems, petioles, and leaf veins.

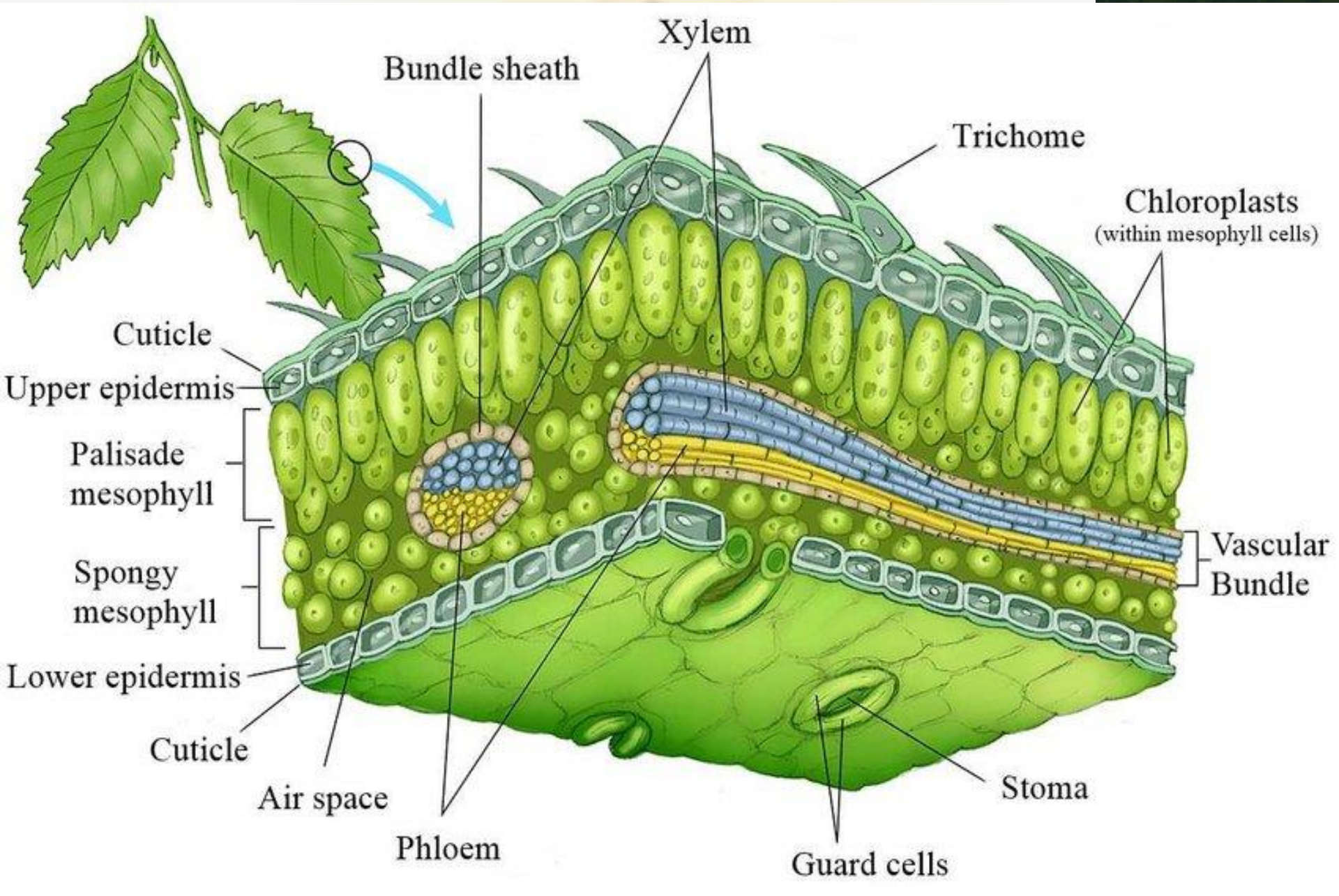


- Sclerenchyma Tissue:
- Characteristics: Sclerenchyma cells have thick, lignified (woody) cell walls, making them rigid and non-flexible.
- Function: Offers strong structural support to mature plant parts and provides mechanical protection.
- Types: Includes fibers and sclereids, with fibers being long and slender and sclereids being short and irregularly shaped.
- Locations: Present in stems (in bundles), leaf veins, and the outer layer of seeds and fruit



Protective Tissue

- Protective tissue refers to specialized plant tissue that primarily serves to protect various parts of the plant from external factors such as physical damage, pathogens, and excessive water loss.
- **Epidermis**
- The epidermis is a specialized plant tissue that serves as the outermost layer of cells in plant organs, including leaves, stems, roots, and young shoots. It plays several essential roles in the growth, development, and protection of the plant
- **Protection:**
- Physical Protection: The epidermis provides protection against physical damage, such as abrasion, injury, and desiccation (drying out). It acts as a shield that helps prevent mechanical harm to the underlying tissues.
- Pathogen Defense: The epidermis acts as a barrier against pathogens, including fungi, bacteria, and viruses. It is the plant's first defense mechanism against disease-causing agents.



- **Water Regulation:**
- **Cuticle:** The outer surface of the epidermis is often covered by a waxy layer called the cuticle. The cuticle is hydrophobic and helps reduce water loss by limiting transpiration, which is the process of water evaporation from the plant surface. It also prevents excess water uptake from rain or dew.
- **Stomata:** Some epidermal cells, particularly in leaves, contain specialized openings called stomata. Stomata regulate gas exchange (allowing for the uptake of carbon dioxide and the release of oxygen) and water vapor loss. Guard cells, located on either side of stomata, control their opening and closing.

- Root Hairs: In the epidermis of roots, specialized structures known as root hairs can extend from individual epidermal cells. Root hairs increase the surface area of the root and enhance the plant's ability to absorb water and nutrients from the soil.

- Absorption and Secretion: The epidermis in certain plant structures, such as roots, may play a role in the absorption of water and nutrients from the soil, as well as the secretion of substances like organic acids that facilitate nutrient uptake.

.

- **Transpiration:** The epidermis, especially in leaves, is involved in the process of transpiration, where water is lost from the plant through evaporation. Transpiration is essential for nutrient and water transport within the plant and helps create tension that pulls water and nutrients up from the roots

- **Environmental Adaptations:** The epidermis can vary in structure and composition based on environmental conditions. For example, in arid environments, plants may develop thicker cuticles and specialized epidermal cells to reduce water loss. In aquatic plants, the epidermis may have adaptations to facilitate gas exchange in submerged conditions.

Cork

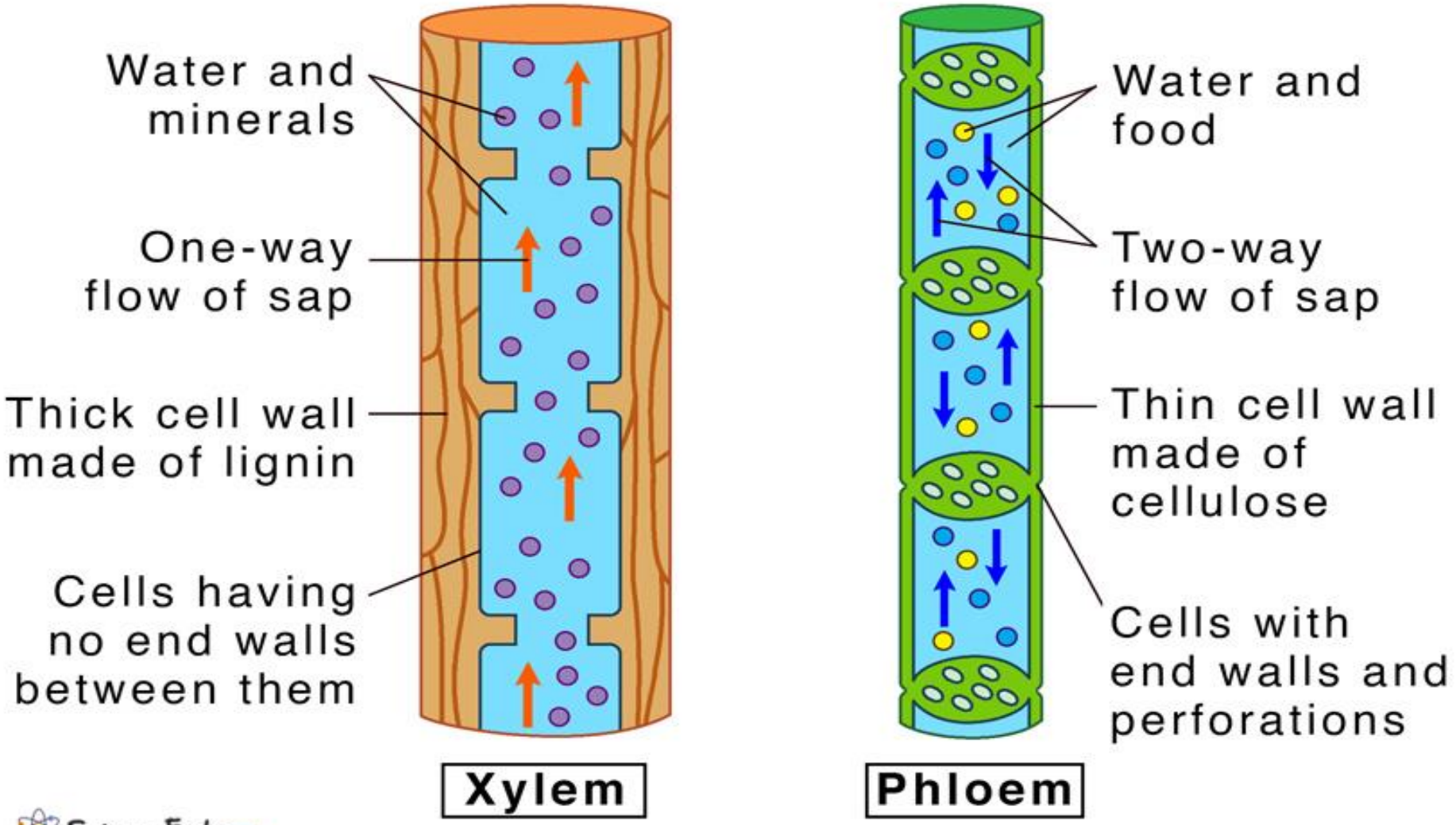
- Cork is a specialized tissue found in the bark of woody plants, primarily in the stems and roots. It is an essential component of the periderm, which is a protective tissue that replaces the epidermis in older parts of woody plants undergoing secondary growth.
- Cork Cambium (Phellogen):
- Cork tissue is produced by a specialized lateral meristem called the cork cambium or phellogen. This cambium is responsible for the continuous production of cork cells.
- Cork cambium originates in the cortex or other layers beneath the epidermis and produces both cork cells toward the outside and phelloderm cells toward the inside of the stem or root.

- **Protective Function:**
- The primary function of cork tissue is protection. It serves as a durable and protective outer layer that shields the inner, more delicate tissues of the plant from various external threats, including physical damage, pathogens, and environmental stressors.
- The impermeability of cork cells to water and gases helps reduce water loss from the plant and minimize the risk of infection.
- **Insulation:**
- The presence of suberin in cork cells also provides thermal and mechanical insulation. It helps regulate the temperature of the underlying tissues and protects them from extreme temperatures.

- **Growth and Renewal:**
- As the cork cambium continues to produce cork cells, the older cork layers are pushed outward, making room for new layers. This outward growth contributes to the increase in girth (diameter) of stems and roots in woody plants, a process known as secondary growth.
- Cork cambium activity ensures that the outermost layer of cork is continually replaced, maintaining the protective function of the tissue.

- Cork is a specialized tissue in woody plants that forms a protective outer layer in the bark. It is characterized by cork cells with impermeable cell walls containing suberin. Cork tissue plays a crucial role in protecting the plant from external threats, regulating temperature, and facilitating secondary growth in woody plants.

Xylem and Phloem



- **Xylem and Phloem (Complex Permanent Tissues):**

- **Xylem:** Conducts water and minerals from roots to other parts of the plant. Contains tracheids, vessel elements, fibers, and parenchyma cells- Unidirectional Flow

- **Phloem:** Transports sugars (mainly sucrose) from leaves to other plant parts. Comprises sieve tube elements, companion cells, fibers, and parenchyma cells.- Bi directional Fow

Xylem

- **Components of Xylem:**
- **Tracheids and Vessel Elements:**
  - Tracheids and vessel elements are the primary water-conducting cells in xylem tissue.
  - Tracheids are long, tapering cells with overlapping ends that allow water to move through pits (small openings) in their cell walls.
  - Vessel elements are shorter, wider cells with perforated end walls called perforation plates. These plates facilitate more efficient water transport compared to tracheids and are found in angiosperms (flowering plants).
- **Parenchyma Cells:**
  - Parenchyma cells are thin-walled, living cells found in xylem tissue. They function in storage and can also play a role in lateral water movement within the plant.
- **Sclerenchyma Fibers:**
  - Sclerenchyma fibers provide structural support to xylem tissue. They have thick, lignified walls that are no longer living when mature.

- **Functions of Xylem:**
- **Water Transport:** The primary function of xylem is to transport water and dissolved minerals (mainly ions) from the roots to the rest of the plant. This process is known as transpiration or sap ascent. Water is pulled upward through the plant due to transpiration in the leaves, creating a negative pressure gradient.
- **Mineral Transport:** In addition to water, xylem also transports essential minerals, such as nitrogen, phosphorus, and potassium, absorbed by the plant's roots from the soil.
- **Support:** Xylem tissue provides structural support to the plant, helping it maintain an upright position. This is especially important in tall trees.
- **Storage:** Parenchyma cells in xylem can store water, nutrients, and other substances for later use by the plant, especially during periods of drought or when the plant is not actively transpiring.
- **Defense:** Some elements in the xylem, such as lignin, provide protection against microbial pathogens and herbivores.

Phloem

- **Phloem plays a crucial role in the transport of organic compounds, primarily sugars (such as glucose and sucrose), from where they are produced (usually in the leaves) to where they are needed for growth, energy, and storage throughout the plant.**
- **Components of Phloem:**
- **Sieve Tubes:**
  - Sieve tubes are the main conducting cells in phloem tissue. They are elongated cells with perforated end walls called sieve plates.
  - These sieve plates contain numerous sieve pores, which allow for the flow of sap (the sugary solution) between adjacent sieve tubes.
  - Sieve tubes are interconnected, forming a continuous system for the transport of organic compounds.

- **Companion Cells:**
  - Each sieve tube is closely associated with a companion cell. Companion cells are metabolically active and provide energy and support for the sieve tube, which lacks a nucleus and other organelles.

- **Parenchyma Cells:**
  - Parenchyma cells in the phloem serve as storage cells and may also assist in lateral nutrient transport within the plant.

- **Fibers:**
  - Some phloem tissues contain fibers for structural support

- **Functions of Phloem:**

- **Transport of Sugars:** The primary function of phloem is the transport of sugars, mainly sucrose, produced during photosynthesis in the leaves. These sugars are transported to various parts of the plant, where they are used for energy, growth, and storage.

- **Nutrient Distribution:** Phloem also transports other organic nutrients, including amino acids, hormones, and certain ions, to various plant tissues(translocation)..

- **Storage:** Parenchyma cells in the phloem can store excess sugars and other organic compounds when photosynthesis exceeds immediate metabolic needs.