THE TISSUES

The journey from individual cells to the formation of tissues marks a crucial phase in the structural organization of organisms. Tissues, the collaborative outcome of interactions among cells, exhibit properties distinct from those of the individual constituent cells. While these cells often serve a common function, their structural characteristics may either align or diverge. Thus, a tissue is defined as a collective of cells, either structurally similar or dissimilar, united by a common function and shared origin.

- Each tissue within a plant plays a specific role, and the various types of plant tissues work in concert to sustain the overall life of the plant.
- A plant, comprising diverse tissues, is fundamentally categorized into two main groups: meristematic and permanent tissues. This classification hinges on the capacity of cells to undergo division. Meristematic tissues, with their various subtypes, share a common trait – the enduring ability of constituent cells to divide. Conversely, cells forming permanent tissues undergo specialization in both structure and function, relinquishing their ability to divide either temporarily or permanently. Therefore, the pivotal criterion for distinguishing plant tissues lies in the persistence or loss of the 'ability of division.'
- Understanding the dynamics of tissue formation and the subsequent classification is paramount for comprehending the intricate organization and functioning of plant structures. The collaboration and specialization of different tissues contribute synergistically to the vitality and sustenance of the plant life cycle.

Meristematic Tissues

- Meristematic tissues represent a collective of immature cells actively engaged in preparing for division or perpetually undergoing the division process. These tissues play a fundamental role in fostering the growth of plants, predominantly localized in regions characterized by active growth. Their primary function is pivotal in the genesis of the primary plant body, contributing to the plant's incremental growth over successive years.
- To comprehend meristematic tissues, it is imperative to delve into the foundational principles of plant growth. The growth pattern in plants is distinctive, characterized by an enduring capacity for unlimited growth throughout their life cycle. This remarkable capability is intrinsically linked to the perpetual division within meristematic tissues.

Meristems:

Meristems denote specialized regions within the plant body housing meristematic tissues (derived from the Greek word 'meristos,' meaning divided). These zones are hotspots of active cell division, where cells continuously undergo division to generate new cells. The cells originating from meristematic division soon forfeit their division potential, becoming integral components of the overall plant body structure. The sustained activity within meristems underscores their crucial role in perpetuating the growth and development of plants.

Classification of Meristems:

Meristems, the crucial regions of active cell division in plants, can be classified based on two key criteria: their origin in the life of a plant and their position within the plant body.

Based on Origin in the Life of a Plant:

- **Primary Meristems:** These meristematic cells emerge early in the life of a plant and actively participate in the formation of the primary plant body. They are in a perpetual state of division, contributing to the creation of primary permanent tissues.

- **Secondary Meristems:** Appearing later than primary meristems, secondary meristems play a role in generating secondary tissues, especially in woody areas. Unlike primary meristems, they are not present at the initial stages of organ formation but develop subsequently to give rise to additional tissues.

Based on Position in the Plant Body:

- **Apical Meristem:** Positioned at the apices or tips of stems, roots, or branches, apical meristems are further categorized into root apical meristem and shoot apical meristem. Root apical meristem occupies the root tip, while shoot apical meristem occupies the shoot tip.

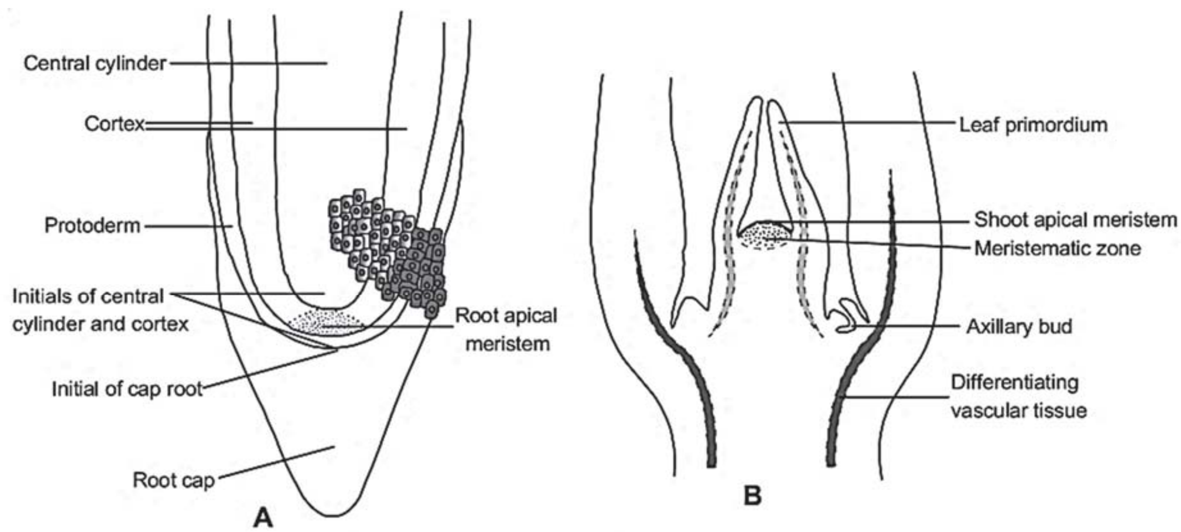


Fig. : Apical meristem : A. Root, B. Shoot

- **Function of Apical Meristem:** These meristems contribute to primary growth in plants, primarily increasing length by elongating the axis. This process, known as primary growth, involves the continuous division of cells in the shoot apical meristem, resulting in stem elongation. Additionally, axillary buds, found in the axil of leaves, are formed by cells 'left behind' from the shoot apical meristem, capable of developing into branches or flowers.
- **Intercalary Meristem:** Positioned amidst mature tissues, intercalary meristems are separated from the organ apex by mature tissue. Despite this separation, the activity of intercalary meristem aids in elongating the plant or its organs, contributing to an increase in overall length.
- Intercalary meristems are found in grasses where they help to regenerate the parts removed by the grazing herbivores. They help in elongation of organs and also allow fallen stems of cereals to become erect.

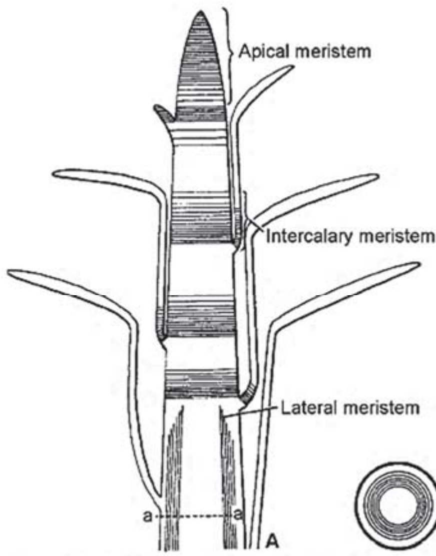


Fig. : A. Locations of meristematic tissues in L.S. of a shoot, **B.** T.S. of A at a-a

- **Lateral Meristem:** Lateral meristems represent a distinct category of meristematic tissues located along the sides or peripheries of the roots and shoots in numerous plants. Typically situated in the mature regions of roots and shoots, these meristems are not universally present across all plant species. Instead, they are primarily found in plants that undergo secondary growth, producing a woody axis. Termed secondary meristems due to their appearance after primary meristems, lateral meristems play a pivotal role in the radial expansion or increase in girth of stems and roots.
- Lateral meristems are specialized cylindrical meristematic tissues that initiate their activity in the mature regions of roots and shoots. Unlike primary meristems, they manifest later in the life cycle of a plant and are specifically associated with plants undergoing secondary growth. Secondary growth, characterized by an increase in girth, results from the radial division of cells by lateral meristems.
- The primary function of lateral meristems is to generate secondary tissues, contributing to the overall growth and development of the plant's vascular and protective structures. These secondary tissues include, but are not limited to, secondary xylem, secondary phloem, secondary medullary rays, cork, and secondary cortex.

  Several specific types of lateral meristems exist, each with a distinct role in secondary growth:.

  Fascicular Vascular Cambium: This meristematic tissue develops within the vascular bundles, alternatively referred to as interfascicular vascular cambium.

  Interfascicular Cambium: Found between vascular bundles, interfascicular cambium is another type of lateral meristem.

  Cork Cambium: Responsible for the formation of cork, a durable protective material, cork cambium is a lateral meristem integral to secondary growth.

Permanent Tissues

- The cells originating from both primary and secondary meristems undergo a process of division and subsequent differentiation, resulting in the production of primary and secondary permanent tissues within the plant body. Following cell division, the newly formed cells exhibit structural and functional specialization, accompanied by the loss of their ability to undergo further division. These specialized and non-dividing cells are referred to as permanent or mature cells, and the tissues constituted by these cells are designated permanent tissues. The maturation process involving the transformation of meristematic cells into permanent cells is known as differentiation. Thus, meristematic cells undergo differentiation to give rise to the diverse and specialized cells that compose permanent tissues.

Classification of Permanent Tissues:

Permanent tissues can be broadly categorized into two main types:

- **Simple Permanent Tissues:** A tissue is classified as simple when it comprises only one type of cells. In this context, 'one' type of cells denotes that the cells share structural and functional similarities with each other. Therefore, simple permanent tissues consist of cells that are alike in both structure and function, working in coordination to fulfill a common function or a set of functions.

Various simple tissues contribute to the composition of plant bodies, and these include:

Parenchyma

Collenchyma

Sclerenchyma

- **Parenchyma:** Parenchyma is characterized by several features:
  Ubiquitous Presence: Parenchyma constitutes a predominant component in various plant organs, being distributed across roots, stems, leaves, flowers, fruits, and seeds. It forms the fundamental bulk of the plant body.
  Parenchymatous Cells: The individual cells that make up parenchyma are referred to as parenchymatous cells. Importantly, these cells retain their protoplasm (the living contents of a cell) throughout maturation, signifying that they remain living cells.

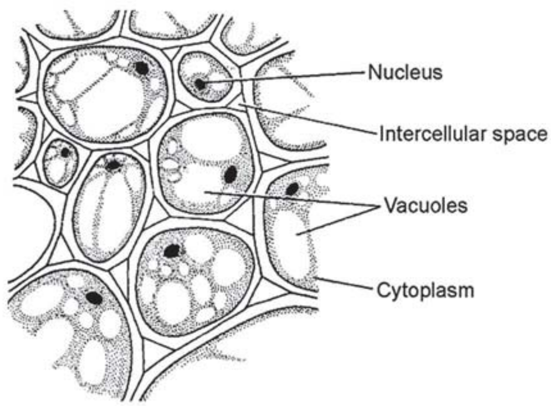


Fig. : Parenchyma

Isodiametric Cells: Parenchymatous cells typically exhibit an isodiametric configuration. The term 'iso' denotes equality, and 'diametric' pertains to diameter. Consequently, parenchymatous cells possess nearly equal diameters in various planes, showcasing diverse shapes such as spherical, oval, round, polygonal, or elongated (with polygonal cells having many sides and elongated cells being longer in shape).

Thin-Walled Cells: The cell walls of parenchymatous cells are characterized by their thinness. Composed primarily of cellulose, these cell walls constitute a major structural element in plant cell walls.

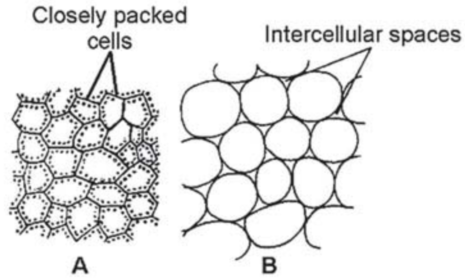


Fig. : A. No intercellular spaces, **B.** Intercellular spaces present

Intercellular Arrangement: Cells in parenchyma tissue may either be densely packed with no intercellular spaces or possess small intercellular spaces, adding to the variability in the structure and organization of parenchymatous cells.

Functions of Parenchyma: Parenchyma fulfills a range of functions, including:

Storage of Food: An essential role of parenchyma is the storage of food. Parenchymatous cells serve as reservoirs for various food materials such as carbohydrates, oils, fats, proteins, and other essential nutrients.

Photosynthesis: Certain parenchymatous cells exhibit the development of chloroplasts, allowing them to engage in photosynthesis. In this process, these cells synthesize food from inorganic substances in the presence of light energy. When parenchyma contains chloroplasts, it is specifically referred to as chlorenchyma.

Secretion: Some parenchymatous cells are involved in the secretion of substances like resin, nectar, oil, among others. These specialized cells are often situated in structures such as resin ducts and other secretory organs. They play a crucial role in releasing these secretions from the plant body, contributing to various physiological processes.

- **Collenchyma:** Collenchyma exhibits various characteristics, including:

  Elasticity and Living Nature: Collenchyma is identified as an elastic and living mechanical tissue within plant structures.

  Collenchymatous Cells: Cells forming collenchyma are referred to as collenchymatous cells, which may have oval, spherical, or polygonal shapes.

  Intercellular Spaces and Thickenings: Unlike parenchyma, collenchyma cells are closely packed without intercellular spaces. Notably, thickenings composed of cellulose, hemicellulose, and pectin occur at the corners of these cells, contributing to increased wall thickness. These complex carbohydrates provide strength to the cell walls.

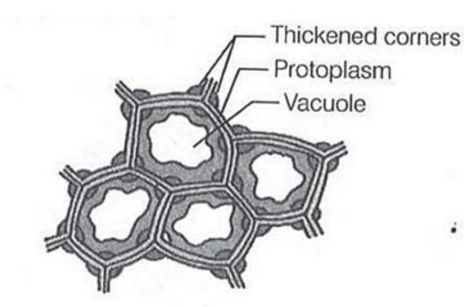


Fig.: Collenchyma

Location and Arrangement: Collenchyma is situated in layers beneath the epidermis in dicotyledonous plants. It is typically found as 3-4 layers below the epidermis, either as a continuous layer or discontinuously in patches. Notably, collenchyma is absent in monocotyledonous plants.

Photosynthetic Activity: Some collenchymatous cells contain chloroplasts. These chloroplast-containing cells are capable of photosynthesis, contributing to the assimilation of food within the plant.

Functions of Collenchyma:

Mechanical Support: Collenchyma serves as a living mechanical tissue, offering essential support to the actively growing regions of the plant, such as young stems and petioles of leaves. Its primary role involves preventing the bending of stems and protecting against the potential damage caused by wind, ensuring the structural integrity of young leaves. Consequently, collenchyma plays a dual role by providing both support and strength to the developing parts of plants.

Contribution to Photosynthesis: When collenchyma cells contain chloroplasts, they actively participate in the synthesis of food through photosynthesis. This process enables these specialized cells to contribute to the production of nutrients within the plant, showcasing the diverse functional roles that collenchyma can perform.

- **Sclerenchyma:** The term "sclerenchyma" originates from the Greek language, signifying "hard tissue." This plant tissue exhibits distinctive characteristics:

  Sclerenchymatous Cells: The individual cells comprising sclerenchyma are termed sclerenchymatous cells. Unlike parenchyma, these cells undergo maturation by losing their protoplasts, leading to a state of dormancy or death.

  Elongated and Narrow Cells with Thickened Walls: Sclerenchymatous cells are characterized by their elongated and narrow structure. Remarkably, these cells feature highly thickened cell walls, comprising cellulose, hemicellulose, and a specialized organic substance known as lignin. Lignin plays a pivotal role in conferring mechanical strength to the plant and its various parts. The extensive deposition of lignin results in robust, rigid cell walls that become impermeable to water.

  Presence of Pits in Cell Walls: The walls of sclerenchymatous cells are marked by the existence of pits, ranging from a few to numerous. These pits contribute to the overall structural complexity of the cells, adding to their unique characteristics within the plant tissue.

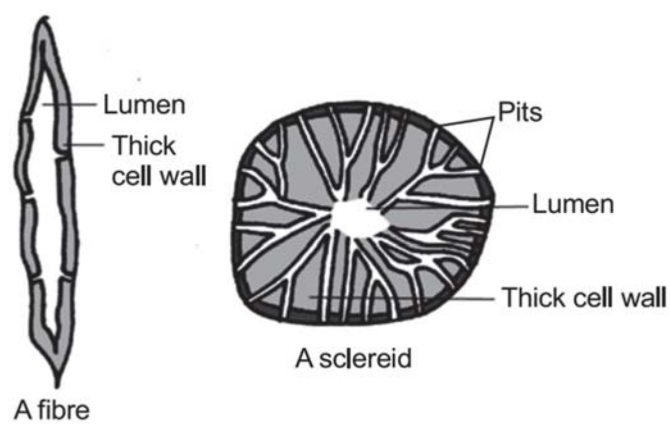
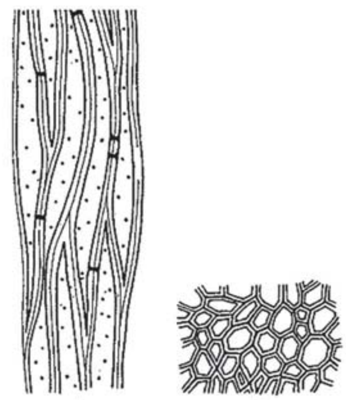


Fig. : Sclerenchyma

Types of Cells in Sclerenchyma:
Based on variations in origin, development, form, and structure, sclerenchyma exhibits two distinct types of cells:

- Sclerenchymatous Fibres: Sclerenchymatous fibres are characterized by their highly elongated structure, featuring pointed or oblique ends. Resembling fibres due to their elongated and narrow appearance, these cells have thick walls, and in certain instances, the cell wall undergoes significant lignification, leading to a substantial reduction in the lumen or inner space.
- Typically occurring in groups or bundles, sclerenchymatous fibres are distributed in various plant parts such as stems. Their association with the xylem and phloem within vascular bundles imparts mechanical strength to the respective organs.



A B
Fig. : Sclerenchymatous fibres :
A. L.S., **B.** T.S.

- Sclereids: Sclereids are cells that can be spherical, oval, or cylindrical, characterized by highly thickened cell walls. The thickness of the cell walls is such that the lumen of these cells is nearly obliterated. Similar to sclerenchymatous fibres, sclereids are also non-living cells.
- Sclereids can occur individually or in groups and are found in diverse plant parts, including roots, stems, and leaves, flowers, fruits, and seeds. Notably, they are prevalent in both hard and soft plant tissues, such as the pulp of fruits. Examples of sclereids' presence include:
- In the fruit walls of nuts like walnut and almond.
- Within the pulp of fruits like guava, pear, and sapota (cheeku), contributing to the characteristic "gritty" texture.
- Forming the seed coats of legumes such as peas and beans.
- Existing in the leaves of tea plants.
- Complex Permanent Tissues: Complex permanent tissues are comprised of multiple cell types, each varying in form and structure; nevertheless, these distinct cells collaborate as a functional unit. Thus, a complex tissue can be characterized as a group of cells with diverse structures that collectively carry out a common function or a set of functions.

Types of Complex Tissue:
There are two main types of complex tissues present in plants:
Xylem
Phloem

- **Xylem:** Xylem, as the principal water-conducting tissue in plants, plays a pivotal role in facilitating the movement of water and minerals from the roots to the upper regions of the plant, including stems and leaves. Its primary function lies in the efficient conduction of vital substances necessary for the plant's growth and metabolic processes.
- Beyond its role as a conduit for water and minerals, xylem also contributes significantly to providing mechanical strength to various parts of the plant. Mechanical strength encompasses the plant's ability to withstand external stresses, pulling forces, and compressive forces without succumbing to breakage or tearing. This dual functionality highlights the crucial role of xylem not only in the vital transport of nutrients but also in fortifying the structural integrity of plant tissues.

Types of Xylem:
Xylem tissue can be categorized into two main types based on its origin:
Primary xylem
Secondary xylem

- **Primary Xylem:** Primary xylem is the xylem that originates early in the primary growth phase of the plant body. It further divides into two types based on the relative state of maturity:
  Protoxylem
  Metaxylem.
  Protoxylem: The initially formed primary xylem is referred to as protoxylem. Protoxylem exhibits vessels with a narrow diameter.
  Metaxylem: The later-formed primary xylem is known as metaxylem, and it is more mature than protoxylem. Metaxylem vessels have a broader diameter.

Arrangement of Primary Xylem:
The arrangement of primary xylem is determined by the relative position of protoxylem and metaxylem within an organ, leading to two types:
Endarch
Exarch

- **Endarch Arrangement:** In the endarch type, the protoxylem, or the first-formed primary xylem, is located towards the center (pith) of the organ, while the metaxylem, or later-formed primary xylem, lies towards the periphery. This endarch arrangement is observed in stems.
- **Exarch Arrangement:** In the exarch type, protoxylem is situated towards the periphery, and metaxylem is positioned towards the center (pith) of the organ. The exarch arrangement is characteristic of roots.
- **Secondary Xylem:** Secondary xylem is the type of xylem that develops during the secondary growth phase of a plant. This growth is facilitated by the vascular cambial ring, which functions as a lateral meristem.
- **Elements of Xylem:** Xylem is a complex tissue, consisting of four distinct types of elements, each contributing to its structural and functional complexity. These elements are classified as follows:
  Tracheids
  Vessels
  Xylem fibres
  Xylem parenchyma

Tracheids: Structure: Tracheids represent elongated cells characterized by gradually tapering ends, resembling tube-like structures with pointed tips.

- The walls of tracheids are thick and contain lignin deposits, contributing to their rigidity.
- These cells are non-living and lack protoplasm.

- Cross-sections of tracheids reveal various types of thickenings in their inner walls, primarily composed of lignin and displaying diverse forms.

Fig. : Tracheid

- Despite the presence of thickenings, a central cavity or lumen remains within the tracheid, facilitating the transportation of water and minerals.
- Tracheids align in a continuous row, forming an uninterrupted channel for the conveyance of water and minerals from the roots to the stems and leaves.

Occurrence:
Tracheids are ubiquitous in vascular plants, spanning across Pteridophytes, Gymnosperms, and Angiosperms (flowering plants).
Functions:
- Water and Mineral Transport: Tracheids serve as the primary conduits for the transportation of water and minerals from the plant's roots to its stems and leaves.
- Mechanical Support: The presence of thickened and hardened walls imparts mechanical strength to the plant's overall structure.

Various Types of Thickenings in Inner Walls of Tracheids:
- Annular Type: Characterized by ring-like deposition of lignin.
- Spiral Type: Lignin is deposited in a helical pattern.
- Scalariform Type: Lignin forms a ladder-like arrangement.

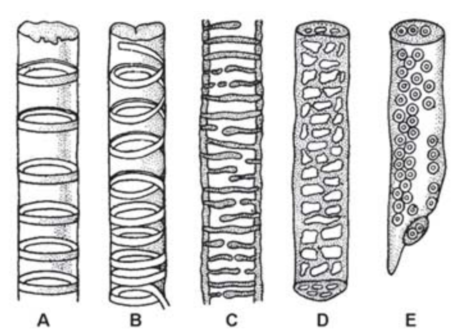


Fig. : Lignified thickenings in xylem tracheids and tracheae : **A.** Annular, **B.** Spiral, **C.** Scalariform, **D.** Reticulate, **E.** Bordered pit

- Reticulate Type: Lignin is deposited in a net-like pattern.

- Pitted Type: The thickening occurs across the entire inner surface, leaving unthickened circular areas, defining a pitted structure.

Vessels: Structure: Vessels, also referred to as tracheae, embody long cylindrical tube-like structures composed of multiple cells (multiple cells constitute one vessel). These constituent cells are termed vessel members or vessel elements.

Fig. : Vessels

- Unlike tracheids, vessels result from the fusion of cells, forming an extended tube-like structure comprised of multiple cells fused together. The intervening walls between these cells dissolve, creating a vessel.
- Each vessel member features a lignified cell wall and a spacious central cavity, facilitating the transport of water.

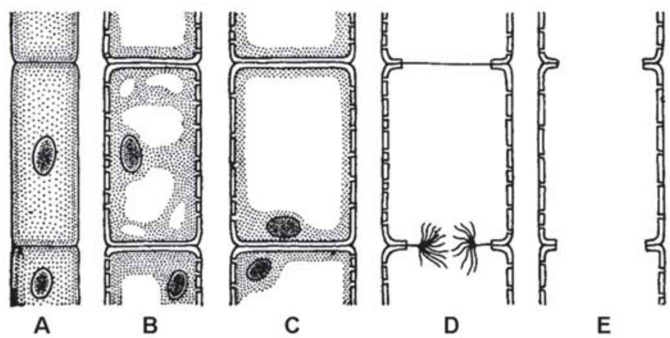


Fig. : Stages in development of tracheae (vessels) showing dissolution of intervening walls between vessel elements

- Vessel cells are lifeless and lack protoplasm.
- The end walls of vessel cells are typically oblique and are denoted as perforation plates. These plates connect vessel members through openings known as perforations.

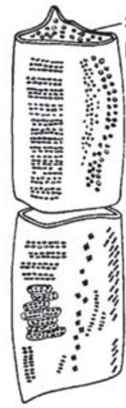


Fig. : Tracheae placed upon one another and connected through perforations

Occurrence:

The presence of vessels is a distinctive trait of angiosperms. Gymnosperms and pteridophytes lack vessels in their xylem, although other xylary elements exist to enable the conveyance of water and minerals. Primitive angiosperm families such as Tetracentraceae, Trochodendraceae, and Winteraceae do not possess vessels.

Functions:

- Longitudinal Water and Mineral Transport: Vessels serve as conduits for the longitudinal transport of water and minerals within the plant.
- Mechanical Support: Vessels contribute to the mechanical support of the plant structure.

Xylem Fibres: Xylem fibres, also known as sclerenchymatous fibres, represent elongated elements that are lengthy, narrow, and taper at both ends. Similar to vessels and tracheids, xylem fibres are lifeless elements.

Fig. : Xylem fibres (Xylem sclerenchyma)

- These fibres feature highly thickened lignified walls, contributing to their structural integrity.
- Xylem fibres possess obliterated central lumens, where the absence of space results from the thickness of the walls.
- Two variations of xylem fibres exist: septate and aseptate. Septate fibres have internal septa or cross walls, while aseptate fibres lack internal septa.

Occurrence:

Xylem fibres constitute integral components of the xylem in all categories of vascular plants.

Functions:
Primarily serving a mechanical role, xylem fibres play a crucial part in providing support to various plant organs.
Xylem Parenchyma: Cells constituting the xylem parenchyma are alive and characterized by thin-walled structures. Their cell walls primarily consist of cellulose, and they feature a well-defined nucleus and dense cytoplasm.

Occurrence:
Xylem parenchyma is a component found in the xylem of all vascular plants.
Functions:
- The xylem parenchyma cells play a vital role in storing reserve food materials such as starch or fat.
- Additionally, these cells serve as storage sites for various substances, including tannins.
- Their significant function involves facilitating the radial conduction of water, operating in directions perpendicular to the longitudinal axis. Specifically, parenchymatous cells aiding in the radial conduction of water are referred to as ray parenchyma cells.
- **Phloem:** Phloem is a dynamic living tissue responsible for conveying food materials, primarily sucrose (a form of sugar), from the source, where it is generated, to the sinks, where it is required. This essential transport system ensures the movement of organic substances, typically from leaves to various plant components such as roots, growing tips of stems and leaves, flowers, and fruits. The nourishment produced in the leaves through the photosynthesis process needs efficient transportation to every part of the plant, a function expertly performed by the phloem, making it a crucial conducting tissue.

Types of Phloem:
Similar to xylem, phloem is categorized into primary and secondary phloem based on its origin.
- **Primary Phloem:** Primary phloem, originating during the initial growth phase of the plant body, is further classified into two types based on the relative states of maturity:
  Protophloem: The first-formed primary phloem is termed protophloem.
  Metaphloem: The subsequently developed primary phloem is referred to as metaphloem.
- **Secondary Phloem:** Formed during the secondary growth of the plant body, secondary phloem is produced by the vascular cambial ring, a lateral meristem.

Elements of Phloem:
- Similar to xylem, phloem is a complex tissue in angiosperms and comprises four key elements:

Sieve Tube
Companion Cells
Phloem Fibres
Phloem Parenchyma

Sieve Tube Elements: Structure: Sieve tube elements, akin to vessels, are composed of multiple cells known as sieve tube elements or sieve tube members.
- Arrangement: These elements, forming the sieve tubes, are elongated tube-like structures arranged longitudinally, stacked one above the other in distinctive linear rows.
- Cell Wall Composition: Sieve tube elements are living structures with thin cellulosic walls, albeit thicker than the surrounding parenchyma cells.

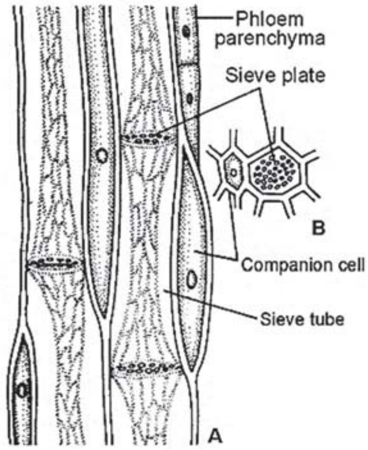


Fig. : Parts of phloem :
A. L.S. of phloem tissue, **B.** T.S. of phloem tissue

- Cytoplasm and Vacuole: A mature sieve tube element features peripheral cytoplasm and a large central vacuole, lacking a nucleus. The cytoplasm forms a thin, living layer along the inner side of the cell walls.
- End Walls and Sieve Plates: The end walls of sieve tube elements are termed sieve plates, typically oblique in shape. Sieve plates are characterized by numerous sieve pores, facilitating the movement of food materials between adjacent elements. The sieve plates' perforations give them a sieve-like appearance.
- Association with Companion Cells: Sieve tube elements are closely associated with companion cells, another essential element of phloem. As mature sieve tube elements lack nuclei, the functions of these elements are regulated by the nuclei of companion cells, which are found in close proximity. Both sieve tube and companion cells share an ontogenetic relationship, earning them the designation of sister cells.
- Protophloem and Metaphloem Distinction: Protophloem comprises narrower sieve tubes, while metaphloem features larger sieve tubes.

Occurrence:
Sieve tubes are absent in pteridophytes and gymnosperms. Instead, these plants have sieve cells, which lack distinct linear arrangements. Sieve cells also possess sieve plates, located on lateral or side walls rather than end plates. Unlike the specialized sieve tubes of angiosperms, sieve cells are less specialized.
Functions:
Sieve tube elements serve as the conduits for transporting food in plants. Synthesized food moves through sieve tube elements, forming a continuous channel for translocation.

Companion Cells: Structure: Companion cells are specialized parenchymatous cells closely associated with sieve tube elements, earning them the name companion cells.

- These cells are elongated, narrow, and possess thin walls, usually attaching to the lateral sides of sieve tube elements.
- The shared wall between sieve tube elements and companion cells is typically thin and contains pit fields—areas of significantly reduced wall thickness resembling holes. Pit fields are located between the common longitudinal walls of sieve tube elements and companion cells, facilitating material transfer. Thus, pit fields establish close cytoplasmic connections between sieve tube elements and companion cells.
- Unlike sieve tube elements, companion cells retain a nucleus throughout their lifespan, making them living cells.

Occurrence:
Companion cells are exclusive to angiosperms; gymnosperms and pteridophytes lack these cells. Gymnosperms feature albuminous cells in lieu of companion cells, with albuminous cells associated with sieve cells.
Functions:
Companion cells play a crucial role in maintaining the pressure gradient within sieve tubes. The pressure gradient, defined as the difference in pressure determining fluid flow direction, is regulated by companion cells.

Phloem Fibres:
- Also known as bast fibres, phloem fibres are a type of sclerenchymatous fibres.
- These fibres are elongated and lack branches, maintaining an unbranched structure.

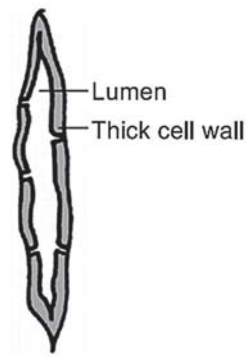


Fig. : A fibre

- Featuring pointed, needle-like apices, phloem fibres exhibit a distinctive morphology.
- The thick cell wall of phloem fibres imparts mechanical support to the plant.
- Upon reaching maturity, these fibres undergo the loss of protoplasm, rendering them dead

Occurrence:
Phloem fibres are generally absent in primary phloem but are prevalent in secondary phloem.
Functions:
The primary function of phloem fibres is to provide mechanical support to the plant structure.
Commercial Use:
Phloem fibres, particularly those derived from jute, flax, and hemp, are commercially utilized for various purposes.

Phloem Parenchyma: Comprising living parenchymatous cells, phloem parenchyma is characterized by elongated cells with tapering ends, exhibiting a cylindrical shape.
- These cells possess dense cytoplasm and a prominent nucleus, indicative of their living nature.
- The cell walls of phloem parenchyma cells consist of cellulose and feature pits that facilitate intercellular connections in the common walls. Plasmodesmata, microscopic channels formed by these pits, establish connections between adjacent phloem parenchyma cells.

Occurrence:
Phloem parenchyma is present in both primary and secondary phloem. Notably, it is absent in the majority of monocotyledons.
Functions:
- The primary function of phloem parenchyma cells is to store the food synthesized by cells engaged in photosynthesis, contributing to the transport of food.

- Additionally, these cells serve as storage sites for various organic materials such as resins, tannins, mucilage (a thick gluey substance), and latex (milky fluid). These materials are often observed exuding from plants, with their entry into phloem parenchyma cells facilitated by pitted cell walls.