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S.5 BIOLOGY

PLANT TISSUES

Plant tissues can be divided into two groups:

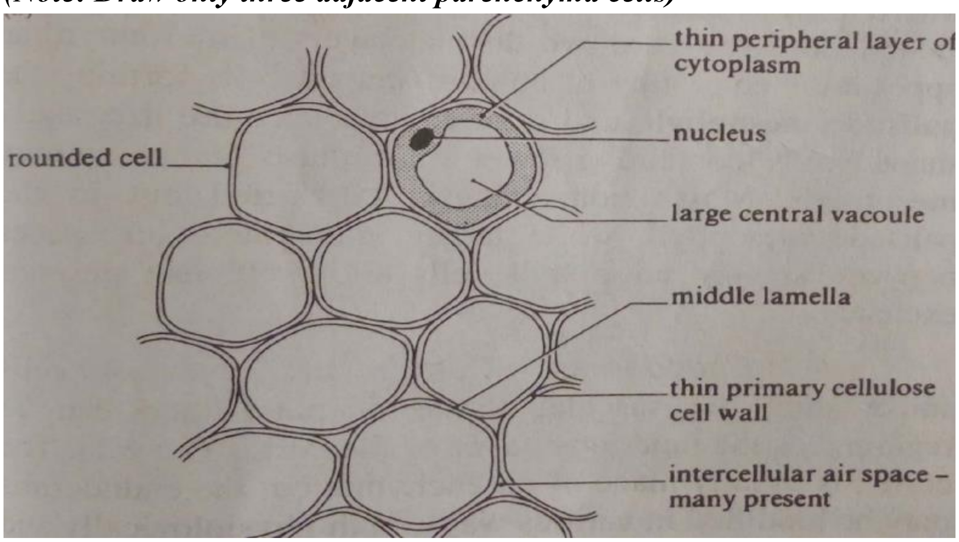
1. **Simple tissues**-These have one type of cells. They include
   - *(i) Parenchyma*
   - *(ii) Collenchyma*
   - *(iii) Sclerenchyma*
2. **Complex/compound tissues**- These have more than one type of cell. They include
   - *(i) Xylem*
   - *(ii) Phloem*

Simple plant tissues (tissues consisting of one type of cell)

(i) Parenchyma

Consists of living cells that are roughly spherical (rounded), though may be elongated; with thin primary cell walls, large central vacuole filled with cell sap and thin peripheral layer of cytoplasm. The cell wall is made of cellulose, pectins and hemicelluloses. The cells are loosely packed leaving intercellular air spaces.

(Note: Draw only three adjacent parenchyma cells)



Functions of parenchyma and distribution

- The cells are unspecialized and act as packing tissue between more specialized tissue, as in the central pith of stems and outer cortex of stems and roots. They form a large bulk of the young plant.
- The osmotic properties of parenchyma cells are important because when turgid, they become tightly packed and provide support for the organs in which they are found. This is

particularly important in the stems of herbaceous plants where they form the main means of support. During periods of water shortage the cells of such plants lose water and this result in plants wilting.

- The cells are metabolically active and are the sites of many of the vital activities of the plant body e.g. photosynthesis.
- Air spaces around the parenchyma cells allow exchange of gases to take place. Oxygen for respiration and carbon dioxide for photosynthesis can diffuse through the spaces.
- Parenchyma cells are often sites of food storage, most notably in organs such as potato tubers where the parenchyma cortex stores starch. In some rare cases, parenchyma cells store food in thickened cell walls e.g. hemicelluloses and date seed endosperm.
- The walls of parenchyma cells are important pathways of water and mineral salt transport through the plant (part of the 'apoplast pathway'). Substances may also move through plasmodesmata between neighbouring cells.

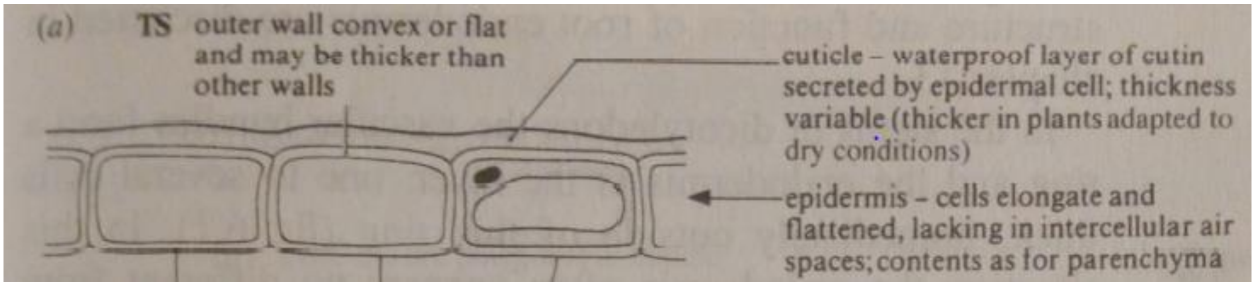
Assignment 1: *Describe how parenchyma tissue is adapted to its function*

Parenchyma cells may become modified and more specialized in certain parts of the plant. Some examples of tissues that can be regarded as modified parenchyma are

(i) *Epidermis*
(ii) *Pericycle*
(iii) *Mesophyll*
(iv) *Companion cells*
(v) *Endodermis*

(a) EPIDERMIS

This is the layer, one cell thick that covers the whole of the primary plant body.
Its basic function is to protect the plant from desiccation and infection.
The epidermal cells are living, elongated and flattened, lacking in intercellular air spaces, contain central vacuole, cytoplasm and nucleus. Their cell wall contains cellulsose, pectins and hemicelluloses and covering of cutin. Cutin is a water proof waxy substance secreted by the epidermal cells and forms a layer of variable thickness called **cuticle** within and on the outer surface of the cell walls. The waxy cuticle reduces water loss by evaporation from the plant surfaces and prevents the entry of pathogens.
The epidermis contains specialized epidermal cells called **guard cells** which occur in pairs side by side, with a pore between them called a **stoma**. Guard cells have a distinctive shape and are the only epidermal cells that contain chloroplasts, the rest being colourless.
The size of the stomata is adjusted by the turgidity of the guard cells. The stomata allow gaseous exchange to occur during photosynthesis and for respiration and are most numerous in the leaf epidermis, though they are also found in the stem. The stomata also allow escape of water vapour by transpiration.



Sometimes the epidermal cells grow hair like extensions which may be unicellular or multicellular and serve a wide variety of functions i.e.

- ❖ In roots, unicellular hairs grow from a region just behind the root tip and increases surface area for absorption of water and mineral salts.
- ❖ In climbing trees, hooked hairs often occur and function to prevent the stems from slipping from their support.
- ❖ Epidermal hairs offer an additional protective feature. They assist the cuticle in reducing water loss by trapping a layer of moist air next to the plant, as well as reflecting radiation.
- ❖ Some hairs are water absorbing, notably xerophytic plants (plants adapted for dry conditions).
- ❖ May have mechanical protective function as with short, stiff bristles.
- ❖ Hairs may form barriers around the nectarines of flowers preventing access to crawling insects and helping to promote cross-pollination by larger flying insects.
- ❖ Glandular cells are also common feature of epidermis and these may be hair-like. They secret sticky substances that may trap and kill insects, either for protection or if the secretion contain enzymes, for digestion and subsequent absorption of food. Such plants may be regarded as carnivorous.
- ❖ Glandular hairs are sometimes responsible for the scents given off by plants, such as on leaves of lavender.

Note:

1. The epidermal cells of dicotyledonous leaves are irregularly arranged and often with wavy margins while those of monocotyledons tend to be more regular and rectangular in shape (as the leaf surfaces are examined in light microscope)
2. During secondary growth the epidermis may be ruptured and replaced by cork layer.

Adaptations to functions

- *Consists of elongated epidermal cells that are closely packed covering whole primary plant body to offer protection.*
- *The outer surface of epidermal cells is covered with thick waxy cuticle which reduces water loss by evaporation and prevents entry of pathogens.*
- *Epidermis of leaves have many stomata which allow efficient gaseous exchange to occur.*
- *Contain guard cells that occur sided by side in pairs which control the opening and closing of stomata.*
- *Epidermal cells may grow hair-like extensions specialized for a wide variety of functions e.g.*
  - ❖ *Slender numerous root hairs increases surface area for absorption of water and mineral*

salts

- ❖ *Hooked hairs in climbing trees prevent the stem from slipping from their support.*
- ❖ *Epidermal hairs assist the cuticle in reducing water loss by trapping a layer of moist air. The layer of moist air also helps to reflect radiation.*
- ❖ *Some epidermal airs absorbs water as in xerophytes*
- ❖ *Epidermal hairs may form a barrier around the nectarines of flowers preventing access to crawling insects. This helps to promote cross-pollination by larger flying insects.*

- *Epidermis may contain glandular cells which secrete sticky substances that help to trap insects either for protection or digestion and absorption if the secretion contain enzymes (carnivorous plants)*

(b) Mesophyll

This is the packing tissue found between the two epidermal layers of the leaves and consists of parenchyma modifies to carry out photosynthesis. Photosynthetic parenchyma is sometimes called **chlorenchyma**. The cytoplasm of such cells contains numerous chloroplasts where the reactions of photosynthesis occur.

In cotyledons, there are two distinct layers of mesophyll:

1. **The palisade mesophyll**- This is the upper layer consisting of column-shaped (palisade) cells, with numerous chloroplasts in a thin layer of cytoplasm. Most photosynthesis is carried out in the palisade (main photosynthetic tissue).
2. **Spongy mesophyll**- This is the lower layer made up of more irregularly shaped cells (spongy cells), containing fewer chloroplasts and loosely packed leaving large air spaces. The large air spaces between the spongy cells allow efficient gaseous exchange (main gaseous exchange tissue).

Adaptations

- *Palisade mesophyll cells contain numerous chloroplasts which maximize light absorption and photosynthetic reactions.*
- *The palisade mesophyll cells are column-shaped and are arranged with their long axes perpendicular to the surface forming a continuous layer which trap most of incoming light.*
- *The chloroplasts in the column-shaped palisade cells are strategically positioned to prevent overlapping maximizing light absorption.*
- *Chloroplasts within the mesophyll cells may move towards light for maximum absorption.*
- *The cells of spongy mesophyll are irregularly shaped and fit together loosely leaving larger intercellular air spaces between them. These spaces allow efficient gaseous exchange.*

(c) Endodermis

This is the layer of cells surrounding the vascular tissue of plants (inner most layer of the cortex). The endodermal cells are living, elongated and flattened, their cell wall contains cellulose, pectins and hemicelluloses and deposits of suberin.

Endodermis is more conspicuous in roots, where it is one cell thick, than in stems because in roots each cell develops **a casparian strip**, a band of suberin (a fatty substance) that runs around the cell.

In the stems of dicotyledons, the endodermis is the layer, one to several cells thick immediately outside the ring of the vascular bundle where it appears no different from the rest of the cortex, but may store starch grains and form a starch sheath which becomes visible when stained with iodine solution. These starch grains may sediment inside the cells in response to gravity, making the endodermis important in the geotropic response in the way as root cap cells.

Functions of endodermis:

- ❖ Selective barrier to movement of water and mineral salts (between cortex and xylem) in roots due to presence of casparian strip around the endodermal cells.
- ❖ Starch sheath with possible role in gravity response in stems

Adaptations

- *Each cell of endodermis of roots has a band of suberin which is water proof running around its cell wall (casparian strip). Suberin prevents water and solutes (mainly salts) to pass through cell wall of endodermal cells and therefore must pass through cell surface membrane into living cytoplasm of endodermal cells and this can control and regulate the movement of solutes through to the xylem.*

  Note: This regulation is a protective measure against entry of toxic substances, harmful disease-causing organisms, fungi e.t.c.
- *Endodermal cells of stems contain starch grains which may sediment inside the cells in response to gravity bringing about geotropic response.*

(d) Pericycle

Roots possess a layer of parenchyma, one to several cells thick, called pericycle, between the central vascular tissue and the endodermis.

Functions of pericyle:

- ❖ It retains the capacity for cell division and produces lateral roots.
- ❖ It also contributes to secondary growth if this occurs.

Note: In stems there is usually no equivalent layer to pericycle.

(e) Companion cells

These are specialized parenchyma cells found adjacent to sieve tubes and are vital for functioning of the sieve tubes. They are very active metabolically and have a denser cytoplasm with smaller vacuoles than normal parenchyma cells. They also have large number of mitochondria and ribosomes. There are numerous plasmodesmata between the companion cells and the sieve tube elements.

Adaptations:

- ❖ The companion cells have large number of mitochondria to produce much ATP for active loading and unloading of the sieve tubes.
- ❖ The companion cells have dense cytoplasm with small vacuole and are very active

metabolically to sustain functioning of sieve tubes in translocation of food materials.

- ❖ The companion cells have numerous plasmodesmata for communication with sieve tube elements.

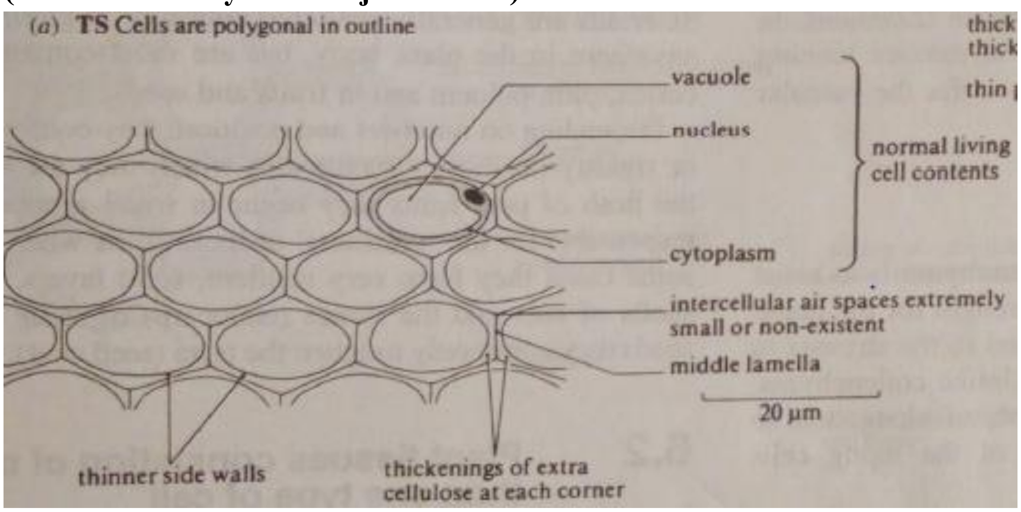
(ii) Collenchyma

Collenchyma consists like parenchyma of living cells but is modified to give support and mechanical strength.

Structure:

Consists of collenchyma cells that are living, elongated and polygonal with tapering ends, their cell wall is made up of cellulose, pectins and hemicelluloses. Unlike parenchyma, the collenchyma cells are characterized by the deposition of extra cellulose at the corners of the cells. The deposition occurs after the formation of the primary cell wall. The cells also elongate parallel to the longitudinal axis of the organ in which they are found. The intercellular air spaces extremely small or non-extent. The cells have the normal living cell contents-the cytoplasm, nucleus and vacuole.

(Note: Draw only three adjacent cells)



Function and distribution

- ❖ Collenchyma is a mechanical tissue and provides support for organs in which it is found. It is particularly important in young plants, herbaceous plants and in organs such as leaves where secondary growth does not occur. In these situations, it is an important strengthening tissue supplementing the effects of turgid parenchyma.
- ❖ It is the first of the strengthening tissues to develop in the primary plant body and, because it is living, can grow and stretch without imposing limitations on the growth of other cells around it.
- ❖ In stems and petioles, its value in support is increased by its location towards the peripheral of the organ. It is often found just below the epidermis in the outer region of the cortex and gradually merges into parenchyma towards the inside, thus forming a hollow cylinder in three dimensions. Alternatively, it may form strengthening ridges, as along the fleshy petioles

of celery and the angular stems of plants such as dead-nettle.

❖ In dicotyledonous leaves it appears as solid masses running the length of the midrib, providing support for the vascular bundles.

Assignment 2: *Describe how collenchyma is adapted to its function*

(iii) Sclerenchyma

The function of sclerenchyma is to assist in providing support and mechanical strength for the plant.

Its distribution within the plant is related to the stresses to which different organs are subjected. Unlike collenchyma, the mature cells are dead and incapable of elongation so they develop in organs when their growth in length is completed (do not mature until elongation of living cells around them is complete).

Structure

There are two types of sclerenchyma cells, namely **fibres** and **sclereids**.

The fibres are long, narrow and pointed cells while sclereids or stone cells are shorter, circular (roughly spherical) or more irregularly shaped cells. However, both types of cells vary considerably in size and shape.

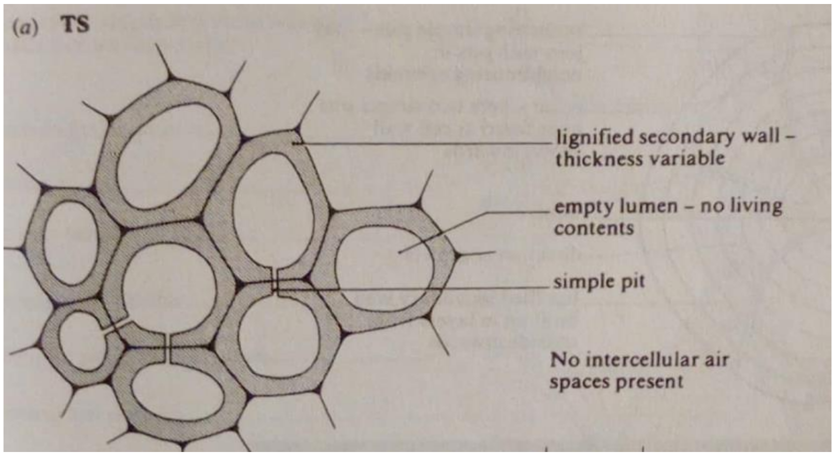
In both, the primary wall is heavily thickened with deposition of **lignin**, a hard substance with great tensile and compressional strength. High tensile strength resist breaking on stretching and high compressional forces resist buckling.

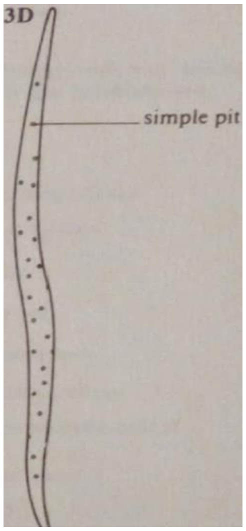
Deposition of lignin takes place in and on the primary cellulose cell wall and, as the walls become thickened and impermeable; cutting off nutrients, the living contents of the cells are lost with the result that mature cells are dead.

In both fibres and sclereids structures called **simple pits** appear in the walls as they thicken. These represent areas where lignin is not deposited (unlignified areas) on the primary wall owing to the presence of groups of plasmodesmata (strands of cytoplasm that connect neighbouring cells through minute pores in the adjacent cell walls).

Each group of plasmodesmata forms one pit. The pits are described as simple because they are tubes of constant width

(Draw 3 adjacent cells)





Function and distribution of fibres

Provide **support** and **mechanical strength** in areas where they are found.

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. In addition, the ends of the fibres interlock with one another, increasing their combined strength.

Fibres are found in the pericycle of the stems, forming a solid rod of tissues 'capping' the vascular bundles of dicotyledons.

They often form a layer in the cortex below the epidermis of stems or roots producing a hollow cylinder of supporting tissue that contains the rest of the cortex and vascular tissues. Fibres also occur in both xylem and phloem, either individually or in groups.

Function and distribution of sclereids

Sclereids are generally scattered singly or in groups almost anywhere in the plant body, but are most common in the cortex, pith, and phloem and in fruits and seeds.

Depending on numbers and position, they confer firmness 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 the seeds they commonly toughen the testa (seed coat).

Assignment 3: ***Describe how sclerenchyma is adapted to its function.***

Compound plant tissues

(Plant tissues consisting of more than one type of cell)

There are two types of tissues consisting of more than one type of cell: namely **xylem** and **phloem**. Both are conducting tissues in plants and together they constitute the vascular tissue.

Xylem conducts water and mineral salts from roots up to other parts of the plant, while phloem conducts organic food from the leaves both up and down the plant.

Both tissues may be increased in amount as a result of secondary growth.

Secondary xylem may become extensive, where it is known as wood.

(i) Xylem

Xylem has two major functions:

1. Conduction of water and mineral salt and
2. Support.

Thus, it has both physiological and structural role in the plant

The xylem consists of **four** types of cells, namely tracheids, vessel elements, parenchyma and fibres.

The tracheid and vessel elements are dead when mature and are the conducting cells of the xylem tissue.

(a) Tracheids

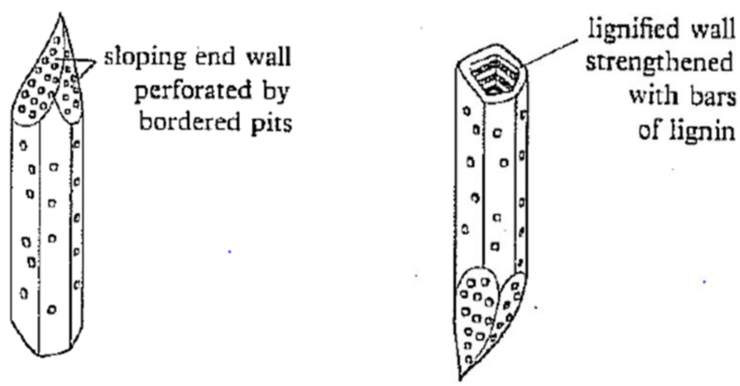
Tracheids are single cells that are elongated; five or six sided in cross section and their walls are lignified. They are dead with empty lumens when mature. The lignified side walls have pits to allow lateral movement of materials. They have tapering end walls that overlap with adjacent tracheids. Thus they have mechanical strength and give support to the plant. Their tapering end walls are perforated with pits for continuous flow of water from one tracheid to the next.

Tracheids represent the original, primitive water conducting cells of vascular plants and are the only cells found in the xylem of the more ancestral vascular plants. Conifers rely exclusively on tracheids to conduct water from the roots to the aerial parts.

They have given rise to xylem fibres and vessel in other plants mainly the angiosperms.

The pattern of lignifications of tracheids resembles that of the xylem vessels (to be described).

Structure of tracheid



Note: *Flowering plants (angiosperms) have relatively fewer tracheids than vessels, and vessels are thought to be more effective transporting structures possibly necessary owing to the larger leaves and high transpiration rates of this group.*

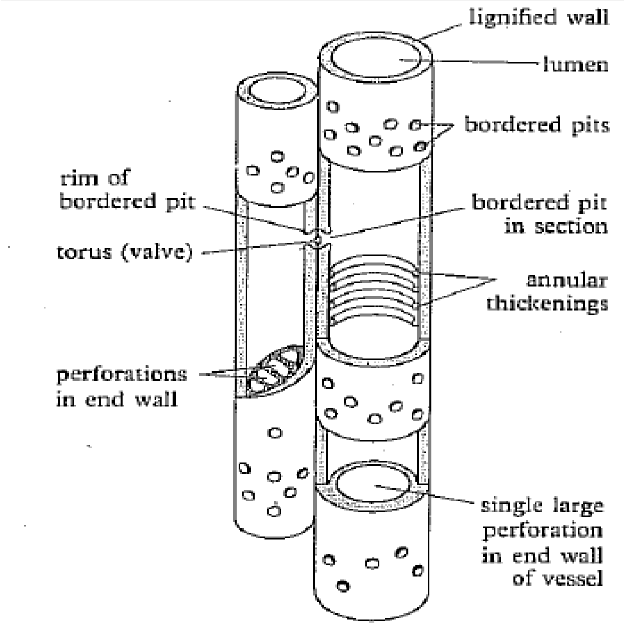
(b) Xylem Vessels

Vessels are the characteristic conducting units of angiosperm xylem.

They are very long, tubular formed by fusion of several cells end to end in a row. Each of the cells forming a vessel is equivalent to tracheid called vessel element. However, vessel elements are shorter and wider than the tracheids.

The first xylem to appear in the growing plant is called primary xylem and develops in the root and shoots apices.

Structure of a vessel

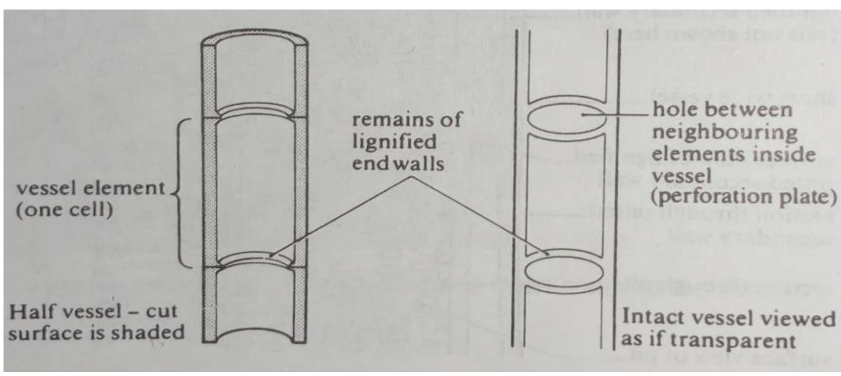


Formation of xylem vessels

The xylem vessel is formed from a chain of elongated, cylindrical cells placed end to end. These cells known as vessel elements develop from procambial strands, on the inner side of the strand in the developing region of the plant.

In the course of development, the horizontal end walls breakdown partially or completely so that the cells are in open communication. A series of rims is left around the inner side of the vessel making the remains of the end walls.

Fusion of vessel elements to form a vessel

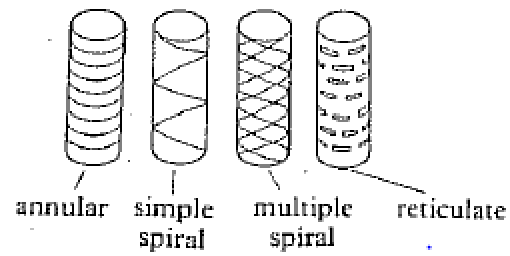


At the same time, the cellulose side walls become impregnated with lignin rendering them impermeable to water and solutes. Unable to absorb nutrients, the protoplasmic contents of the cells die, leaving a hollow tube, the vessel.

Its lignified walls are perforated by numerous pits where lignin fails to be deposited and only the primary cell wall remains. These pits permit the passage of water in and out of lumen. Frequently, the pits are bordered by a lignified rim. In conifers, bordered pits contain a torus, a kind of plug which may play some part in controlling the passage of water.

As the cells develop, lignified ribs of various kinds are laid down on the immediate inside of the walls. These give the vessel added strength and prevent its walls from caving in/collapsing during transport of water.

Different types of thickening found in vessels



Question: *Describe the structure of xylem vessel*

Protoxylem and metaxylem

The first vessels form protoxylem, located in the part of the apex, just behind the apical meristems where elongation of surrounding cells is still occurring. Mature protoxylem vessels can stretch as surrounding cells elongate because lignin is not deposited over the entire cellulose wall, but only in rings (annular thickening) or in spiral (spiral thickening). These act as reinforcement for the tubes during elongation of the stem or root.

As growth proceeds, more xylem vessels develop and these undergo more extensive lignification, completing their development in the mature regions of the organ and forming metaxylem. Meanwhile, the earliest protoxylem vessels have stretched and collapsed. Mature metaxylem cannot stretch or grow because they are dead, rigid, fully lignified tubes. If they developed before the living cells around them had finished elongating they would impose severe restraints on elongation.

Metaxylem vessels show three basic patterns of lignifications namely scalariform, reticulate and pitted.

Assignment: Compare tracheids and xylem vessels

Xylem parenchyma

Xylem parenchyma occurs in both primary and secondary xylem but is more extensive in the latter.

It has thin cell walls and living contents as is typical of parenchyma.

There are two systems of parenchyma that exist in secondary xylem, derived from meristematic cells called ray initials and fusiform initials (Details ref to growth and dev't).

The ray initials give rise to the ray parenchyma which is the more extensive. It forms radial sheets of tissue called **medullary rays** which contain a living link through the wood between the pith and cortex.

Its functions include: *food storage, deposition of tannins, crystals etc, radial transport of food and water, and gaseous exchange through the intercellular spaces.*

The fusiform initials normally give rise to xylem vessels or phloem sieve tubes and companion cells, but occasionally they give rise to parenchyma cells. These form vertical rows of parenchyma in the secondary xylem.

Xylem fibres

Xylem fibres like xylem vessels are thought to have originated from tracheids. They are shorter and narrower than tracheids and have much thicker walls, but they have pits similar to those in tracheids.

Xylem fibres closely resemble the sclerenchyma fibres, having overlapping end walls. Since they do not conduct water they can have much thicker walls and narrower lumens than xylem vessels and are therefore stronger and confer additional mechanical strength to the xylem.

Adaptations of xylem tissue to its functions

(i) Transport (as a vascular tissue)

- Both vessels and tracheids consist of long cells joined end to end. This allows water to flow in a continuous column.
- The end walls of xylem vessels have broken down to give an uninterrupted flow of water from roots to the leaves. Even in tracheids where end walls are present, large bordered pits reduce the resistance to flow caused by the presence of these walls.
- There are pits at points in the lignified wall which permit lateral flow of water where this is necessary.
- The walls are impregnated with lignin, making them especially rigid to prevent them collapsing under large tension forces set up by transpiration pull.
- The impregnation of cellulose wall with lignin increases the adhesion of water molecules and helps the water to rise by capillarity.
- The narrowness of lumen of vessels and tracheids increases the capillary force

(ii) Support

- The walls of xylem vessels and tracheid are lignified which increases mechanical strength for support.
- The tapering end walls of tracheids interlock with one another increasing mechanical strength.
- Xylem Sclerenchyma fibres have thick walls impregnated with lignin making them strong, and their end walls overlap with one another conferring additional strength.

Distribution and function

- In the primary plant body the distribution of xylem in the roots is central, helping to withstand the tugging strains of the aerial parts as they bend or lean over.
- In the stems, the vascular bundles are arranged either peripherally in a ring as in dicotyledons, or scattered as in monocotyledons so that in both cases separate rods of xylem run through the stem and provide some support.
- In leaves, they run along the solid midrib and veins where they provide some support

Where secondary growth occurs, extensive growth of secondary xylem occurs producing wood which support large structures of trees and shrubs, taking over from collenchyma and sclerenchyma as the chief mechanical tissue. The nature and extent of the thickness is modified to some extent by the stresses received by the growing plant, so that reinforcement growth can occur and give maximum support.

(ii) Phloem

Like xylem, phloem possesses tubular structures modified for translocation. However, the tubes are composed of living cells with cytoplasm and have no mechanical function.

There are **five** types of cells in the phloem: namely *sieve tube elements, companion cells, parenchyma, fibres and sclereids.*

(a) Sieve tubes and companion cells

Sieve tubes are the long tube-like structures that translocate solutions of organic solutes like sucrose through the plant.

They are formed by the end-to-end fusion of cells called **sieve tube elements**.

Rows of sieve tube elements develop from the procambial strands of apical meristems where primary phloem develops, together with primary xylem in vascular bundles.

The first phloem formed is called **protophloem** and like protoxylem, it is produced in the zone of elongation of the growing root or stem. As the tissue around it grow and elongate, it becomes stretched and much of it eventually collapses and becomes non-functional. However, more phloem continues to be produced and the phloem that matures after elongation has ceased is called **metaphloem**.

Structure of sieve tubes and companion cell

Sieve tubes consist of narrow, tubular elongated cells. These cells known as **sieve tube elements** are joined end to end to form a system of tubes that run throughout the plant. Each element is separated from the next by end walls called **sieve plates** which are perforated by pores to allow the flow of liquids from one element to the next.

Each sieve tube cell loses its nucleus at maturity making it an unusual example of living cell with no nucleus (just like the red blood cells). It also loses other important cell organelles like Golgi apparatus, ribosomes, tonoplast and most of its mitochondria. These disintegrate leaving a few cell organelles with little cytoplasm confined to a thin layer around the peripheral of the cell. The lateral cell walls become thickened by addition of cellulose and pectin substances. The inside of the sieve tube element contain fine **cytoplasmic filaments** which are continuous via the pores in the sieve plates, with similar filaments in the next sieve element. Since the sieve tube element lack nucleus yet it is living, it depends on the adjacent companion cells which develop from the same original meristmatic cell for metabolic activity. The two cells together form a functional unit, the companion cell is elongated and narrow, have thin cellulose cell wall, dense, very active cytoplasm, large nucleus, many mitochondria and ribosomes and other numerous cell organelles. Numerous plasmodesmata connect sieve element with companion cell.

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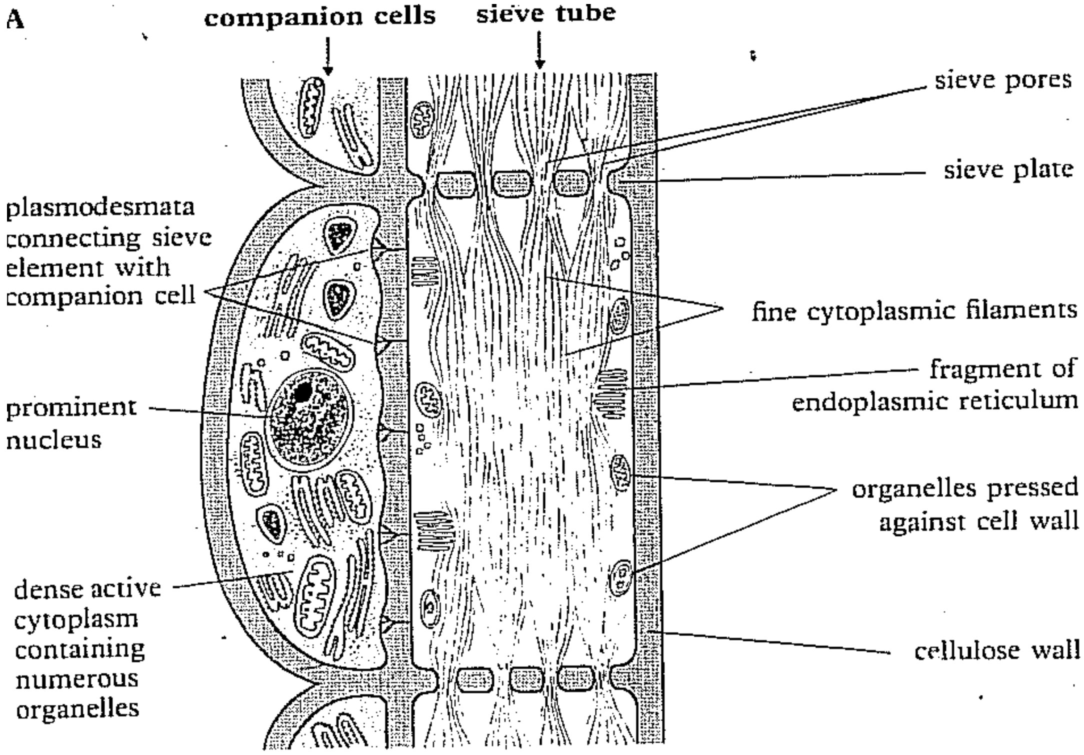

Note: Secondary phloem which develops from the vascular cambium appears similar in structure to primary phloem except that it is crossed by bands of lignified fibres and medullary rays of parenchyma. It is much less extensive than secondary xylem and is constantly being replaced

Phloem parenchyma, fibres and sclereids

Phloem parenchyma and fibres are found in dicotyledons but not in monocotyledons.

Phloem parenchyma has the same structure as parenchyma elsewhere, though the cells are generally elongated.

In secondary phloem, parenchyma occurs in medullary rays and vertical strands as already described for xylem parenchyma.

Phloem parenchyma and xylem parenchyma have the same functions.

Phloem fibres are exactly similar to the sclerenchyma fibres already described.

They occur occasionally in the primary phloem, but more frequently in the secondary phloem of dicotyledons. In secondary phloem they form vertically running bands of cells. Since the secondary phloem is subject to stretching as growth continues, the sclerenchyma help to resist this pressure. Sclereids occur frequently in phloem, especially in older phloem.

Adaptations of phloem to its function

- The sieve tubes are elongated, cylindrical cells connected end to end. Their end walls have sieve plates perforated with pores to allow continuous flow of materials.
- The sieve tubes have no nucleus and most of other cell organelles to create room for movement of materials.
- Within the lumen of the sieve elements are cytoplasmic filaments/strands which are continuous from cell to cell to enable continuous flow of materials.
- The companion cells have nuclei and other organelles. They control the flow of materials through the phloem sieve tubes.

Comparison between phloem and xylem tissues

Similarities

- Both have long tube-like structures
- In both, long tube-like structures consists of tubular cells placed end to end
- In both the cells of tube-like structures have no nucleus.
- Both tissues have parenchyma cells.
- Both tissues have sclerenchyma fibres.
- Both tissues transport materials in plants.
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Differences

Xylem	Phloem
1. Conducting cells (vessel elements and tracheids) are dead	Conducting cells (sieve tube elements) are living
2. End walls of the cells of tubular structures breakdown or are perforated	End walls of the cells of tubular structures have sieve plates
3. Has no companion cell	Has companion cell
4. Lignified	unlignified
5. Have bordered pits on the walls of tracheids and vessels	have no bordered pits
6. Cytoplasmic contents of vessels elements and tracheids lost forming hollow structure	sieve tube elements have some cytoplasmic content such as mitchondria and cytoplasmic filaments
7. Vessels and tracheids have wider lumen	Sieve tubes have narrower lumen
8. Transport water and mineral salts	Transport organic solutes
9. Provide support to plant	Does not support the plant

Question: *Compare the structure of xylem vessel and sieve tube*

Notes: All the tissues described above develop from structurally simplest plant tissues known as **meristematic tissue.**

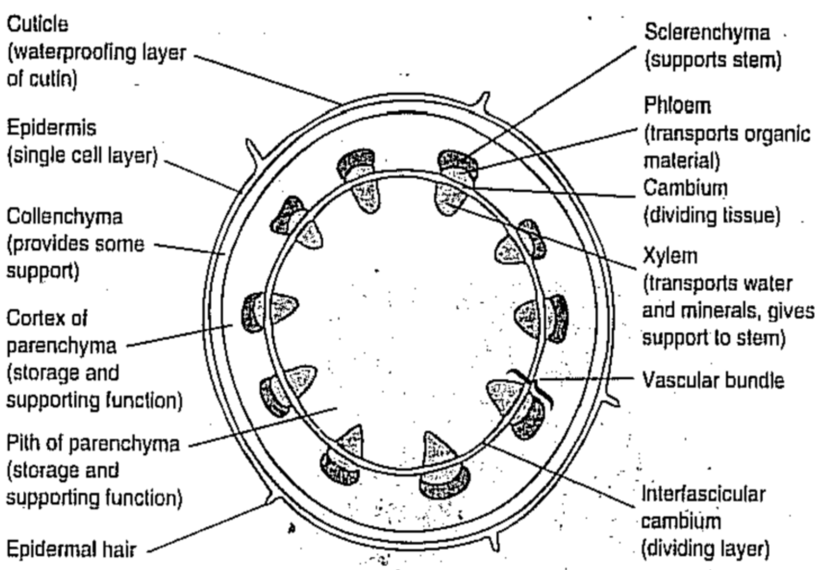
Meristematic tissue occurs at the apical growing points of a plant e.g. the tip of the stem and root.

The characteristics of **meristematic cells** include:

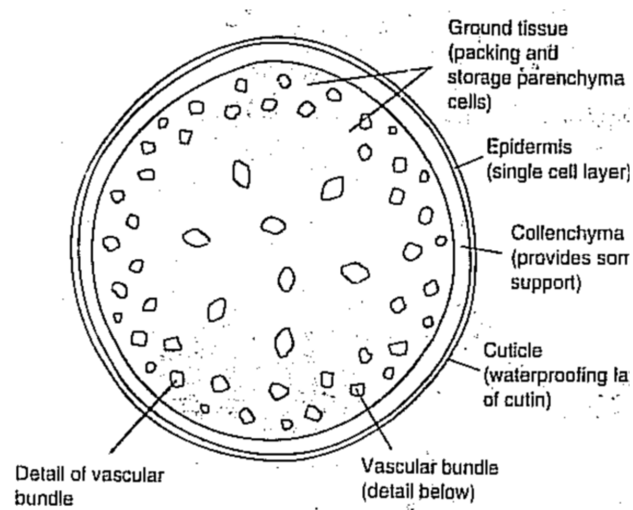
- Are small
- Thin walled
- Lack sap vacuole and chloroplasts
- Contain undifferentiated plastids whose membranes are the sites of intense synthetic activity
- They have the ability to divide and subsequently differentiate into specialized cells (their important feature)

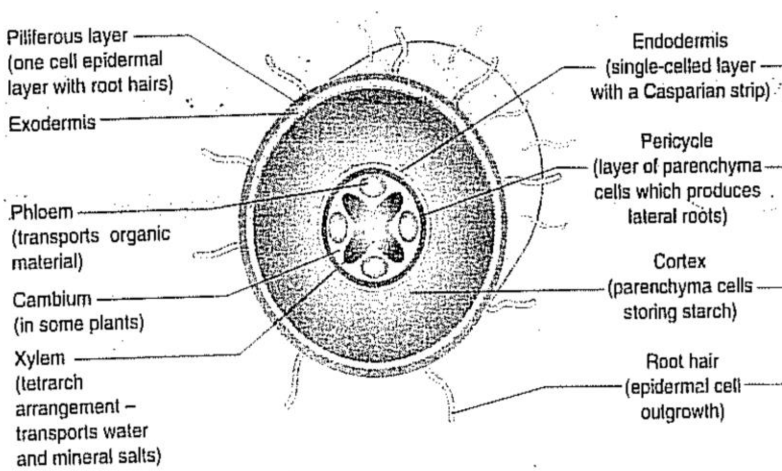
Transverse sections of stems and roots of dicot and monocots showing the distribution of the different plant tissues (please draw plans not pictures! Ref UB pages 455 & 462)

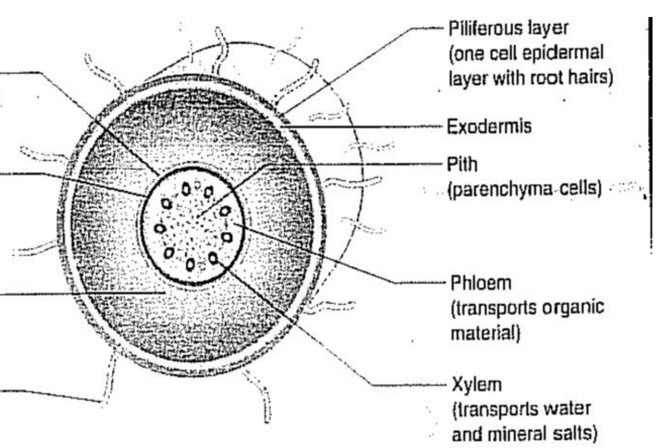
(a) Dicot stem



(b) Monocot stem







(c) **Dicot root** (d) **Monocot root**