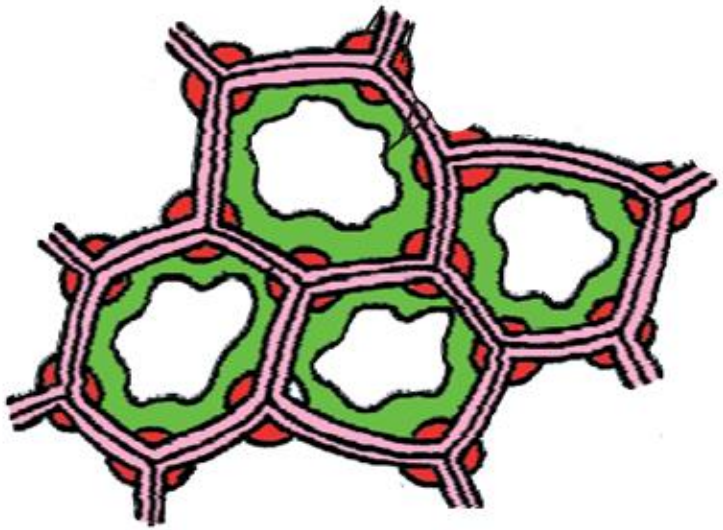
ANATOMY OF FLOWERING PLANTS



MERISTEMATIC AND PERMANENT TISSUES

Anatomy of Flowering Plants

Plant Tissues

Tissues

A group of cells having similar structure and performing similar function are called Tissues.

A plant is made up of different kinds of tissues.

Tissues are classified into two main groups, namely, Meristematic and Permanent tissues based on whether the cells being formed are capable of dividing or not.

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Meristematic Tissues

Depending on the region where the meristematic tissues are present, meristems are classified as apical, lateral and intercalary meristems.

Apical meristem:

The meristem which occurs at the tips of roots, shoots and produce primary tissues are called apical meristems and increases the length of the root and shoot.

Intercalary meristem:

The meristem which is located at the base of the leaves or internodes is called intercalary meristem. They occur in grasses and regenerate parts removed by the grazing herbivores.

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Lateral meristem:

The meristem which is located on the lateral side of the roots and shoots are called lateral meristem or cambium. The thickness of the stem or root increases due to lateral meristem (cambium).

They are cylindrical meristems. Fascicular vascular cambium, interfascicular cambium and cork-cambium are examples of lateral meristems.

They are responsible for producing the secondary tissues.

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Permanent Tissues

Permanent Tissues:
The tissues in which the cells have lost the ability to divide are called permanent tissues.

Simple Permanent Tissues:
The permanent tissues which are made of **only one kind of cells**, are called simple permanent tissues.

Complex Permanent Tissues:
The permanent tissues which are made of **different kinds of cells**, are called complex permanent tissues.

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Simple Tissues

The various simple tissues in plants are

Parenchyma, Collenchyma and Sclerenchyma.

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Parenchyma

Location:

Parenchyma cells are present in all parts of the plant. i.e. roots, stems, leaves, flowers and fruits.

Features:

The cells of the parenchyma are isodiametric.

They may be spherical, oval, round, polygonal or elongated in shape.

Their walls are **thin** and made up of **cellulose**.

They may either be closely packed or have **small intercellular spaces**.

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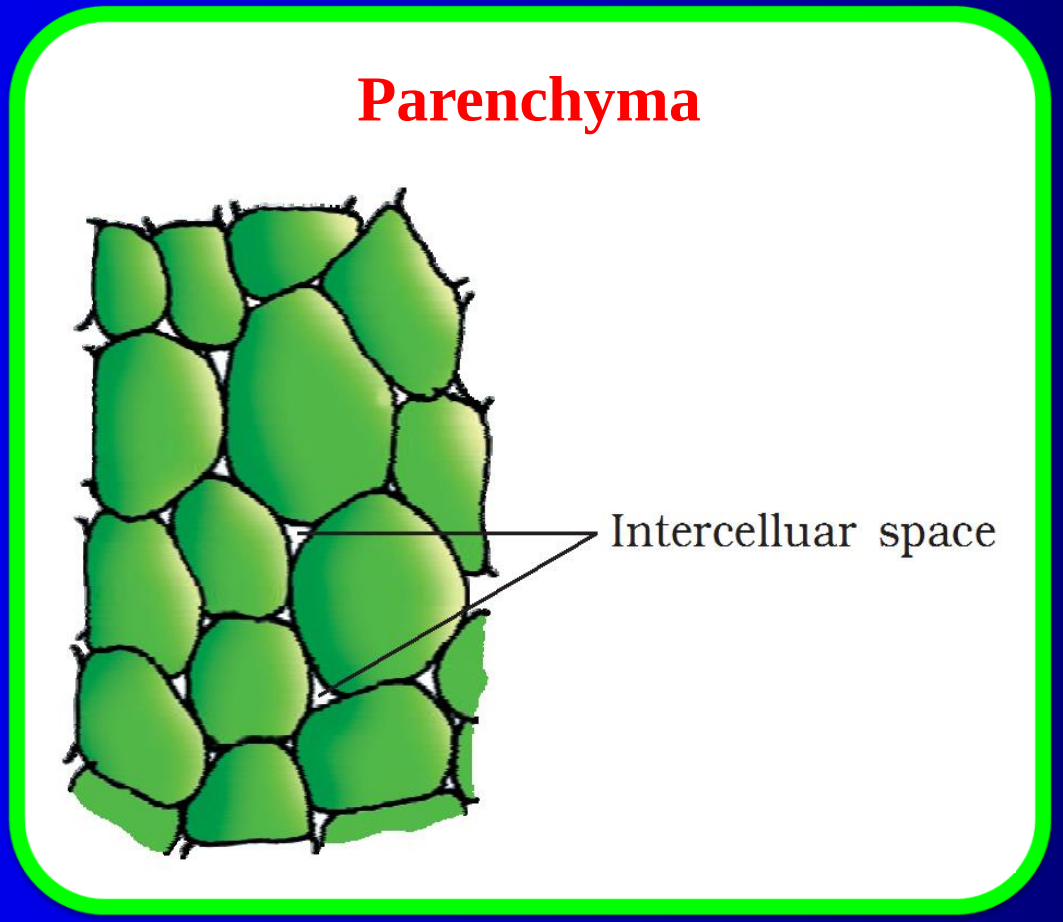
Parenchyma

Function:

The parenchyma performs functions like **photosynthesis, storage, secretion**.



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Collenchyma

Location:

Collenchyma occurs in layers below the epidermis in dicotyledonous plants.

Features:

The cells of collenchyma may be **oval, spherical or polygonal** and often contain chloroplasts.

The cell walls are **thickened at the corners** due to a deposition **of cellulose, hemicellulose and pectin.**

Intercellular spaces are absent.

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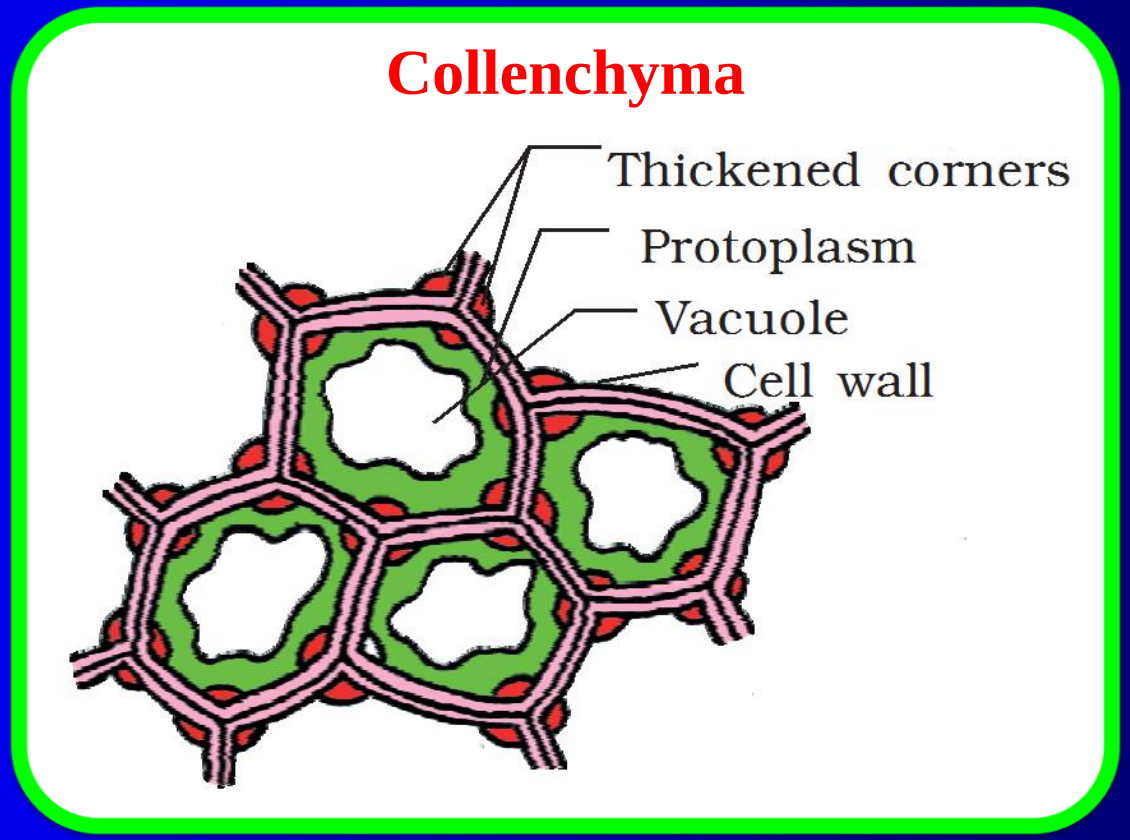
Functions of Collenchyma:

They provide elasticity and mechanical support to the growing parts of the plant such as young stem and petiole of a leaf.

They perform photosynthesis when they contain chloroplasts.



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Sclerenchyma

Location:

Sclerenchyma is present in the xylem and phloem of root, stem, leaves.

These are also found in the fruit walls of nuts; pulp of fruits like guava, pear and sapota; seed coats of legumes and leaves of tea.

Features:

The cells of this tissue are long, narrow **dead** without protoplasts.

The cell walls are uniformly thickened due to **lignin** and cell walls having a few or numerous pits.

The cells of this tissue are **long, narrow and dead** without protoplasts.

There is no intercellular space.

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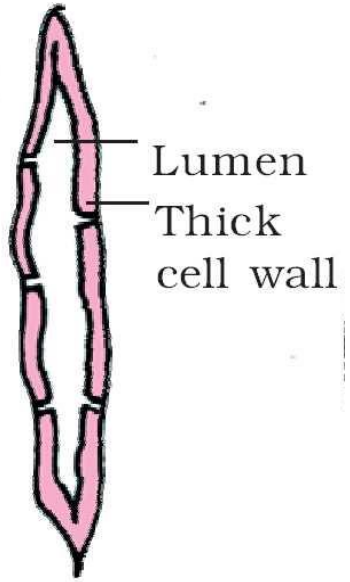
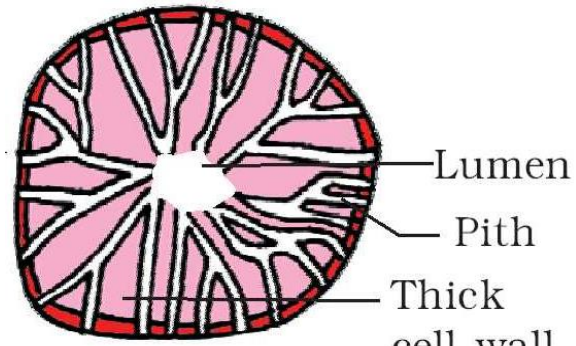
Fibres



Sclereids



On the basis of variation in form, structure, origin and development, sclerenchyma may be either **fibres or sclereids**.

The fibres are thick-walled, elongated and pointed cells found in various parts of the plant.

The sclereids are spherical, oval or cylindrical, highly thickened dead cells with very narrow cavities (lumen).

Function:

Sclerenchyma provides mechanical support to organs.

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The Tissue System

The Tissue System

On the basis of their structure and location, there are three types of tissue systems.

These are the epidermal tissue system, the ground or fundamental tissue system and the vascular or conducting tissue system.

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Epidermal Tissue System

Epidermal Tissue System

The epidermal tissue system forms the outer most covering of the whole plant body and comprises epidermal cells, stomata and the epidermal appendages the trichomes and hairs.

The epidermis is the outermost single layer of the primary plant body.

It is made up of elongated, compactly arranged cells, which form a continuous layer.

Epidermal cells are parenchymatous with a small amount of cytoplasm lining the cell wall and a large vacuole.

The outside of the epidermis is covered with a thick waxy layer called the cuticle which prevents the loss of water.

Cuticle is absent in roots.

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Stomata

Stomata are present in the epidermis of leaves.

Stomata regulate the process of transpiration and gaseous exchange.

Each stoma is composed of two bean shaped cells known as guard cells.

In grasses, the guard cells are dumb bell shaped.

The outer walls of guard cells (away from the stomatal pore) are thin and the inner walls (towards the stomatal pore) are highly thickened.

The guard cells possess chloroplasts and regulate the opening and closing of stomata.

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Subsidiary Cells

Sometimes, a few epidermal cells in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells.

The stomatal aperture, guard cells and the surrounding subsidiary cells are together called stomatal apparatus

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Root Epidermis

The cells of root epidermis bear a number of hairs.

The **root hairs** are unicellular elongations of the epidermal cells and help in absorbing water and minerals from the soil.

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Stem Epidermis

The epidermal hairs of the stem are called trichomes.

The trichomes in the shoot system are usually multicellular.

They may be branched or unbranched and soft or stiff.

They may even be secretory.

The trichomes help in preventing water loss due to transpiration.

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Ground Tissue System

Ground Tissue

All tissues except epidermis and vascular bundles form the ground tissue.

It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma.

Parenchymatous cells are usually present in cortex, pericycle, pith and medullary rays, in the primary stems and roots.

In leaves, the ground tissue consists of thin-walled chloroplast containing cells and is called mesophyll.

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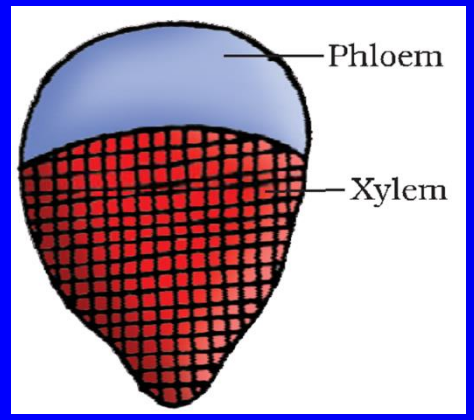
Vascular Tissue System

The Vascular Tissue System



It mainly comprises of complex permanent tissues - xylem and phloem. Cambium may or may not be present.

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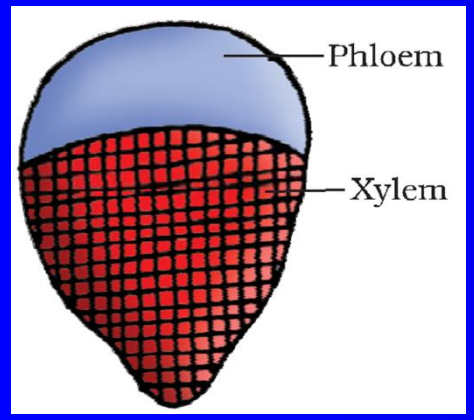
Conjoint Vascular Bundle



Xylem and phloem are arranged on the same radius of vascular bundle. Such types of vascular bundles are found in stems and leaves.

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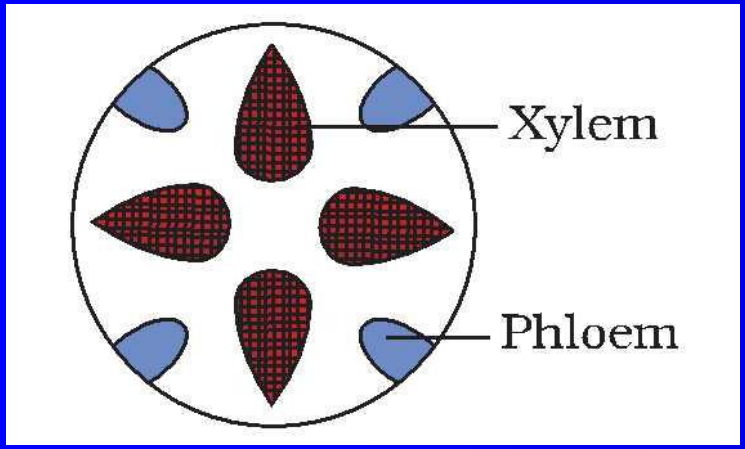
Radial Vascular Bundle



Xylem and phloem are arranged alternately on different radii. Such types of vascular bundles are present in roots.

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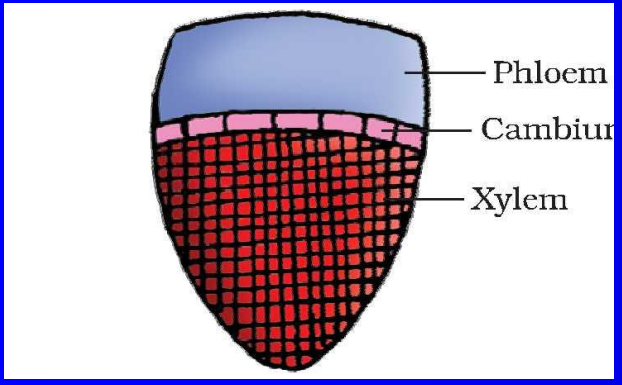
Open Vascular Bundle



It contains cambium between xylem and phloem.

Cambium has the ability to form secondary tissues.

It is the characteristic feature of dicotyledonous stem.

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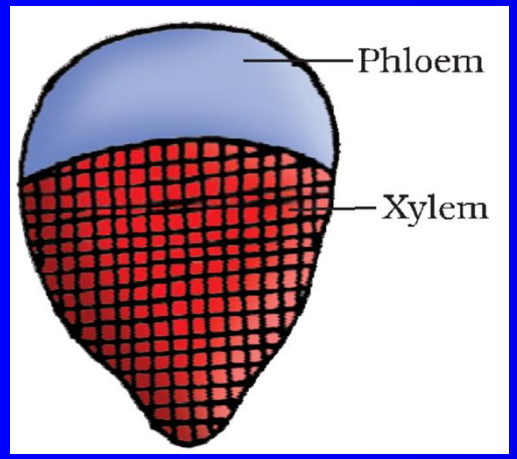
Closed Vascular Bundle



It lacks cambium between xylem and phloem.

Since cambium is absent, it is called closed vascular bundle. It lacks the ability to form secondary tissues.

Closed vascular bundle is the characteristic feature of monocotyledonous stems.

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Complex Tissues

Complex Tissues

The complex tissues are made of more than one type of cells and these work together as a unit.

Xylem and phloem constitute the complex tissues in plants

Xylem is a tissue which conducts water and minerals from roots to the stem and leaves.

It also provides mechanical support to the plant parts.

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Xylem

Xylem

Xylem is a tissue which conducts water and minerals from roots to various parts of the plant.

It also provides mechanical support to the plant parts.

It is composed of four different kinds of elements, namely, tracheids, vessels, xylem parenchyma and xylem fibres.

Gymnosperms lack vessels in their xylem.

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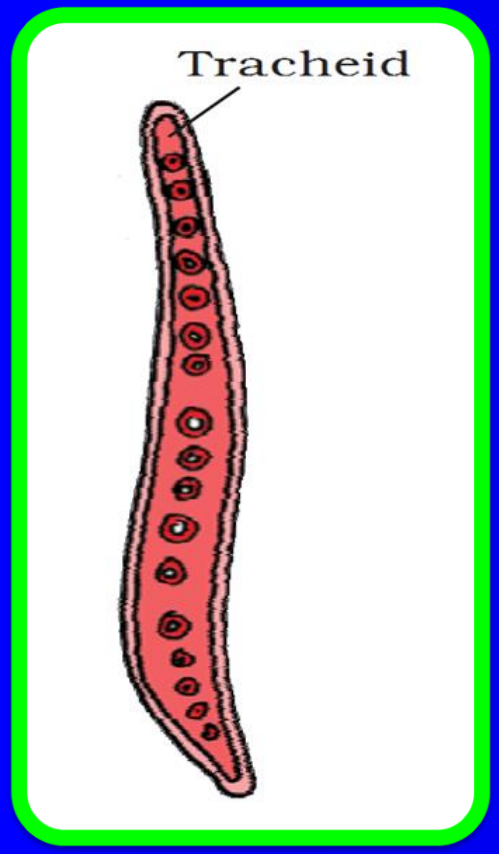
Tracheids



In flowering plants, tracheids and vessels are the main water transporting elements.

Tracheids:

Tracheids are elongated or tube like cells with thick and lignified walls and tapering ends.

These are **dead** and are **without protoplasm**.

The inner layers of the cell walls have thickenings which vary in form.

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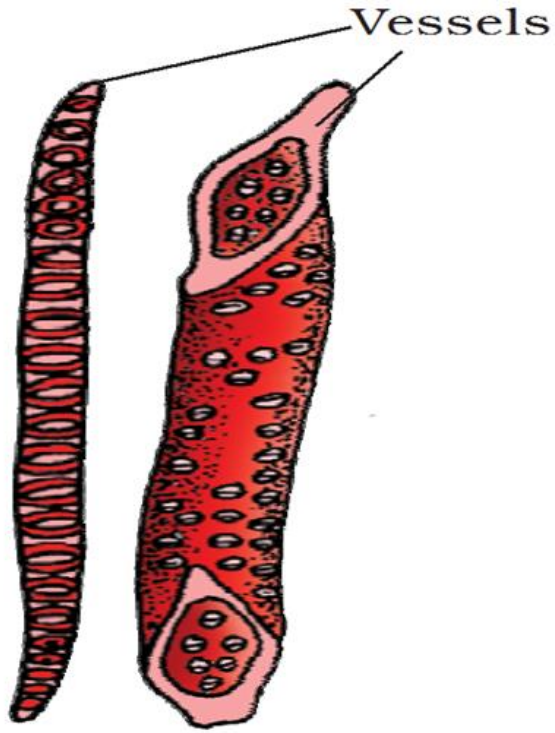
Vessels



Vessel is a long cylindrical tube-like structure made up of many cells called vessel members, each with lignified walls and a large central cavity.

The vessel cells are also devoid of protoplasm.

Vessel members are interconnected through perforations in their common walls.

The presence of vessels is a characteristic feature of angiosperms.

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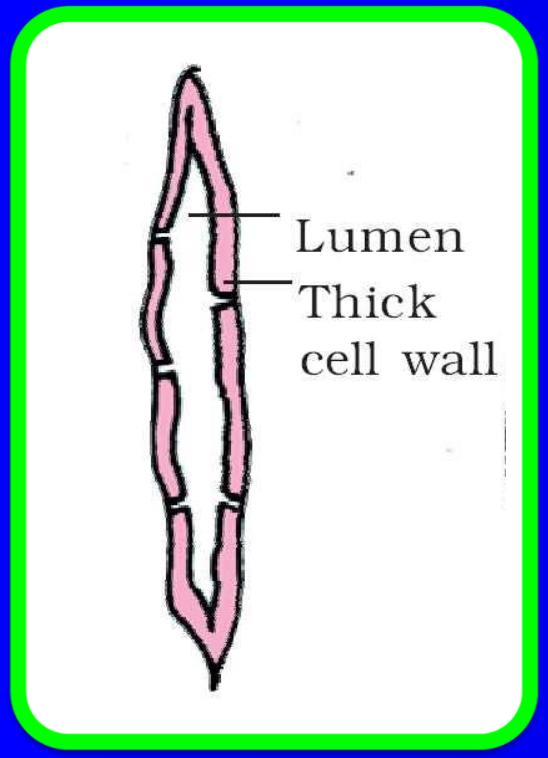
Xylem Fibres



Xylem fibres have highly thickened walls and obliterated central lumens.

These may either be septate or aseptate.

Xylem parenchyma cells are living and thin-walled, and their cell walls are made up of cellulose.

They store food materials in the form of starch or fat, and other substances like tannins.

The radial conduction of water takes place by the ray parenchyrnatous cells.

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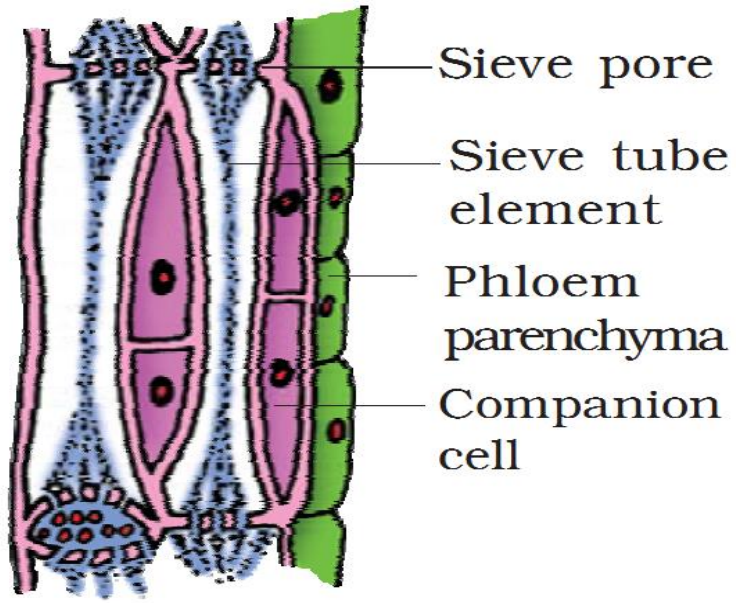
Phloem

Phloem



Phloem transports food materials, from leaves to other parts of the plant.

Phloem in angiosperms is composed of sieve tubes, companion cells, phloem parenchyma and phloem fibres.

Gymnosperms have albuminous cells and sieve cells.

They lack sieve tubes and companion cells.

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Sieve tubes

Sieve tube elements are also long, tube-like structures, arranged longitudinally and are associated with the companion cells.

Their end walls are perforated in a sieve-like manner to form the sieve plates.

A mature sieve element possesses a peripheral cytoplasm and a large vacuole but lacks a nucleus.

The functions of sieve tubes are controlled by the nucleus of companion cells.

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Companion Cells

The **companion cells** are specialised parenchymatous cells, which are closely associated with sieve tube elements.

The sieve tube elements and companion cells are connected by pit fields present between their common longitudinal walls.

The companion cells help in maintaining the pressure gradient in the sieve tubes.

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Phloem Parenchyma

Phloem parenchyma is made up of elongated, tapering cylindrical cells which have dense cytoplasm and nucleus.

The cell wall is composed of cellulose and has pits through which plasmodesmatal connections exist between the cells.

The phloem parenchyma stores food material and other substances like resins, latex and mucilage.

Phloem parenchyma is absent in most of the monocotyledons.

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Phloem Fibres

Phloem fibres (bast fibres) are made up of sclerenchymatous cells.

Phloem fibres are absent in the primary phloem but are found in the secondary phloem.

These are much elongated, unbranched and have pointed, needle like apices.

The cell wall of phloem fibres is quite thick.

At maturity, these fibres lose their protoplasm and become dead.

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Phloem fibres of jute, flax and hemp are used commercially.

The first formed primary phloem consists of narrow sieve tubes and is known as **protophloem**

The later formed phloem has bigger sieve tubes and is referred to as **metaphloem.**


God Bless You!