

Program of Vegetal biology 1

Semester 1

UEF 1.1 Vegetal biology 1 40% and 60%

Chapter 1: introduction to plant biology 4h30

1.1. Systematic

1.2. Plant cytology (reminder of the concepts: cell membranes - cell wall - vacuoles - plastids)

Chapter 2: morphology of superior plants 9:00 a.m.

2.1. Root morphology

2.1.1. Organization of the root system

2.1.2. Different types of roots

2.1.3. Root functions

2.2. Stem morphology

2.2.1. Organization of the culinary system

2.2.2. Different types of stems

2.2.3. Stem Functions

2.3. Leaf morphology

2.3.1. Morphological organization of the leaf

2.3.2. Different types of leaves

2.3.3. Leaves functions

2.4. Flower morphology

2.4.1. Arranging the flower

2.4.2. The inflorescences

2.5. Seed morphology

2.6. Fruit morphology

Chapter 3: different types of tissues

3.1. Primary meristems (root and stem)

3.1.1. Primary tissues

3.1.1.1. Protective tissues (epidermis)

3.1.1.2. Filling tissues (parenchyma)

3.1.1.3. Supporting tissues (collenchyma and sclerenchyma)

3.1.1.4. Conductive tissues (primary xylem, primary phloem)

3.1.1.5. Secretory tissues

3.2. Secondary (lateral) meristems (the cambium and phellogen)

3.2.1. Secondary tissues

3.2.2. Conductive tissues (secondary xylem and secondary moth).

3.2.3. Protective tissues (suber or cork, phelloderm)

Practical work (V.H: 10:30 p.m.):

1. Study of the morphology of angiosperms (roots - stems - leaves - flowers).

2. Study of the morphology of gymnosperms (roots - stems - leaves - flowers).

3. Covering tissues: epidermis - piliferous base - corky base - suberoid.

4. Parenchyma (chlorophyll - reserve - aeriferous - aquifer}.

5. Supporting tissues (collenchyma - sclerenchyma).

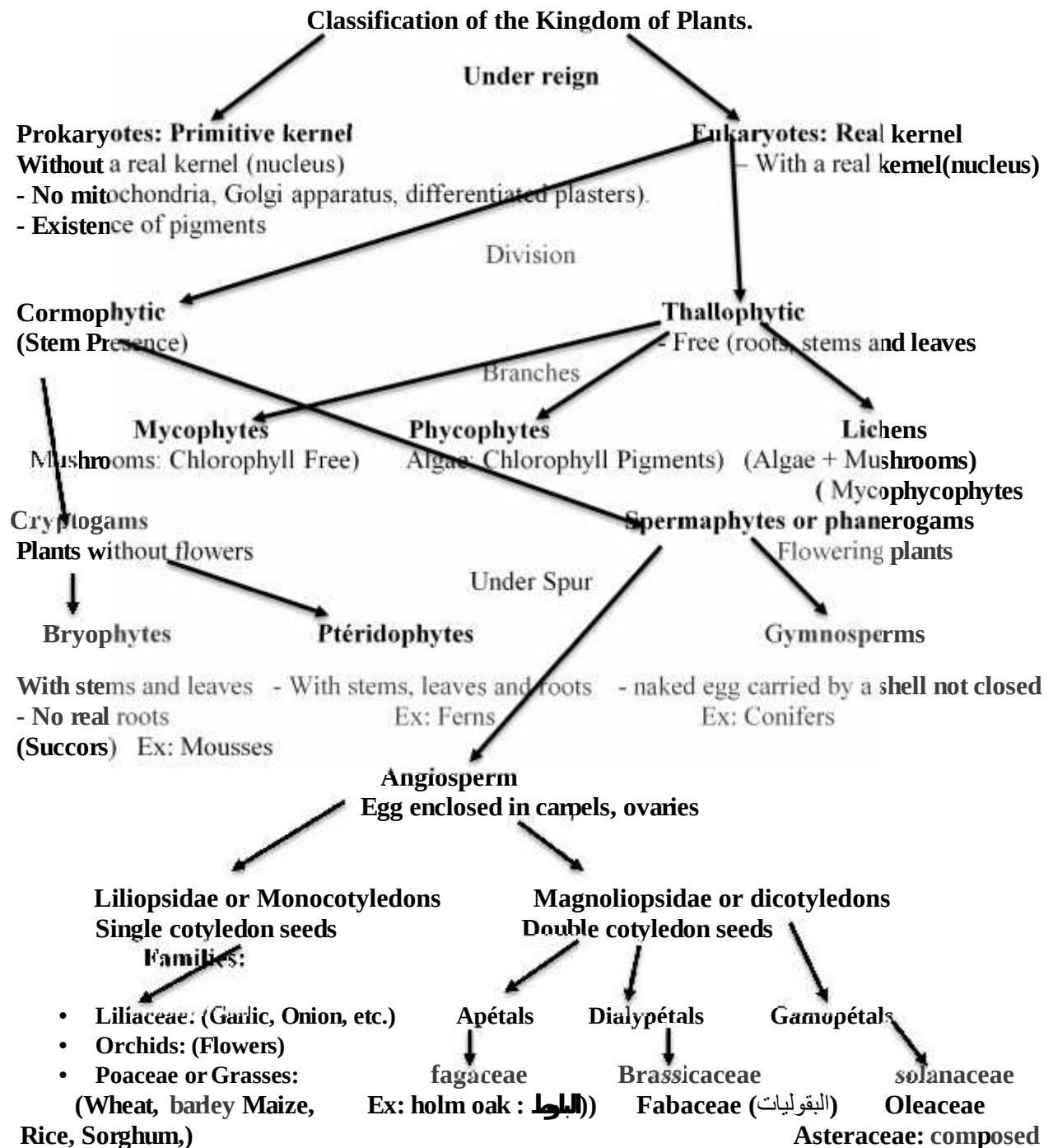
6. Primary conductive tissues (phloem - xylene).

7. Tissue secondary protectors (cork) and conductors (wood - bast)

Chapter 1: introduction to plant biology.

1.1. Systematic

Plant biology: study of plant organisms



All living beings are divided into: prokaryotes and eukaryotes

1. Prokaryotes: - Little evolved

- The cells are little evolved
- The kernel is individualized
- No nuclear membrane

- **Bacteria: Unicellular microbes of form:** - elongated (Baciles) ex: Colli bacile, E. Colli
- Spherical (shells) ex: Hull bacillus
- **Cyanobacteria: Classes of nearby blue algae bacteria (Cyano = blue).**

2. Eukaryotes: they are characterized by:

- More advanced cells
- Well individualized nuclei
- The presence of mitochondria
- The presence of plasters
- They are generally autotrophic (heterotrophic).

2.1 Thallophtic: They are characterized by:

- A vegetative apparatus consisting of a thylles
- No leaves • No roots • No stems

Algae (الطحالب), Fungi (الفطريات) and lichens (الاشنيات).

2.1.1 Algae: belong to the phycophytes branch; contain a pigment and chlorophyll. There are about 250,000 species, they lead an aquatic life (mother and fresh water), and they are not vascular (thallophytic).

This branch contains three sub branches:

- **Chlorophytes (green algae): they contain only chlorophyll.**
- **Under Chromophytes (brown algae): they contain chlorophyll and brown pigment.**
- **Rodophytes (red algae): They contain chlorophyll and a red pigment.**

Some classifications place cyanophytes as a phycophyte branch.

The mode of reproduction of phycophytes is vegetative or sexual.



Algae under microscopic view.

2.1.2 Mushrooms: do not contain chlorophyll, live in parasites or saprophyte of organic matter, and belong to the Mycophytes branch, their wall is not cellulosic (except Oomycetes) but based on chitin, their reserves are organic matter and glycogen; probably come from algae after chlorophyll has disappeared.

Their vegetative apparatus is a filamentous talus (hyphae) whose whole forms the mycelium.

The mode of reproduction is asexual (vegetative) or sexual (fusion of both male and female gametes).

Fungi can be associated with higher plants to form mycorrhizae (ex: Beetroot) or with algae to form lichens.



Wild mushrooms

2.1.3 Lichens:

Formed by the association of algae and fungi, algae provide organic matter and fungi provide water and mineral salts. There are about 20.000 species, example: Xanthoria of the walls, are yellow-orange plates fixed on old stones or bark of trees.



The Lichens on trees.

2.2 Cormophytes:

2.2.1 The Cryptogames:

2.2.1.1 Pteridophytes:

(Ferns, Pteridos = wing or feather), it is the oldest branch of vascular plants, they are formed of leaves, stems and roots.

They grow on the old walls and emit rhizomes with fine roots and leaves called fronds, under which are grouped clusters of sporangia in the form of yellow lobes, carried by pedicels that rupture by releasing monocellular spores, ovals and their germination gives rise to a new plant material.



The ferns

2.2.1.2 Bryophytes:

(Mosses); Non-vascular cryptogams, they are formed of leaves, stems and no real roots. They multiply asexually (vegetative) or sexually (gametes).



Moss on tree trunks

2.2.2 The Phanerogams:

(Phaneros: visible, games: flowers/ seeds)= (Spermaphytes = seed plants). They are formed by flowering or seed plants; they contain real roots, stems and leaves. They are propagated sexually (stamens and carpels) or asexually (vegetative multiplication). All organs are traversed by vessels conducting the sap «vascular plants», they carry flowers (stamens (pollen) and carpels (eggs). The fertilized eggs are transformed into a seed containing a seedling and the necessary nutrients for germination (seed plants), they are divided into two branches:

2.2.2.1 Gymnosperms:

Are trees or shrubs, their leaves have small surface or in the form of needles (spines) or scales and persistent.

They have flowers, some reduced to stamens the others to carpels; it is simple flowers often in the shape of cones, the most representative of this te under branch (conifers example: The pine), are more diversified.

Carpels are never closed. They carry eggs but do not enclose them. The seeds are also bare; contain a seedling with variable numbers of cotyledons.

The multiplication is done by sexual way, they are generally formed of monoecious species (male flowers and female flowers are carried by a single foot) or dioecious (male flowers and female flowers are carried by two different feet). 2.2.2 The Phanerogams: (Phaneros: visible, games: flowers) = (Spermaphytes = seed plants). **They are formed by flowering or seed plants; they contain real roots, stems and leaves. They are propagated sexually (stamens and carpels) or asexually (vegetative multiplication). All organs are traversed by vessels conducting the sap «vascular plants», they carry flowers (stamens (pollen) and carpels (eggs). The fertilized eggs are transformed into a seed containing a seedling and the necessary nutrients for germination (seed plants), they are divided into two branches:**

2.2.2.2 Angiosperms:

(Angio: cavity or envelope, sperms = seeds): They are characterized by:

- * The presence of a completely enclosed ovary in which the eggs are enclosed.**
- * Plants with very varied habit (woody: ex. Palm and herbaceous: ex. Bean).**
- * Unisexual or hermaphroditic flowers; typical stamens with net and anther, the gynecum may consist of one or more free or welded carpels containing a variable number of eggs surmounted by styles and stigmas.**
- * The transformation of the fertilized ovary into a fruit containing seeds.**
- * A great diversity of species and varieties and they are found in various environments.**
- * A first classification into two main classes (Monocotyledons and dicotyledons).**
 - Monocotyledons: (mono = one and cotyledon = lobe) ex. Wheat, More...**
 - Dicotyledons: are characterized by a foliar polymorphism, arrangement of veins, floral type, they are divided into:**
 - apetals (without petals)**
 - Dialypetals (free or separate petals)**
 - Gamopetals (welded petals).**

1.2. Plant cytology (concepts of: cell membranes - cell wall - vacuoles - plastids)

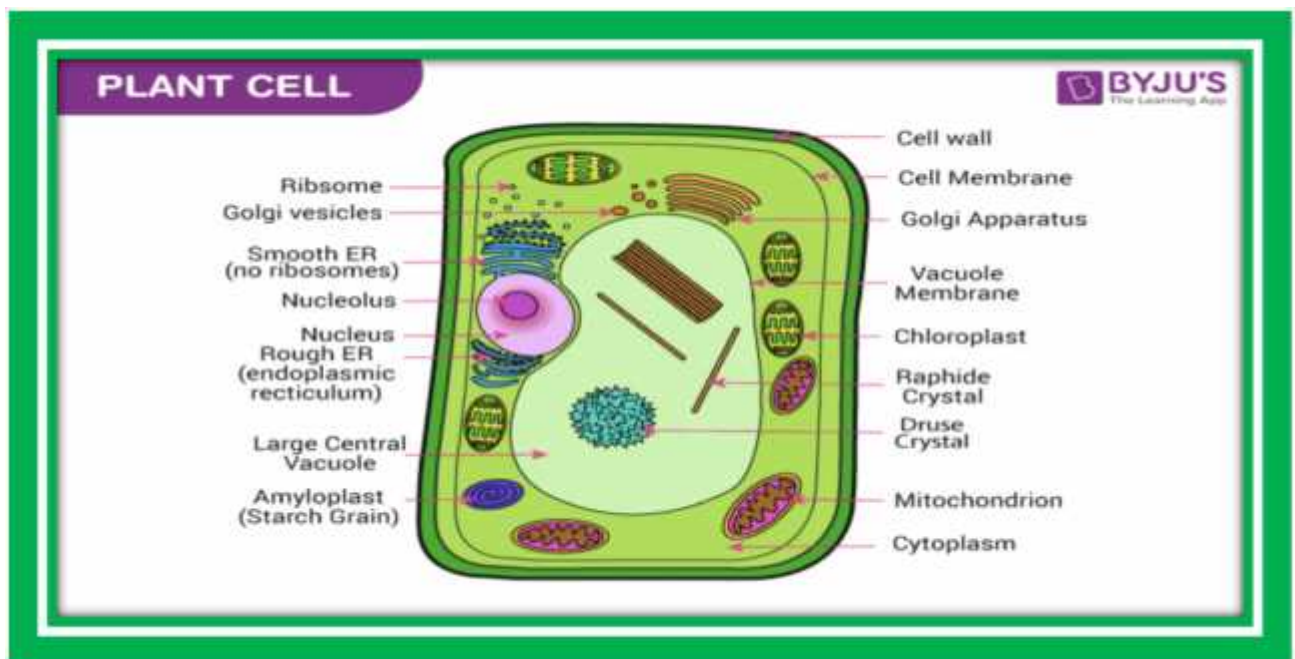
All vegetal is formed by at least one cell, capable of ensuring the vital functions of nutrition, breathing and synthesis. Each cell consists of a more rigid “wall” envelope, which limits the cytoplasm in which inclusions such as the nucleus, vacuoles, plastids, etc. bathe.

1. Wall and Membrane:

Two envelopes surround the plant cell:

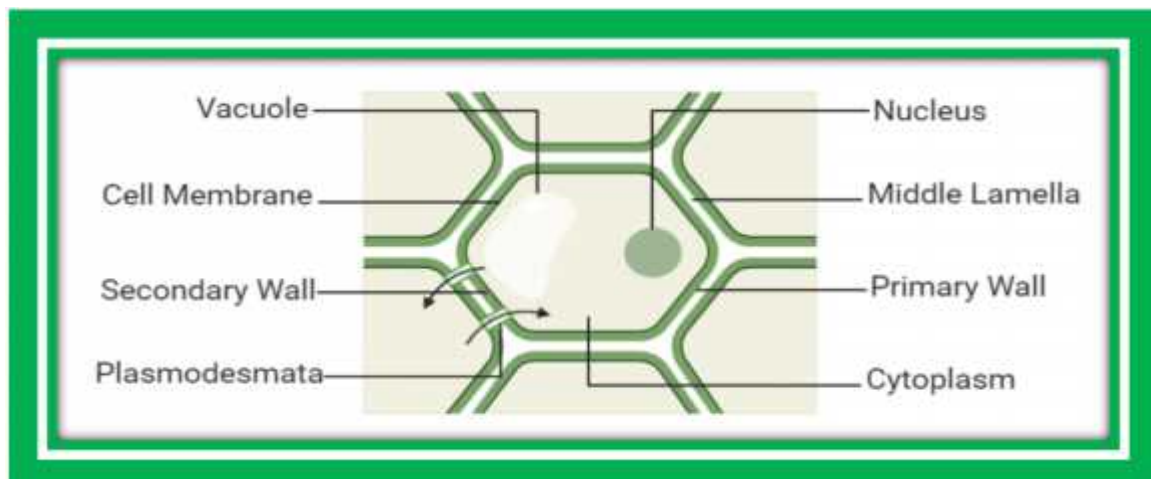
The wall, thick, rigid, ensures the maintenance of the cell and its physical links with neighboring cells.

The thin internal membrane that limits the cytoplasm: plasma membrane.



1.1 Skeletal or cellulosic pecto wall:

It holds the plant, it is inert and permeable, formed of several layers whose structure and thickness vary according to the age and type of the cell and which are from the outside inside of the cell:



1.1.1 Medium Lamella:

Layer between two cells, it is a cement of pectic compound (pectates of calcium and magnesium), insoluble in water, thus ensuring cohesion between cells. In older cells, it is impregnated with lignin. Pectic compounds can be hydrolyzed by pectinase enzymes, in most cases fruit and become soluble during fruit maturity.

1.1.2 The Primary Wall:

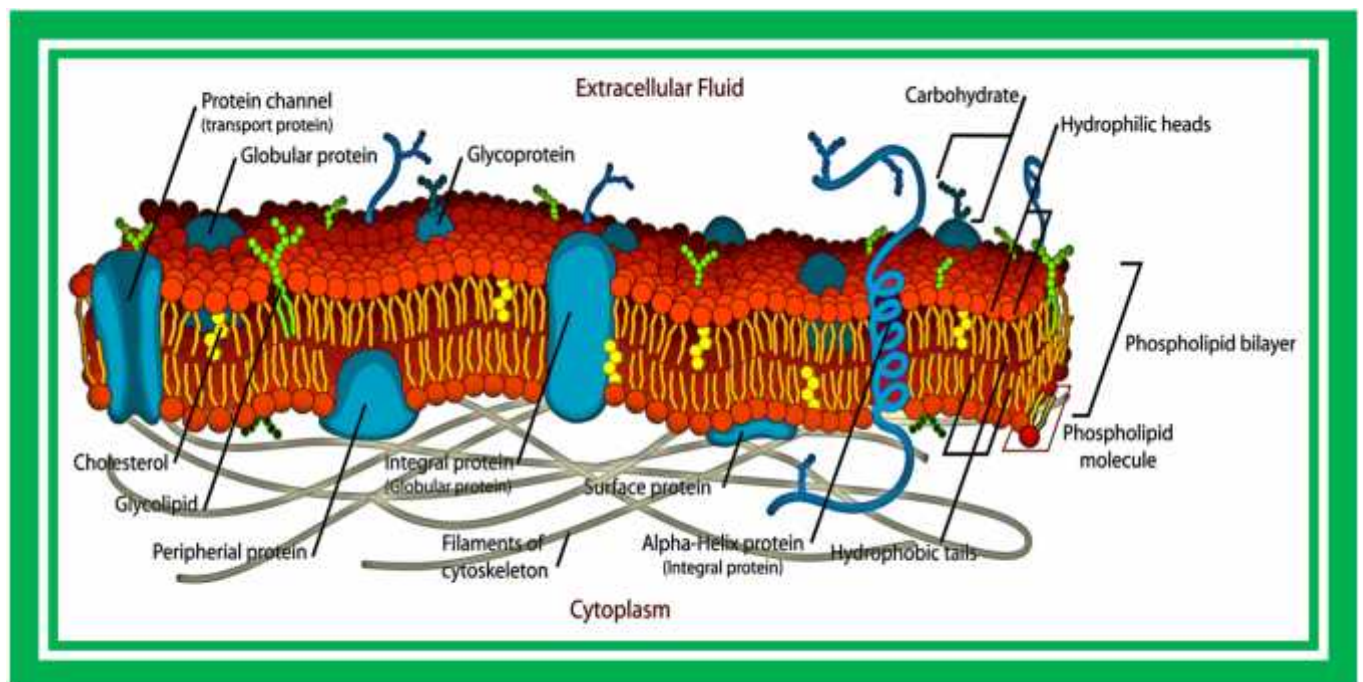
From 1 to 3 μm thick, it exists in meristematic cells and many young parenchymas. It consists of micro cellulose fibrils, arranged in networks, pectic compounds, hemicelluloses, structural proteins and a high proportion of water (up to 60%). These primary walls are developed by the cytoplasm and are formed of one or more layers. It is the only wall of undifferentiated and growing cells.

1.1.3 The secondary wall:

It appears as soon as the primary wall to finish its growth, it is rigid, of very variable thickness, formed of several layers whose recent are the most internal; it is about micro Cytology. All vegetal is formed by at least one cell, capable of ensuring the vital functions of nutrition, breathing and synthesis. Each cell consists of a more rigid “wall” envelope, which limits the cytoplasm in which inclusions such as the nucleus, vacuoles, plasters, etc. bathe.

2. Cytoplasmic or Plasmalemma membrane:

It limits the cytoplasm of all cells, invisible under an optical microscope, ensures the exchange of water, ions, sugars, amino acids, proteins, etc.



The plasmalemma is composed of three sheets; two dark bands surrounding a light band. This membrane is called a membrane unit or membrane unit. It is the same composition as those of

the endoplasmic reticulum, vacuoles (tonoplast) and golgi body, it is doubled in mitochondria and plasts.

These sheets are phospholipids, two of which are hydrophilic and one hydrophobic. The light sheet is formed by a double layer of phospholipids with opposite molecules and the sheet darkens by a layer of proteins and the hydrophilic part is phospholipids.

3. Fundamental cytoplasm or hyaloplasm:

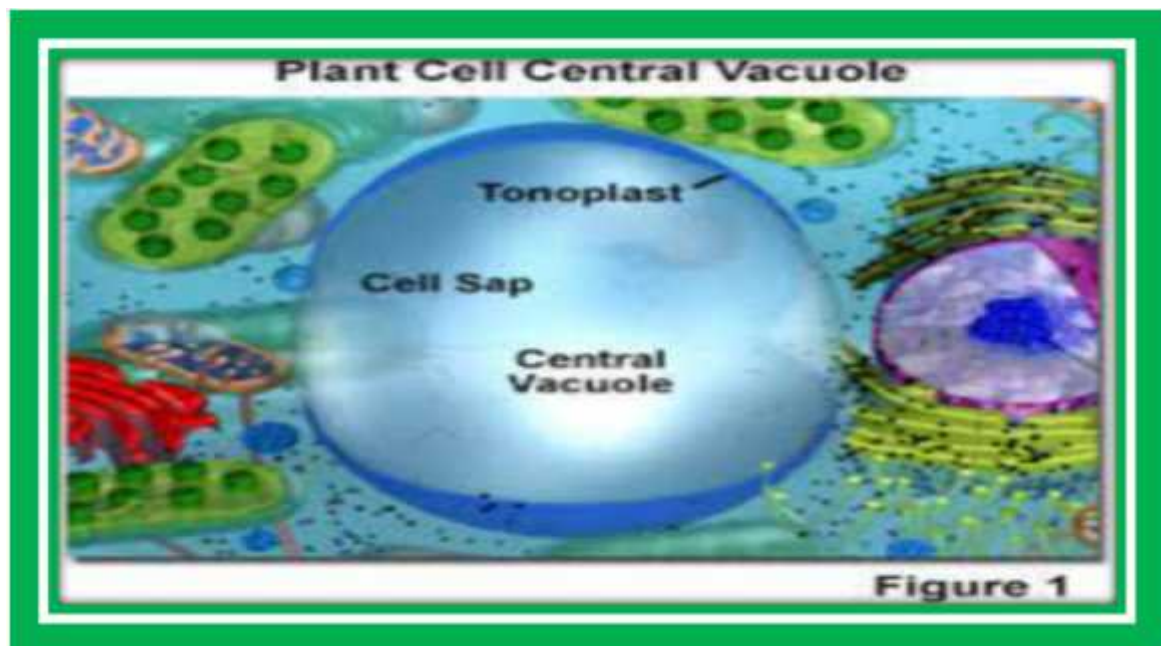
Under the photonic microscope, it appears as a colloidal substance, homogeneous, transparent, more or less viscous and elastic. It presents:

- A fibrous structure, consisting of microfilaments and microtubules from 5 to 25 nm
- An organo mineral composition: 70% to 90% water which decreases to 10% in mature seeds, 10% to 30% dry matter which is divided into:

2 to 6% mineral matter, 8 to 24% organic matter. The mineral elements (Ca, P, S, K, Mg, etc.) are partly dissolved salts and ions and the organic substances are carbohydrates, fats and proteins.

4. Vacuoles:

Are regulatory reserves of the plant cell, occupies more than 90% of the cytoplasmic volume and filled with a liquid rich in water: vacuolar juice.



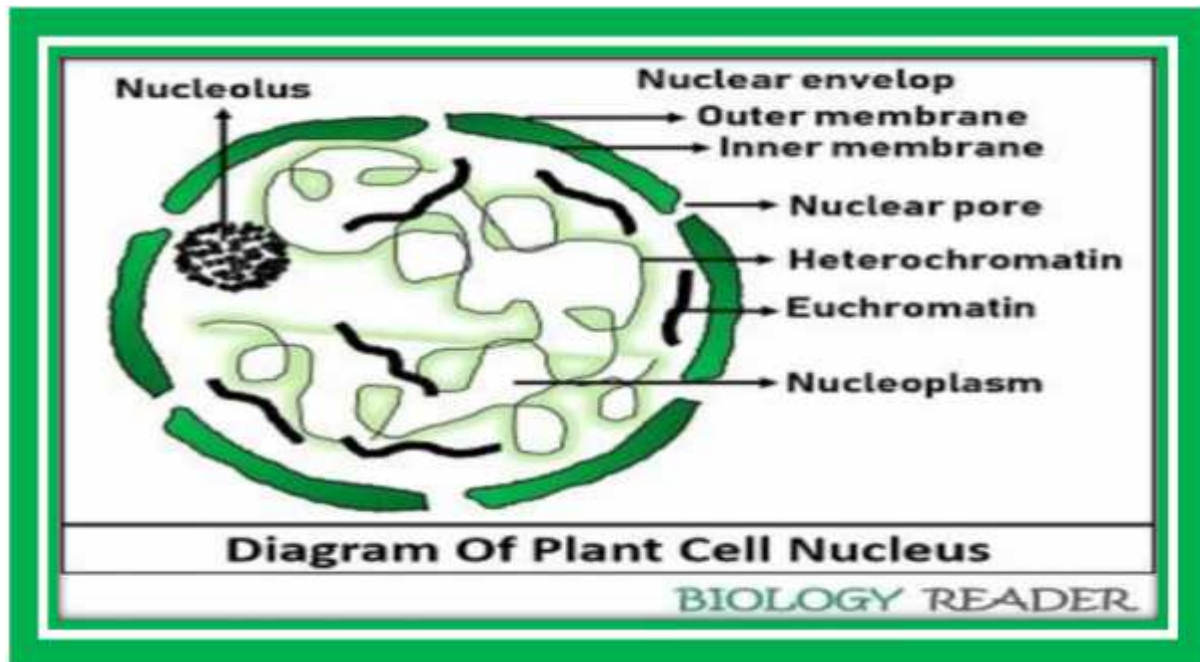
The development is clearly visible in meristematic cells, they are small, numerous and filamentous, they increase in volume and gather to form a unique vacuole in other types of cells. The variation of the water content of the cells is actually due to the variation of the water content of the vacuole (turgor or plasmolysis), the vacuole buffers this variation by the phenomenon of osmosis.

Vacuolar juice varies from liquid to solid; it contains water (main constituent), carbohydrates (glucose, fructose, sucrose, etc.), organic acids (malic, citric, oxalic acids, etc.) tannins, amino

acids, dyes (e.g. anthocyanins, etc.) mineral salts and ions (nitrates, phosphates, etc.) and crystals (e.g. calcium oxalate).

In mature kernels, vacuoles dehydrate (10% water) to form “solid vacuoles” whitefly kernels.

5 The nucleus: (brain of the cell)



5.1 Structure:

It is spherical in young cells (meristems) and often lenticular in plant cells. Its size varies according to the size of the cell and the number of chromosomes, outside the period of division the nucleus includes:

5.1.1 Nuclear envelope: double membrane of cytoplasmic type, punctuated with nuclear pores allowing exchanges with the cytoplasm.

5.1.2 The nucleoplasma:

nuclear juice): colorless substance, which fills the free space of the nucleus, it ensures turgor, rich in simple proteins and phosphates without nucleic acids or lipids, it has properties close to those of the cytoplasm.

5.1.3 Chromatin:

Denser than nucléoplasma, consisting of entangled filaments, distributed throughout the nuclear juice. We speak of euchromatine when they are loose and heterochromatin when they are packed. Chromatin is the form of chromosomes outside the periods of division; it is formed of DNA (deoxyribonucleic acid).

5.1.4 Nucleolus:

Are nuclear inclusions, spherical in shape, their number varies according to species and their shape according to the physiological state of the cells. They are no longer separated from the nuclear juice. They are made of fibrils and granules that contain RNA (ribonucleic acids).

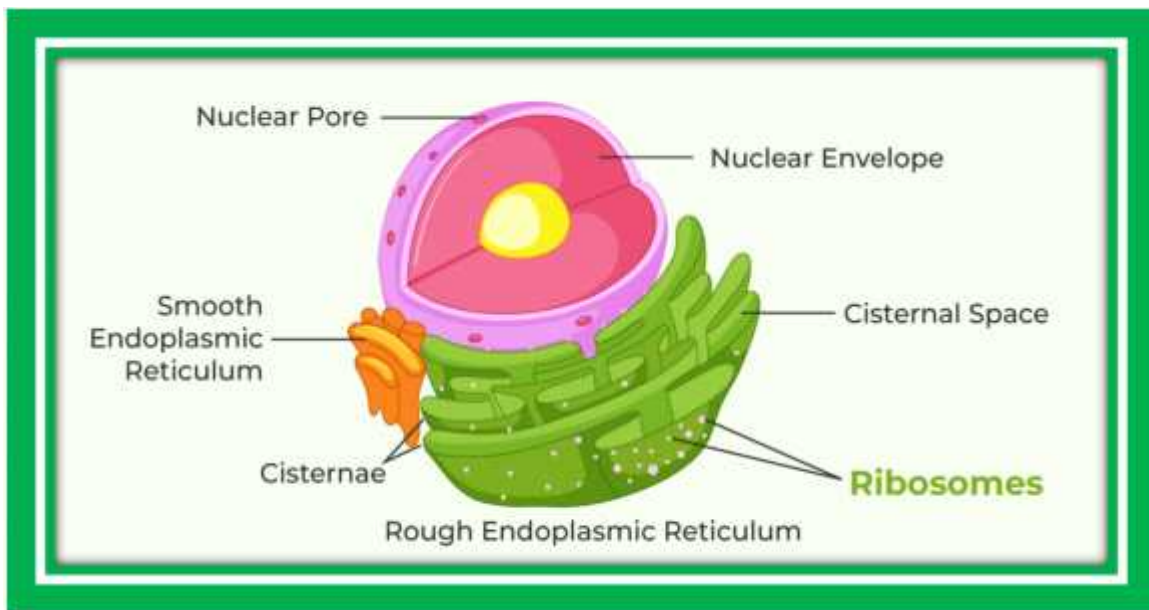
5.2 Role:

The nucleus is the brain of all that is to be performed in the life not only of a cell but of the whole individual.

6. Cellular constituents and their roles:

6.1 Endoplasmic reticulum: Is an organelle of hyaloplasm, in the form of tubules or saccules anastomosed into networks (= reticulum), they are limited by a single membrane of about $50 \text{ \AA}$ and surrounding a transparent internal space. Some elements of the reticulum have a membrane externally lined (on the hyaloplasm side) by osmiophilic grains 150 to $300 \text{ \AA}$ in diameter (ribosomes), this form constitutes the granular endoplasmic reticulum or ergastoplasm (seat of protein synthesis). The ribosome-free parts of the reticulum constitute the smooth endoplasmic reticulum (seat of lipid synthesis). This organelle could intervene in the intra- and inter-cellular circulation of certain substances, it is in direct relation with the nuclear membrane thanks to the tubules evaginations formed by the latter, it acts as a warehouse and with the golgi apparatus it prepares the molecules that need to be excreted.

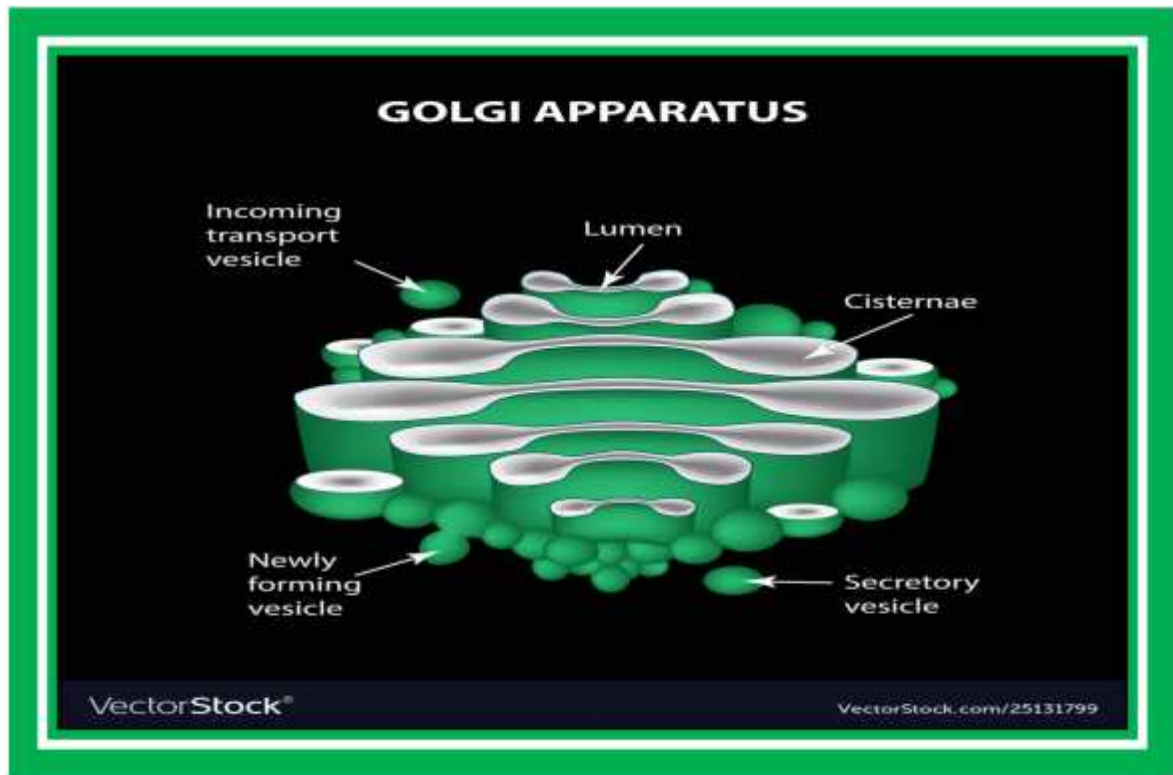
6.2 Ribosomes:



Are very osmiophilic grains, thick in the cytoplasm or applied against the membrane of the endoplasmic reticulum. They consist of proteins and an RNA (ribosomal RNA) and lipids. They can be grouped into polyribosomes by messenger RNA.

6.3 Golgi apparatus:

Discovered in the cells of the root meristem of the onion, it is formed of several elements, dictyosomes; parallel and tight lines, joined two by two by a contour more or less faded. Its appearance corresponds to a stack of saccules, limited by a simple membrane, strongly flattened but bulged into blisters on their edge that can detach and become independent (golgian vesicles separated from the dictyosome).

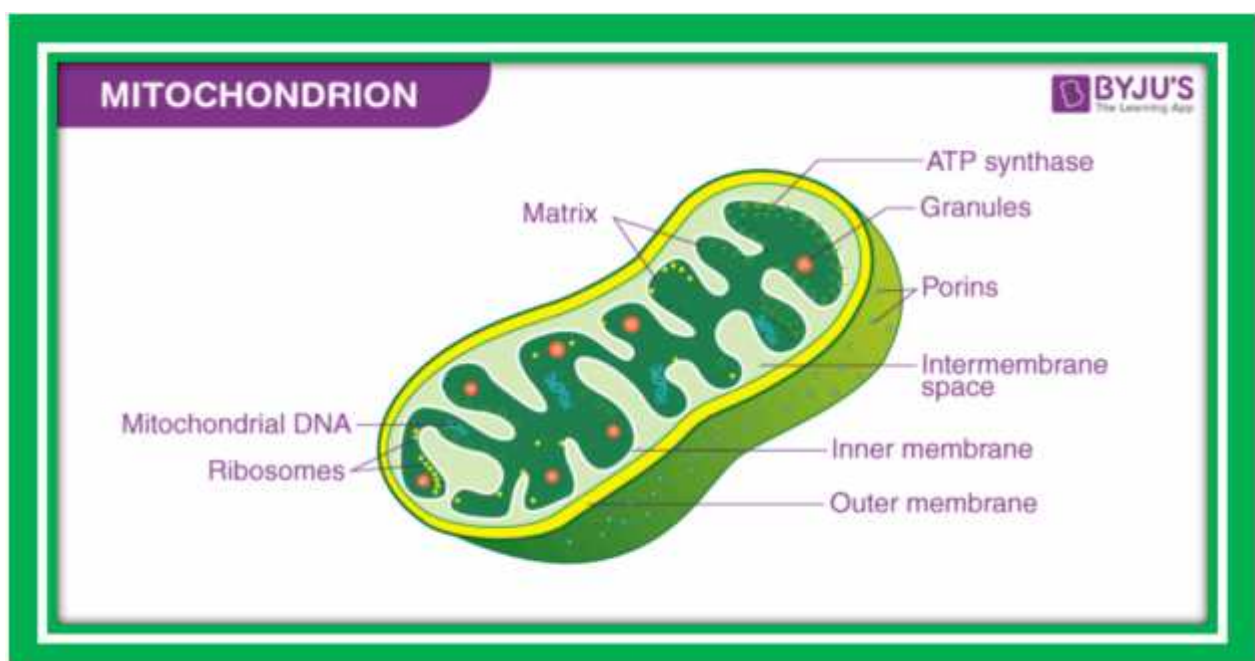


It is

Dictyosomes play a secretory role (secretion), elaboration of cell walls, accumulation of various products elaborated in other organelles and transported by golgian vesicles to the places of excretion.

Golgian saccules contain enzymes capable of grafting sugars, phosphate groups and fatty acids on proteins sent by the endoplasmic reticulum and other vesicles contain enzymes capable of digesting cell elements to be renewed (e.g.: aging mitochondria) , are cellular digesters or lysosomes.

6.4 The Mitochondria:



Micro energy center of the cell (chondriosomes) (chondrios = grain and mitos = threads), 5 to 10 μm long and 0.3 to 1 μm of section, they are flexible deformable and move in the cytoplasm thanks to cyclosis movements, they come from the division of pre-existing mitochondria as they merge to form a large mitochondria.

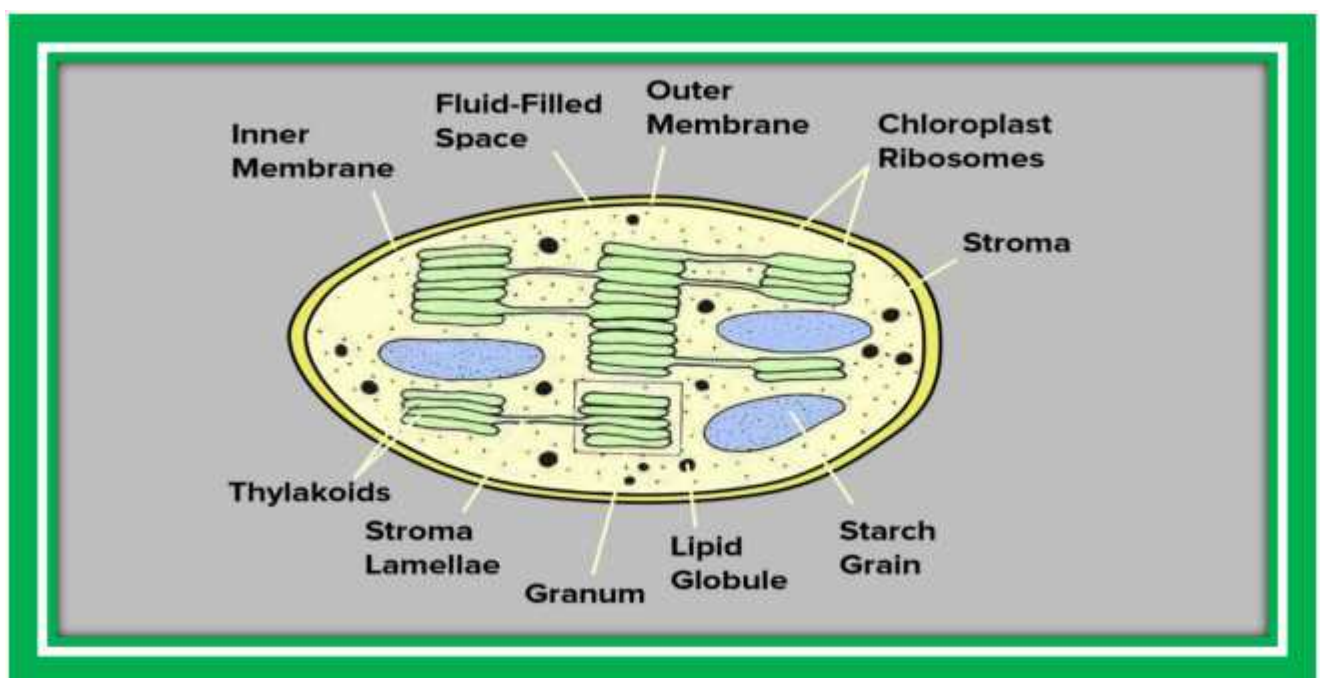
The mitochondria are limited by a double membrane of 4nm; one is external and the other is internal which extends inside by mitochondrial ridges on which attached thousands of spherical corpuscles which are proteins-enzymes «ATP ases»capable of synthesizing ATP = ATP synthase = proton pump = H^+ ion pump.

The mitochondria have autonomous DNA and RNA multiplication equipment as in the nucleus and ribosomes responsible for protein synthesis; it is semi-dependent organelle. They allow the manufacture of ATP (Adenosine tri phosphate), a source of energy from carbohydrates and oxygen.

6.5 The plastes:

They are cytoplasmic organelles of larger dimensions than those of the mitochondria; they are able to accumulate various products that they elaborate: this elaborating power that defines the plastes. According to the nature of the products produced, there are various categories of plastics, the most important and chloroplasts (headquarters of photosynthesis).

6.5.1 Chloroplasts:



They have the shape of lenticular discs of 4 to 6 μm , they are numerous in each cell, organelles close to the mitochondria and DNA carriers, able to divide without appeal to the nucleus. They are surrounded by a double membrane, enveloping a liquid (stroma = tablecloth), this membrane gives rise to lamellae and stacks of green pellets (= thylakoides) of 0.5 μm cross section whose wall contains a green pigment; chlorophyll and enzymes necessary for photosynthesis. All these

thylakoids form the granum, their surface is punctuated by thousands of spherical bodies that are ATP synthase capable of synthesizing the ATP that will be stored in carbohydrates. In mitochondria, however, ATP is supplied directly to cells for their energy-intensive reactions. Chloroplasts contain DNA, RNA, ribosomes, proteins and amid enclaves The mitochondria are limited by a double membrane of 4nm; one is external and the other is internal which extends inside by mitochondrial ridges on which attached thousands of spherical corpuscles which are proteins-enzymes «ATP ases» capable of synthesizing ATP = ATP synthase = proton pump = H^+ ion pump.

There are two categories of chromoplasts:

- Fibrillar chromoplasts whose carotenes are integrated into fibrillar structures.
- Globular chromoplasts whose xanthophylls are integrated or dissolved in lipid droplets dispersed in the fundamental substance of the plaste.

6.5.3 Proteoplasts:

They are infrequent, they are observed in the embryonic sac of certain species, in the cells of the root parenchyma,... They contain protein reserves in the form of tight bundles of protein fibrils.

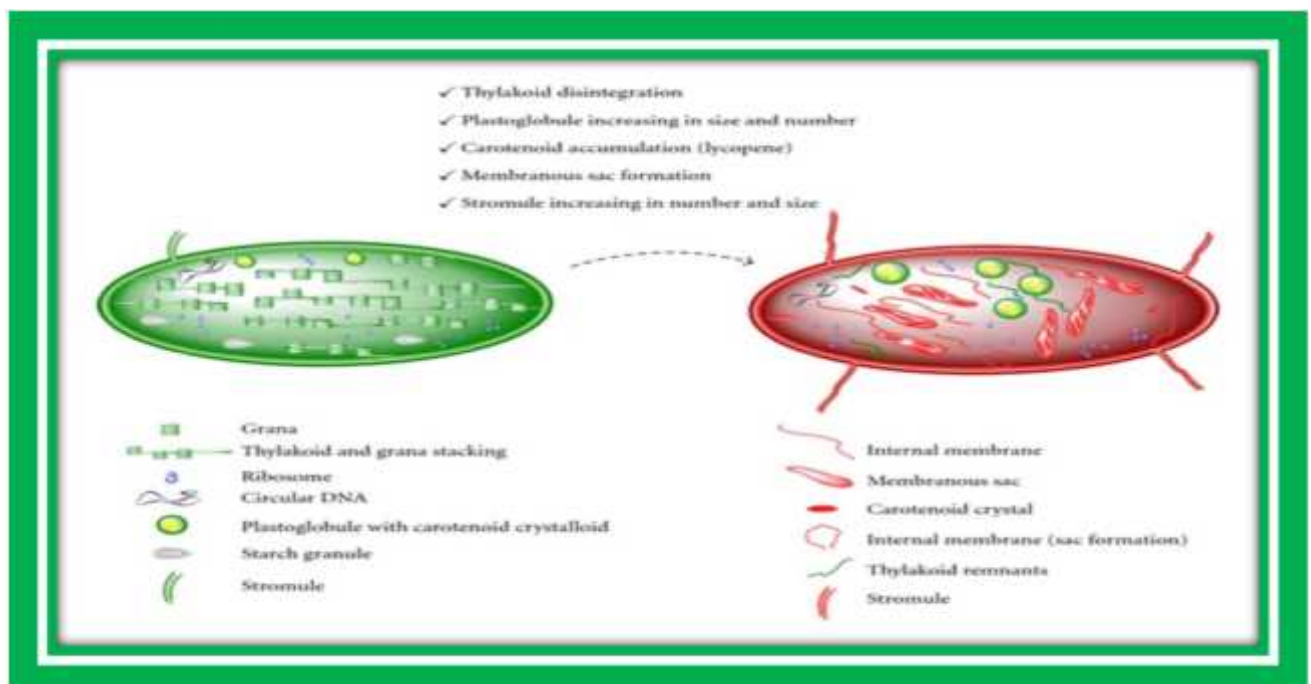
6.5.4 Amyloplasts:

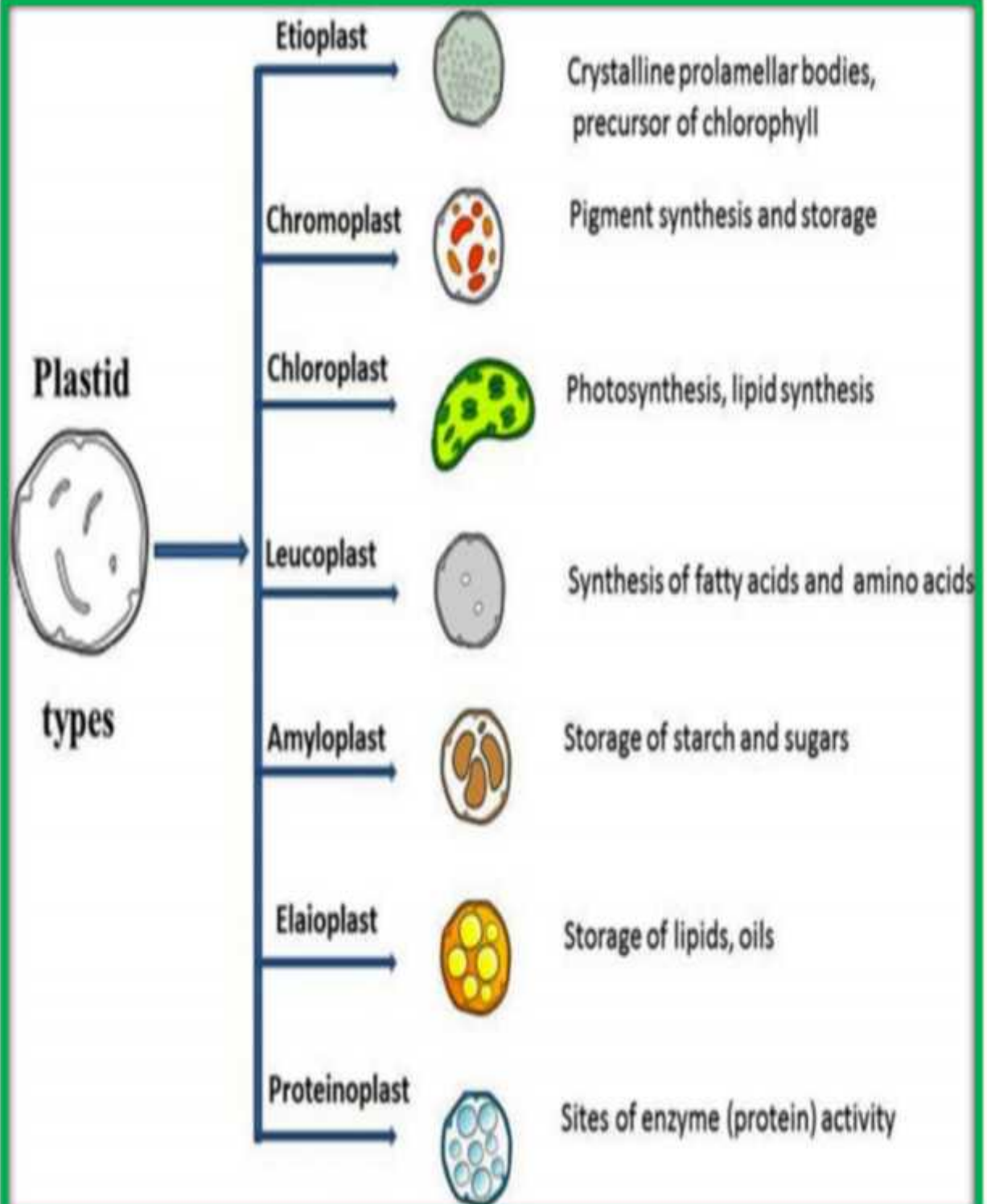
They are abundant in the tissues of reserves, they load starch elaborated in other tissues (the storage of starch in chloroplasts is a transition phase).

- Example of transformation of different categories of plastics Ex: Fruits

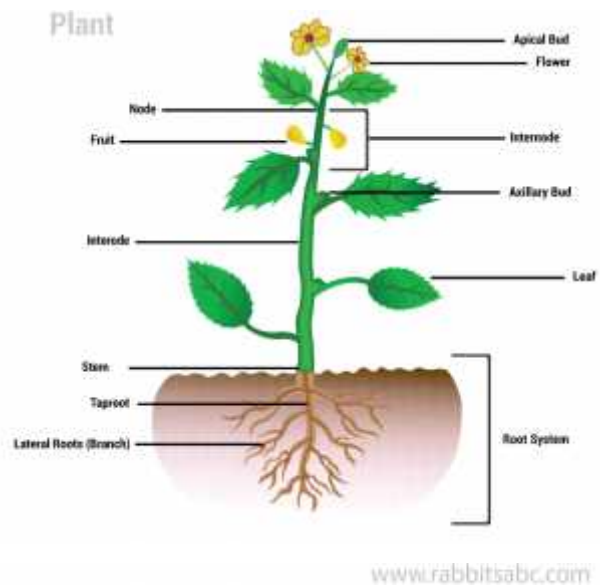
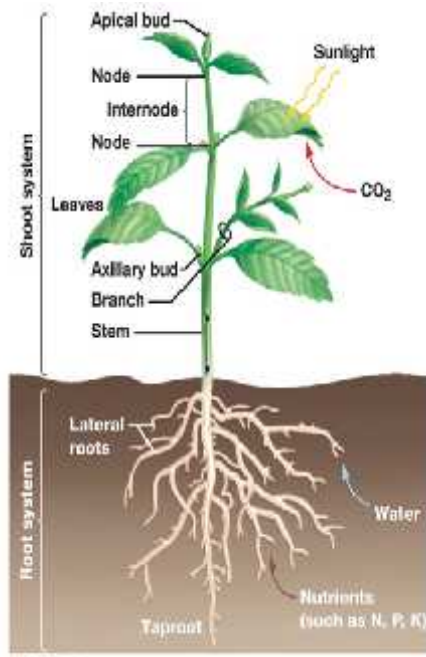
Chloroplasts ex. leaves Amyloplastes Ex: Potato Leucoplasts = Proplastes

6.5.5 Chromoplasts Ex: Tomato

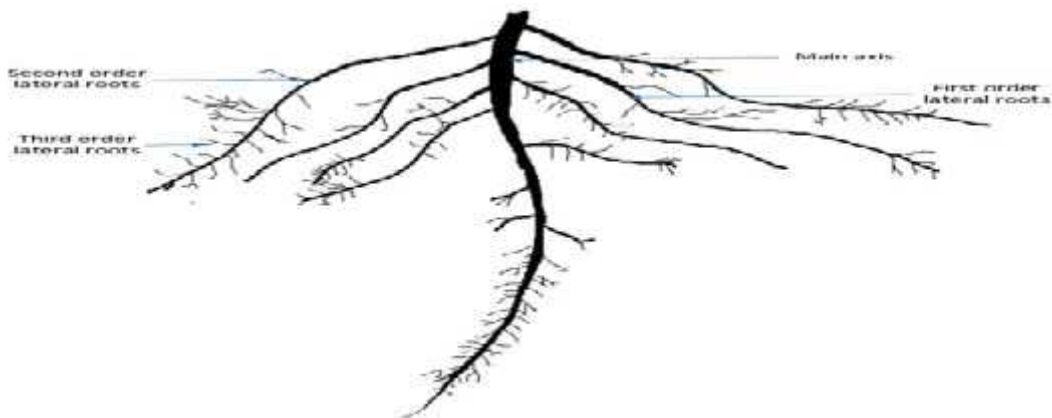




Chapter 2: morphology of superior plants

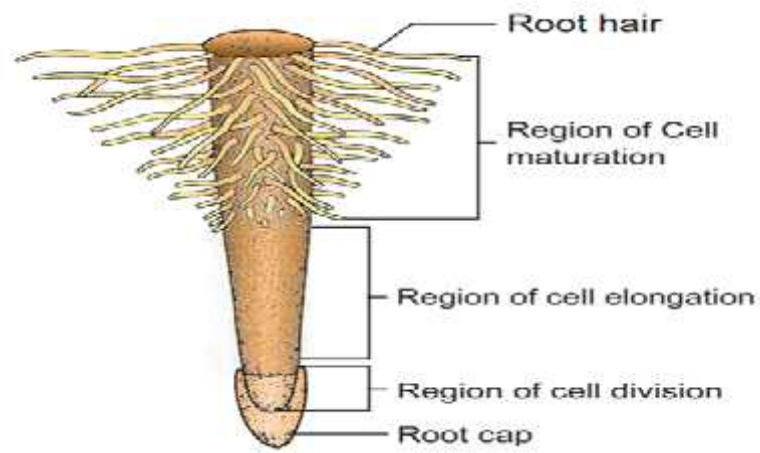


2.1 Morphology of root:



2.1.1. Organization of the root system

- **Regions of the Root :**
 - **Root Cap:** The root cap is a thimble-like structure covering the tip of the root. The root cap protects the tender root apex when it makes its way through the soil.
 - **Region of Elongation:** This part is responsible for the meristematic activity. The cells in this region are very small, have a thin wall and dense protoplasm.
 - **Region of Maturation:** We get the root hairs in this region. These are a part of the root epidermis.

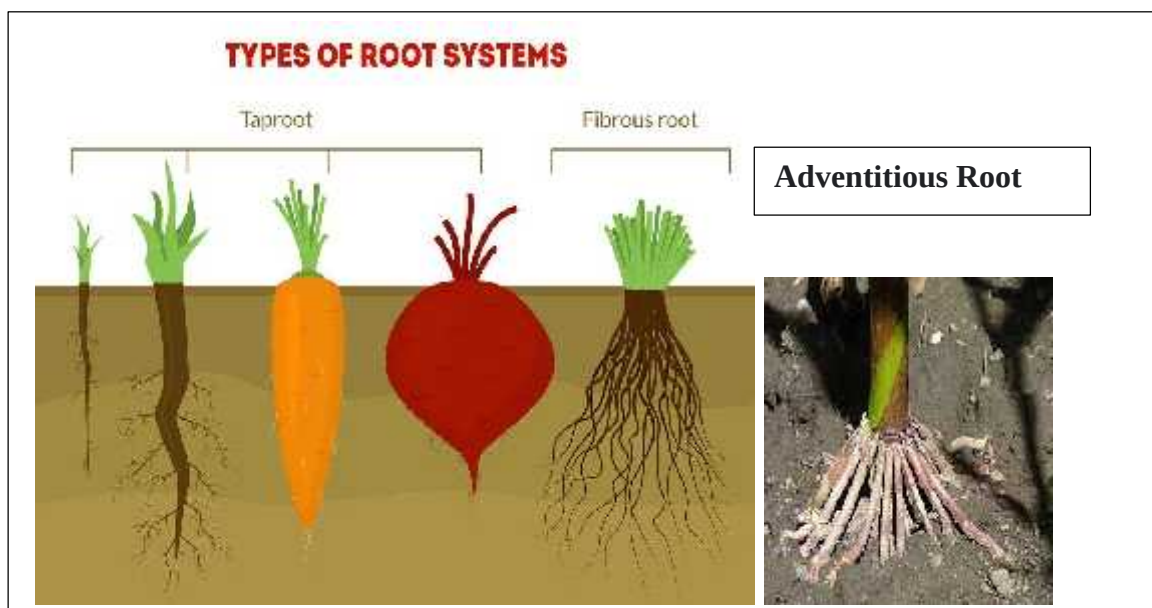


- **Characteristics of the Root**

- The root is the descending portion of the plant axis.
- It is positively geotropic.
- It is usually non-green or brown in colour.
- The root is not further differentiated into nodes and internodes.
- As per the rule, the root does not bear leaves and tree buds.
- Usually, a root cap protects the root tip.
- The root bears unicellular root hairs.

2.1.2 Root systems:

- Taproot System
- Fibrous Root System
- **Adventitious Root System**



2.1.3. Root functions.

Important functions of roots include anchorage of the plant, absorption of water and dissolved nutrients, their conduction to the shoot, storage of nutrients, vegetative propagation, and binding of soil particles.

2.2. Stem morphology.

Stem morphology is simple. Its components are nodes (places where leaves are/were attached) and internodes, long or short (in the last case, plant sometimes appears to be stemless, rosette-like). Stems are different by the type of phyllotaxis. The phyllotaxis refers to the arrangement of leaves.

2.2.1. Organization of the culinary system

2.2.2 Types of stems

1. Underground stem. 2. Aerial Stems. 3. Sub aerial Stems.

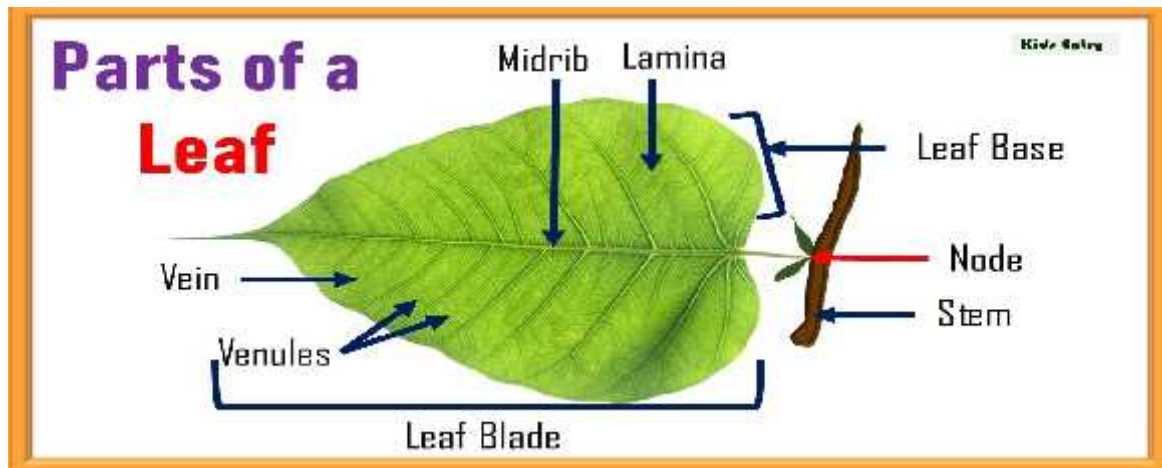


2.2.3. Stem Functions

The main functions of stems are to support and elevation of leaves, fruits, and flowers. Stem arranges leaves in a way that it gets direct sunlight to perform photosynthesis. Xylem and Phloem conduct water across the plant. Stems stores food, water, and nutrients.

2.3. Leaf morphology

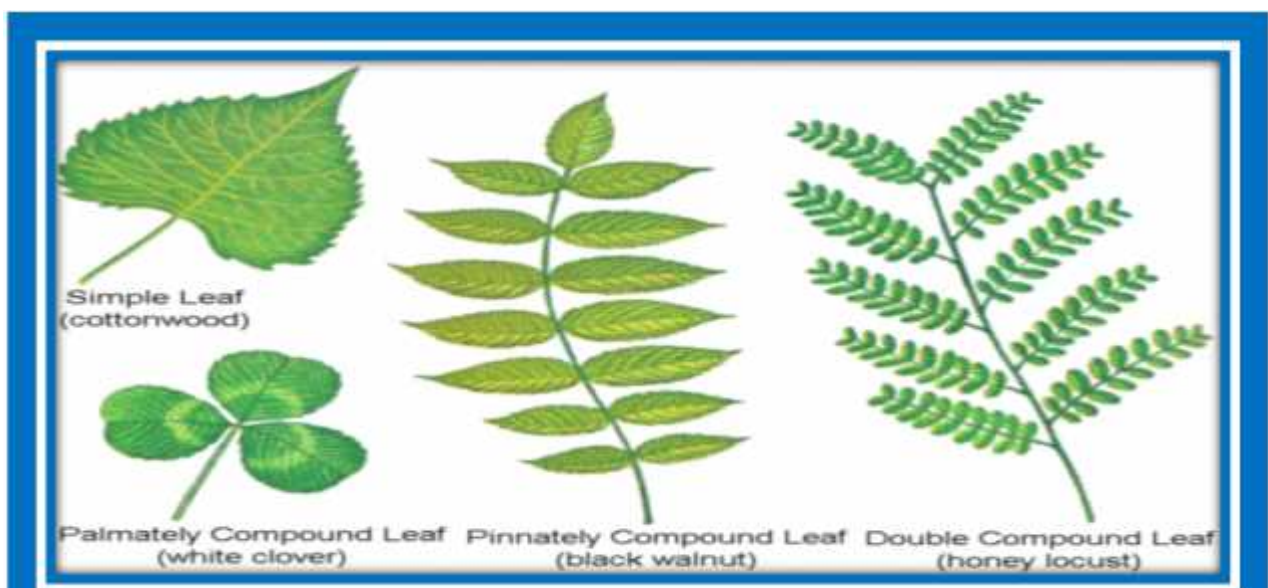
2.3.1. Morphological organization of the leaf



2.3.2. Different types of leaves

There are three main parts of a leaf – Leaf base, leaf lamina, and petiole.

There are two different types of leaves – simple leaves and compound leaves.



The other types of leaves include acicular, linear, lanceolate, orbicular, elliptical, oblique, centric cordate, etc.

2.3.3. Leaf functions.

The main functions of the leaf are:

- Leaf prepares food for plants by the process of photosynthesis.
- Leaf has abundant stomata for gaseous exchange and performs the function of respiration.
- The leaf is the main site of water loss through the process of transpiration.
- Storage of nutriment.

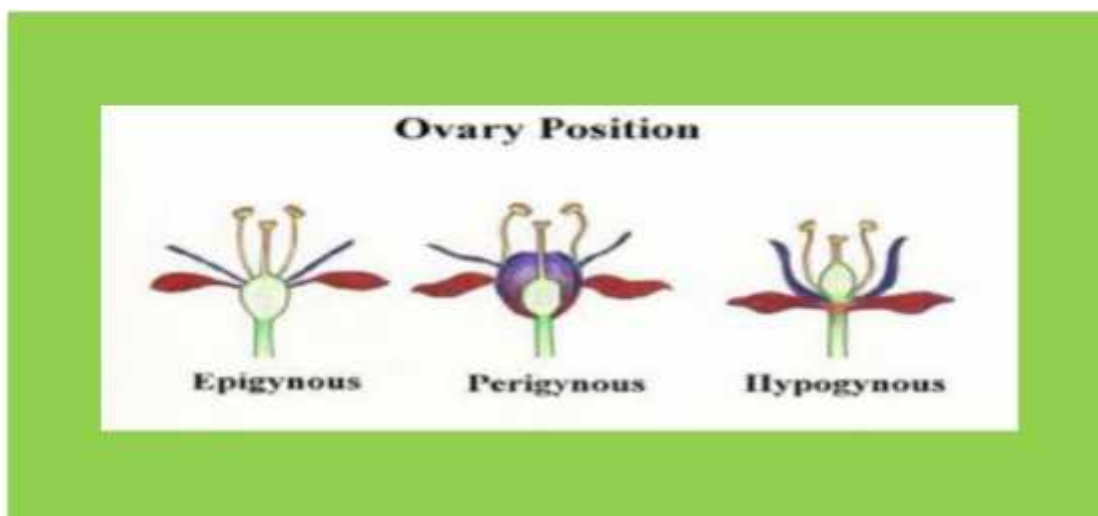
2.4. Flower morphology.



2.4.1 Flower organization.

The structure of flower is the calyx; corolla, androecium, and gynoecium are four whorls of modified leaves that constitute the flower. The sepals, petals, stamens, and pistils, respectively, constitute one of the flower parts in each of these whorls.

Hypogynous & Perigynous and Epigynous Flowers: Based on position of calyx, corolla et androecium with respect to ovary on thalamus, the flowers are described as the hypogynous, perigynous and epigynous.



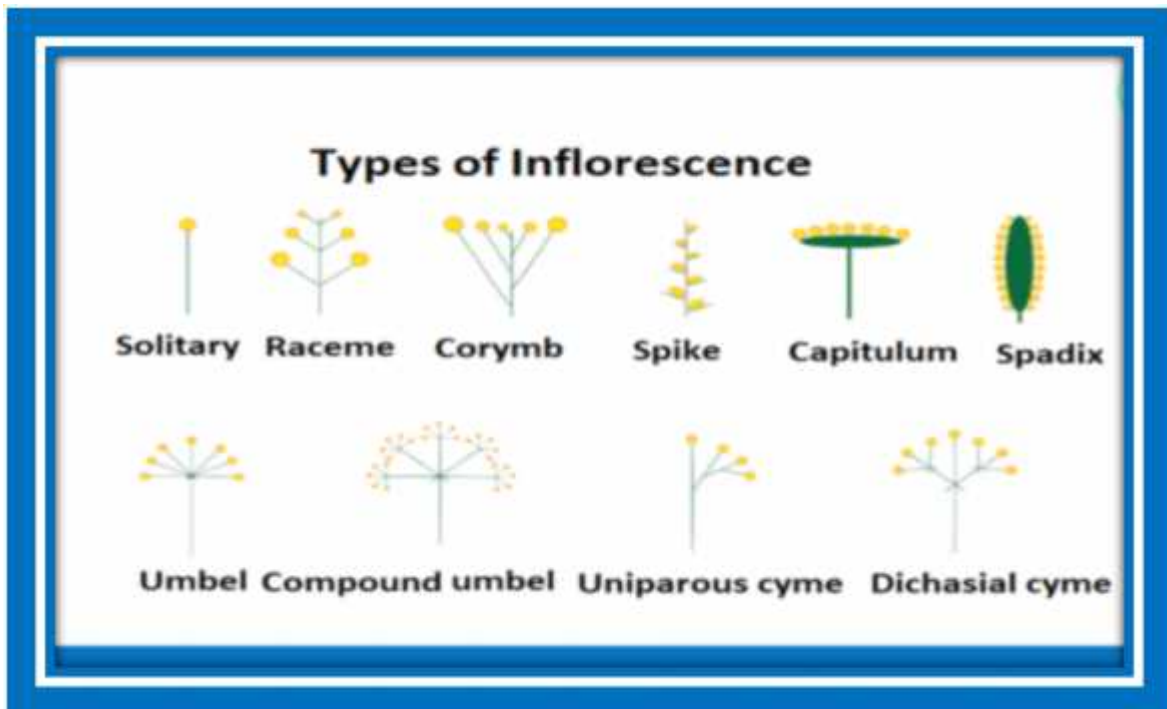
Hypogynous: In a Hypogynous flower, the ovary seems to be superior to the other three whorls. Here ovary is positioned high on the thalamus and other parts are below it, e.g., tomato, tulip, brinjal, etc.

Perigynous: In periginous flowers, the ovary is in the center and all four whorls are almost at same level. Here, the ovary is half superior/ inferior, e.g. are rose, peach, cherry, etc.

Epigynous: In the epigynous flowers, ovary is present inferior to calyx, corolla and androecium. The thalamus in this encloses the ovary inside it & the other three whorls are located above this, e.g., daffodil, cucumber, etc.

2.4.2. The inflorescences

An inflorescence is a group or cluster of flowers arranged on a stem that is composed of a main branch or a complicated arrangement of branches. Morphologically, it is the modified part of the shoot of seed plants where flowers are formed on the axis of a plant.

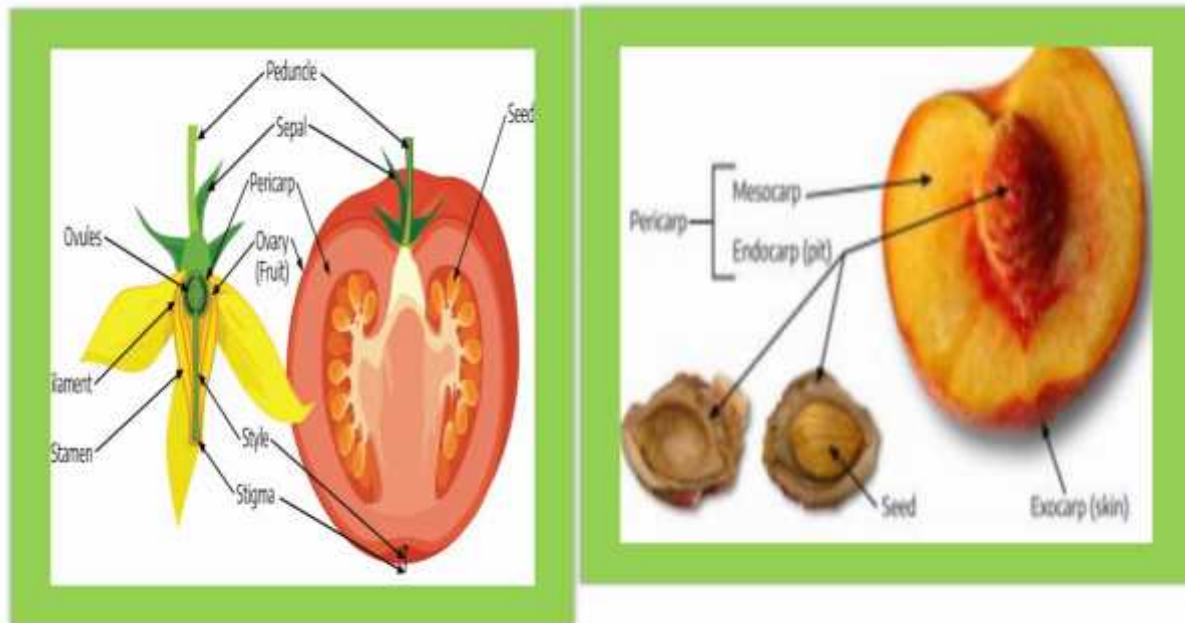


2.5. Seed morphology.



✓ **Types of Seeds.** The two types are: Monocotyledonous Seed and Dicotyledonous Seed

2.6. Fruit morphology.



The fruit have three layers:

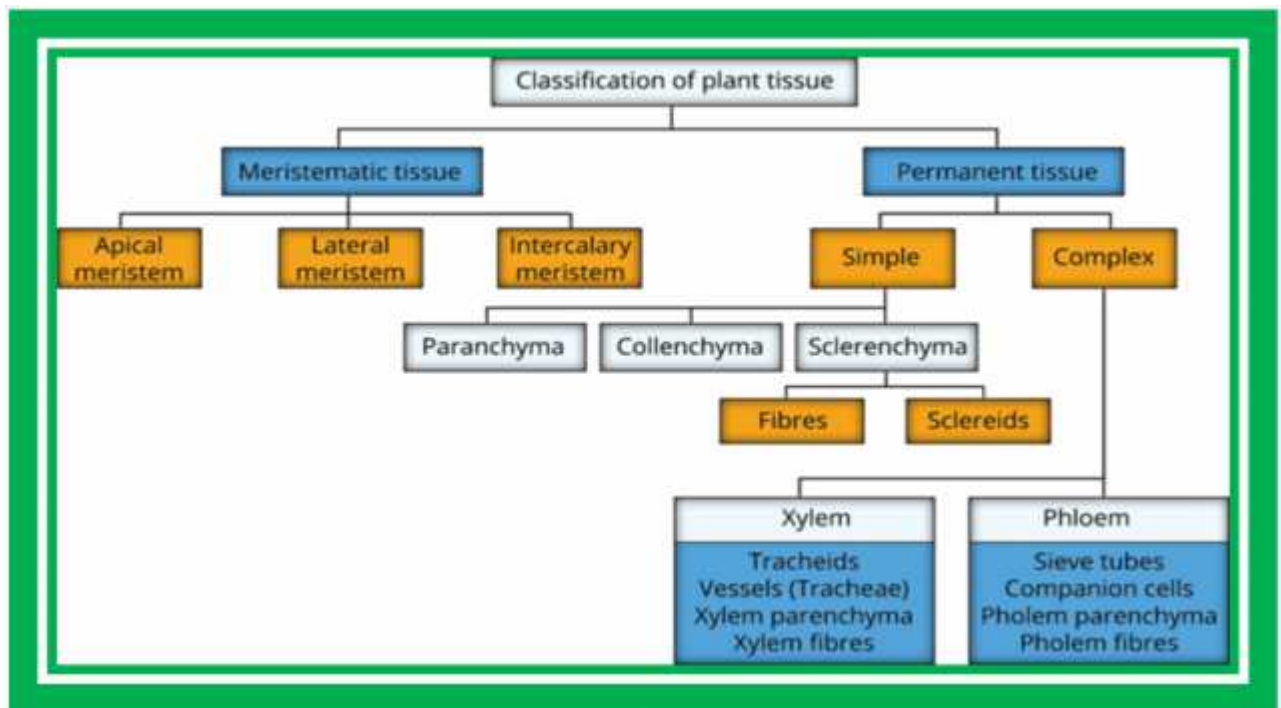
- **Exocarp:** the outer layer of the pericarp (also called the epicarp)
- **Mesocarp:** the middle layer (fleshy in this example)
- **Endocarp:** the inner layer (hardened with sclerenchyma cells).

Chapter 3: different types of tissues

In the higher plant organs, cells with the same organization and function are grouped into sets called **Tissues**. In higher plants (vascular tissues; with highly differentiated conductive tissues) the following tissues are distinguished:

- **Tissues of nutrition or reserves** main tissues, present in all organs
- **protective tissues**
- **Conduction tissues**
- **Support tissues**
- **Secretion tissues**

Adult tissues come from undifferentiated tissues (meristems), the morphological and physiological transformation of meristematic cells into differentiated adult tissues is the process of cell differentiation.

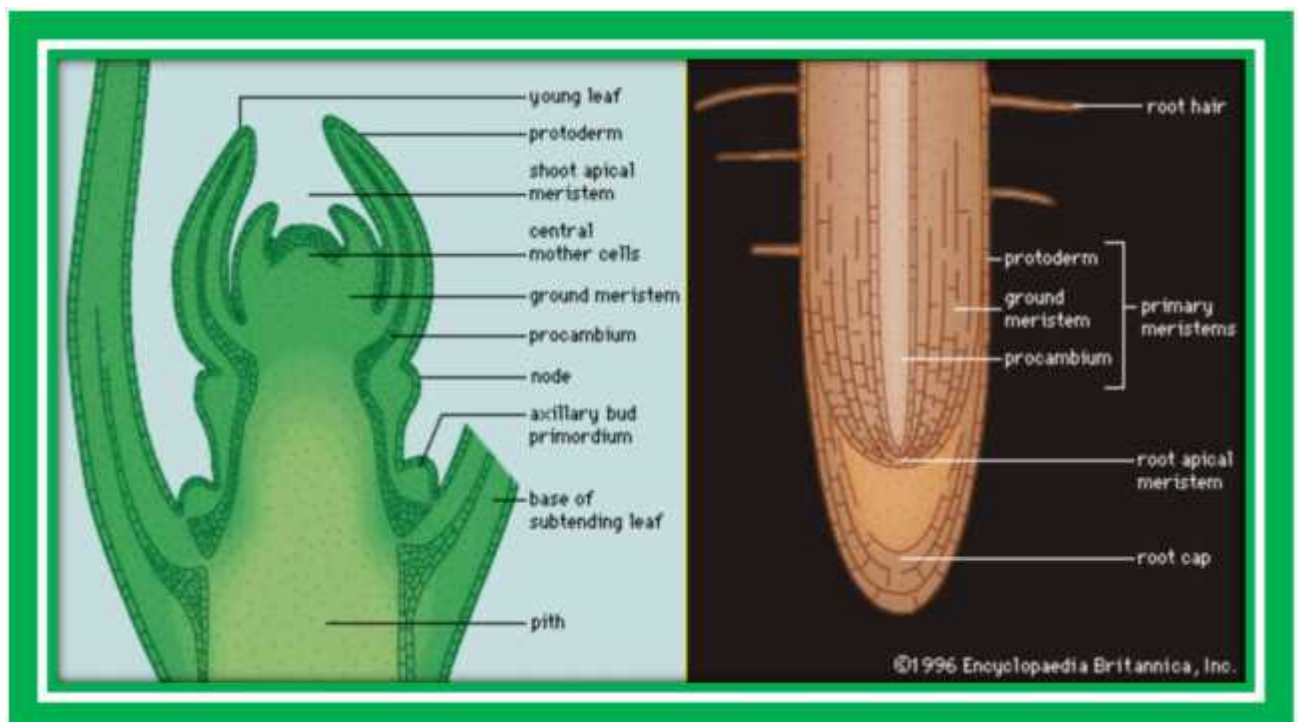


1. Meristems:

Adult or differentiated tissues are constructed from cells formed by undifferentiated plant tissues called Meristems whose cells are actively multiplying.

There are two kinds of meristem, different from each other by their location in the plant, their cytological characteristics and their roles in the construction of organs and tissues: primary meristem and secondary meristem.

1.1 Primary meristems:



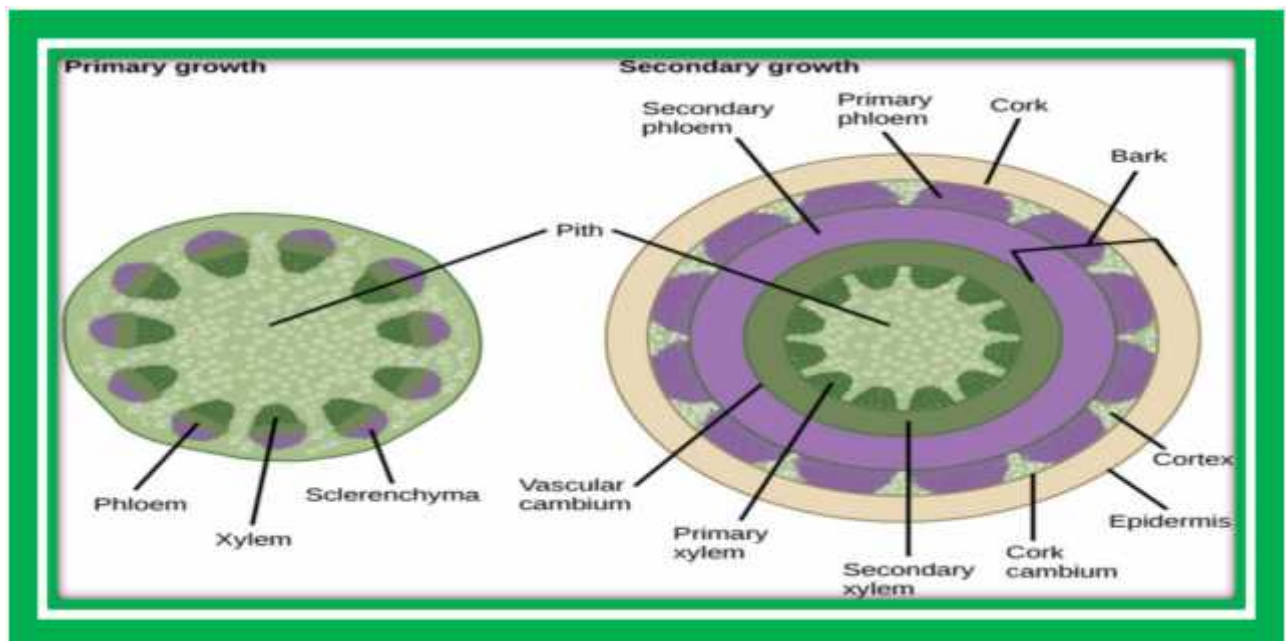
They are located at the end of the stems and roots, which they ensure the growth in length,

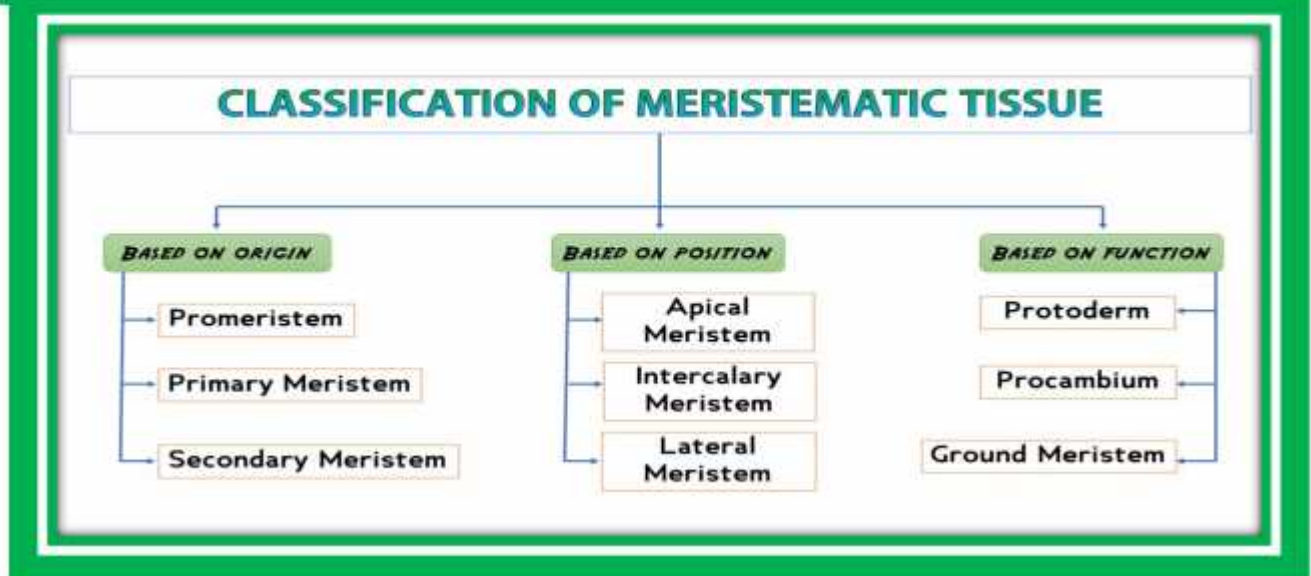
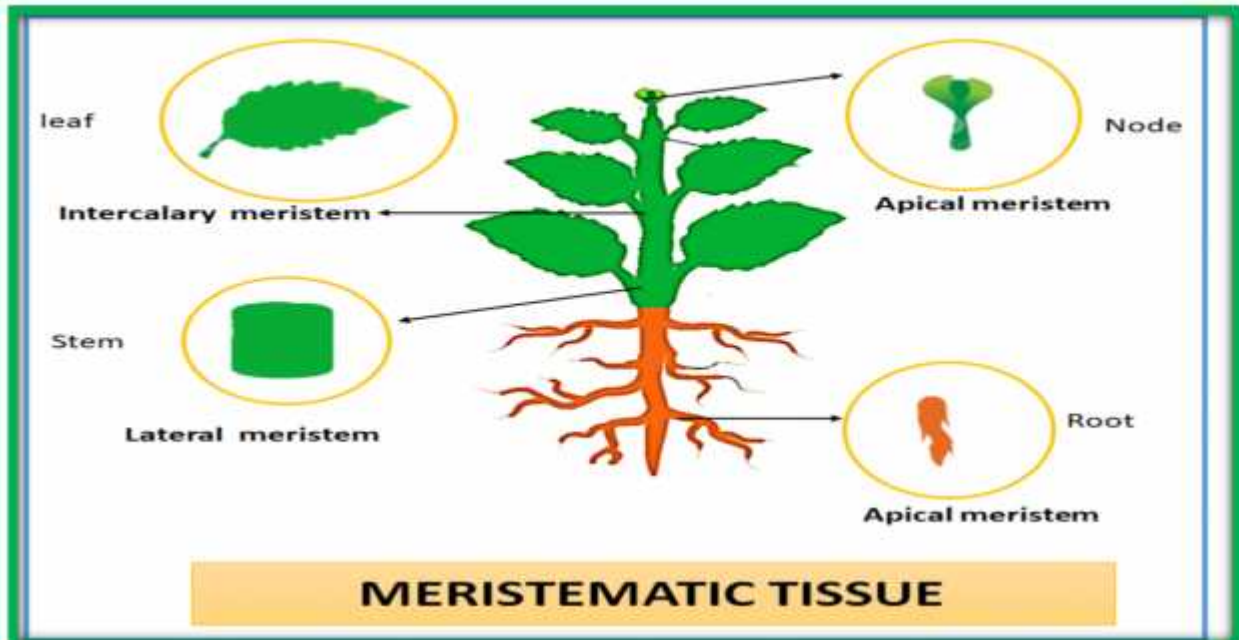
hence their name of apical or terminal meristem. Their cells are small, isodiametric (no elongation in a preferred direction), and perfectly jointed (no meatus between the cells). Their wall is primary, thin, formed only of cellulose and pectic compounds. The cytoplasm is rich in ribosomes, the nucleus contains other chromatin one or more voluminous nucleolus. The nucléoplasma ratio is greater in meristematic cells than that of differentiated cells. The vacuum apparatus is reduced (small vacuoles), are spherical and arranged in a very fine network. Mitochondria are numerous and there are no differentiated plasters, only proplasts.

1.2 Secondary meristems:

They are located in the old parts of the stems and roots which they ensure the growth in thickness. The cells have a rectangular contour, arranged in very regular rows and oriented according to the rays of the organ in question.

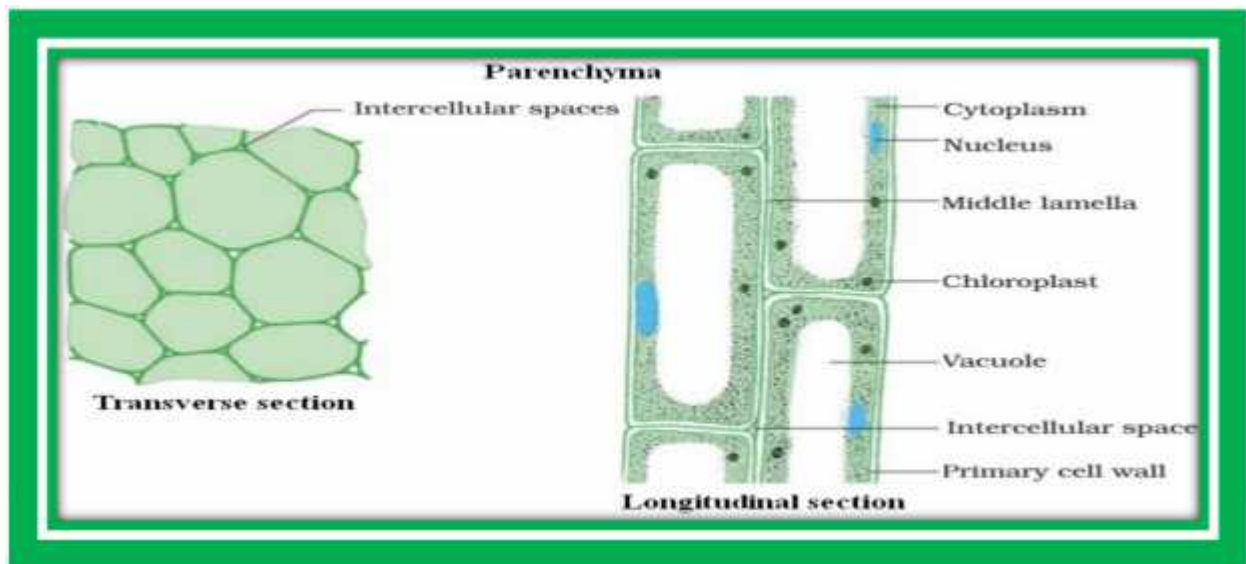
These cells are morphologically different from those of primary meristem, their thin cellulosic wall, many mitochondria and proplasts, the vacuolar apparatus is very developed contrary to what is observed in primary meristem, it is represented by two large vacuoles rejecting the cytoplasm and sometimes the nucleus at the periphery of the cell.





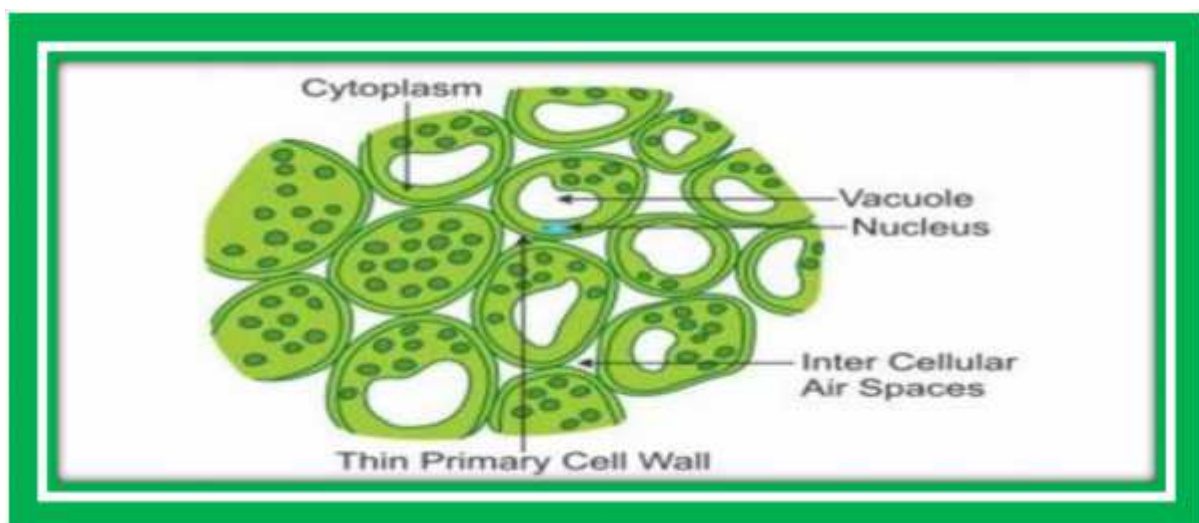
2. Parenchyma:

Parenchyma is a fundamental group of tissues, they constitute an important place in plant organs (leaves, green stems and young roots) and they perform vital functions (photosynthesis and accumulation of reserves). Parenchyma is a fundamental group of tissues, they constitute an important place in plant organs (leaves, green stems and young roots) and they perform vital functions (photosynthesis and accumulation of reserves).



The parenchyma, often the most abundant tissue is made up of isodiametric, globular or elongated cells whose vacuoles are well developed and in the cell wall is quite thin. Parenchyma presents specializations in relation to its position. We thus have chlorophyll parenchyma, sites of photosynthesis; reserve parenchyma that is often found in underground organs. With its living cells with rich cellular content, parenchyma mainly participates in nutritional functions and aquifer and aeriferous parenchyma.

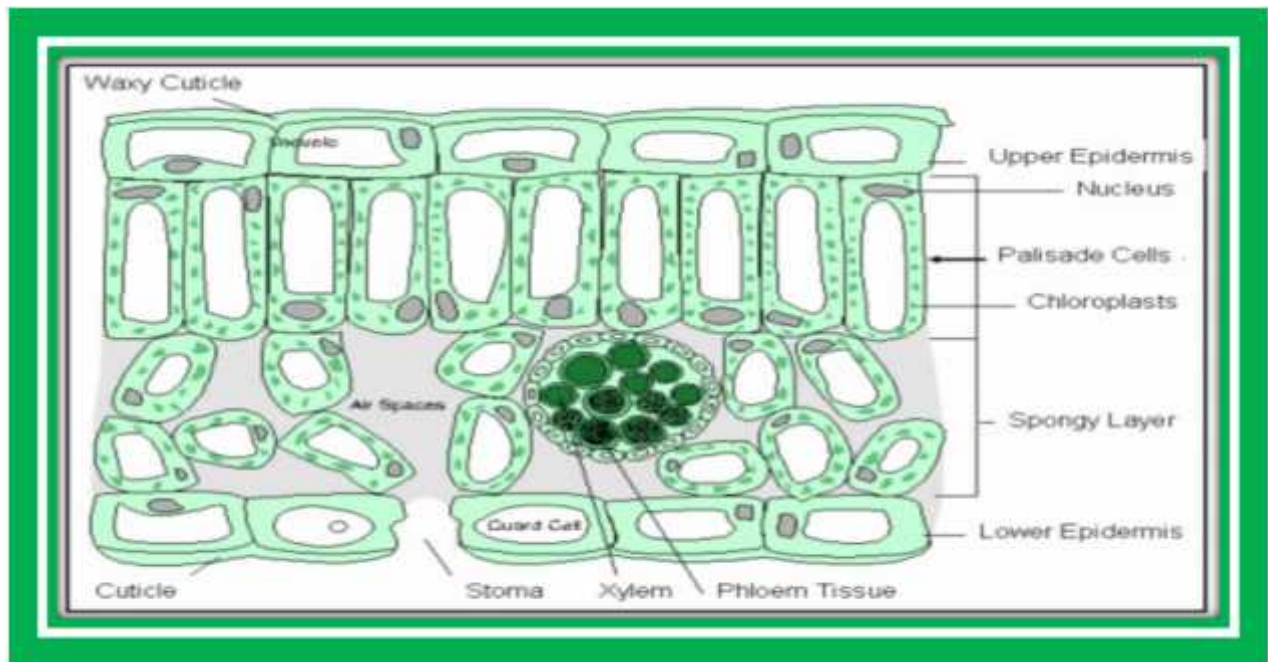
2.1 Parenchyma chlorophyllian:



They are characterized by the presence of many chloroplasts in their cells, which have the rounded shape, sometimes separated by large gaps ensuring the circulation of air. This type of parenchyma is abundant in the organs aerial (leaves, young stems) to which they give the green color. It is homogeneous in monocotyledons (e.g. Maize, Iris, Leek, etc.), whereas in dicotyledons it is heterogeneous; it consists of two regions:

- Towards the upper side of the leaf is the palisade fabric formed by one or two elongated cell bases, pressed together and rich in chloroplasts.

- Towards the underside is the lacuneous tissue, formed of short cells, more or less rounded, less rich in chloroplasts than those of palisade tissues and reserving between them great gaps where the inner atmosphere of the leaf circulates.



2.2 Reserve parenchyma:

They are located in underground organs such as roots (e.g. carrot, radish, beetroot, etc.) underground stems (rhizomes, tubers) and in seeds. This type of parenchyma is devoid of chloroplasts but their cells contain abundant reserves: soluble carbohydrates, starch grains, oils, etc.

In the aerial stems, the marrow, the deep parts of the bark and the parenchyma that accompanies the conductive tissues are formed by a reserve parenchyma often rich in starch grains. In general, the accumulated substances are reserves of carbohydrates, proteins and lipids.

2.2.1 Aquifer parenchyma:

These are cell parenchyma of large volumes, provided with highly developed vacuoles, rich in water and often mucilaginous. They are abundant either in the stems or in the leaves of succulents (succulents) where they constitute a reserve of water usable by the plants during the period of drought. It is a variety of parenchyma where water is the stored substance.

2.2.2 Aeriferous Parenchyma:

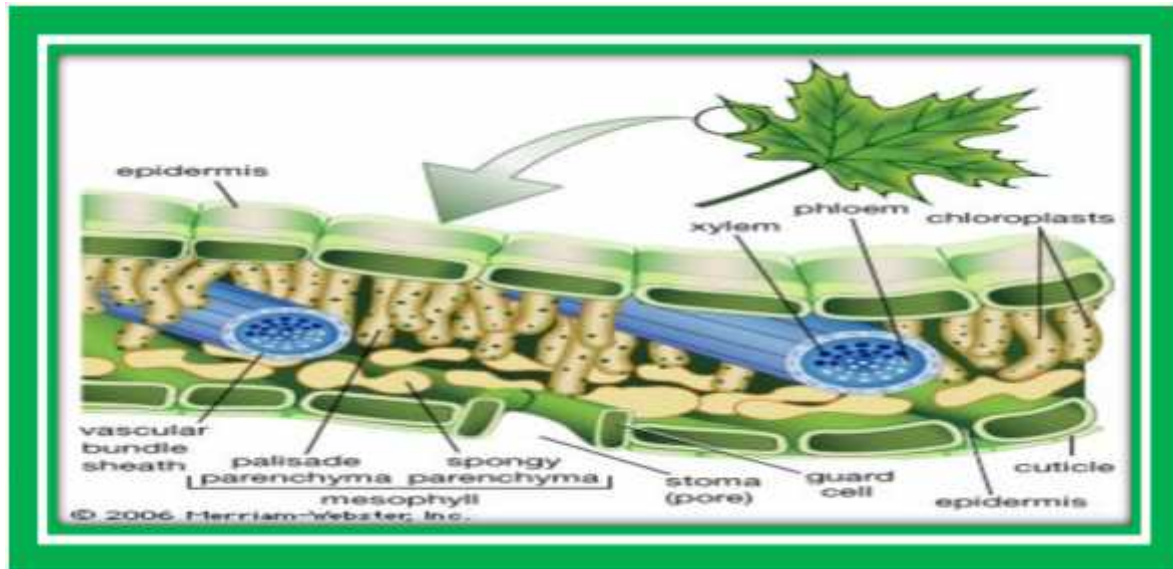
This parenchyma is quite common in aquatic plants, are lacunose tissues where the gaps are very large and store air.

3. Protective tissues:

In terrestrial plants, parenchymal tissues whose cells have thin, permeable walls would be rapidly killed by severe dehydration if they were not separated from the relatively dry external environment by impermeable tissues: The protective tissues.

There are two types of protective tissue: epidermis and cork (suber). These tissues are waterproof; they slow down perspiration, harmful to the tissues but prohibit gas exchanges between the parenchyma and the external environment (respiration and photosynthesis). These exchanges are nevertheless allowed at the level of interruptions existing within the epidermis and cork, where oxygen and carbon dioxide can be exchanged.

3.1 The epidermis:



An epidermis is a tissue that covers the parenchyma of the aerial organs (leaves and young stems), the various floral pieces and fruits.

The epidermis is a primary tissue consisting of a base of joint living cells sometimes covered with cuticle. The epidermis has a protective role.

There are epidermal cells that provide protection against excessive dehydration and stomata that provide gas exchange. In some plants, epidermal cells carry hairs that make the surface of stems and leaves more fluffy.

In the majority of plants, they constitute a single base of cells forming a simple epidermis and other type a composed epidermis.

The epidermal cells have variable forms according to the species considered: isodiametric in the vine, Very elongated in the leek. Their contours are straight except for certain species (potato, tomato, lettuce,.). The epidermal cells are closely juxtaposed and intercellular meats are not distinguished.

A stoma is essentially constituted by an opening (ostiole), delimited by two kidney cells. They are characterized by the presence of chloroplasts and a thickening of the cellulosic membrane into cers of ostiole. In addition to aerating stomata (ensuring gas exchange), there are other types of stomata (aquifer stomata), which are used for the emission of water in the liquid state (guttation phenomenon). They exist little on the edge of the leaves and their number and lower than that of aerating stomata.

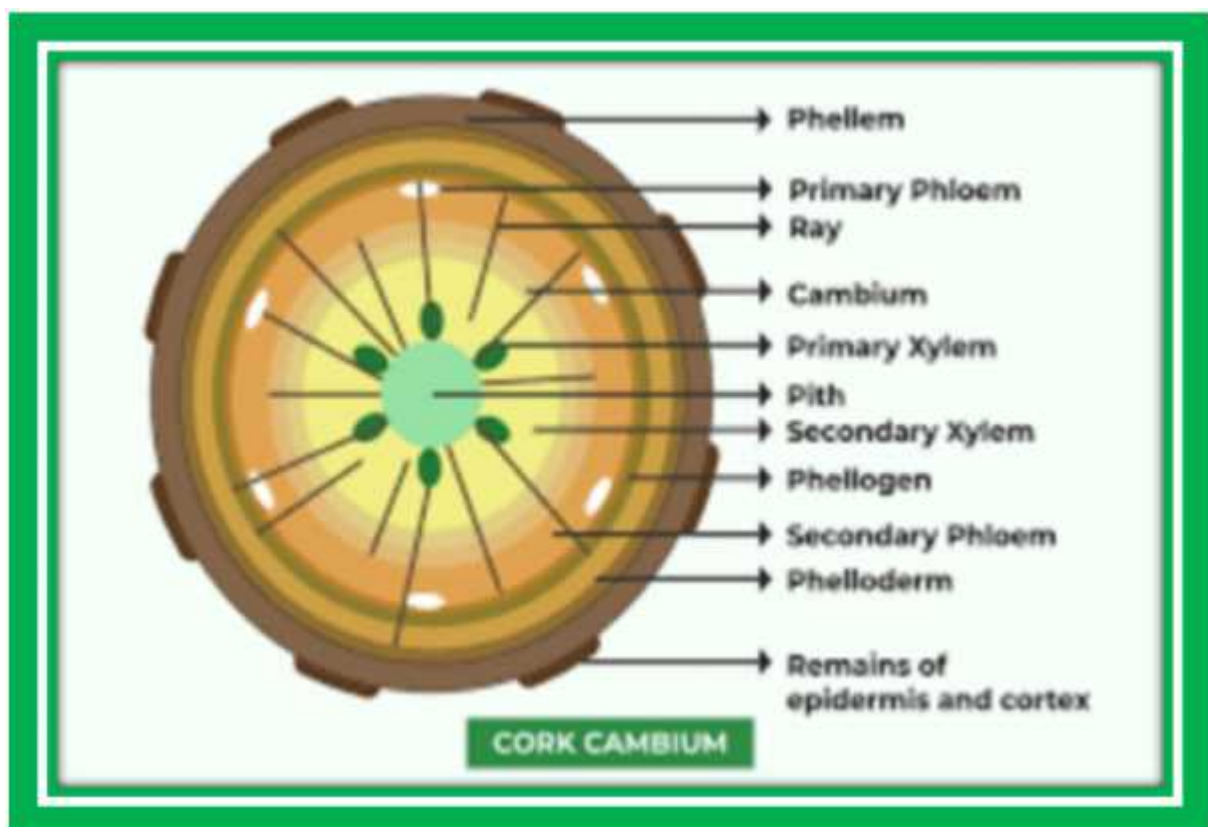
In many plants, the epidermis has hairs of very different shapes and structures:

- Unicellular hairs (papillae): formed by the extension of an epidermal cell (e.g. petals of roses).
- Pluricellular hair: formed by several cells resulting from the proliferation of an epidermal cell.

3.2 Cork or Suber:

Commonly called cork, suber is a plant tissue located on the periphery of a stem (or trunk) or root. It is a tissue of secondary origin; it comes from the differentiation of meristematic cells resulting from the functioning of a secondary meristem, the suberophellodermal or phellogenetic seat. It has a protective role. Because the cells are impermeable, all the cells outside the suber are doomed to die. These dead peeling cells are the rhytidome in woody plants, or more simply the bark of trees. The subuser seat found on the surface of young people is of primary origin.

Suber is a late lining tissue of adult organs with secondary growth (diameter growth). Of yellow-brown appearance, this protective tissue is derived from the phellogen by centrifugal differentiation. Due to its thick growth, it separates the epidermis and cortical cylinder from the rest of the root or stem, and can thus partially or completely replace the epidermis.

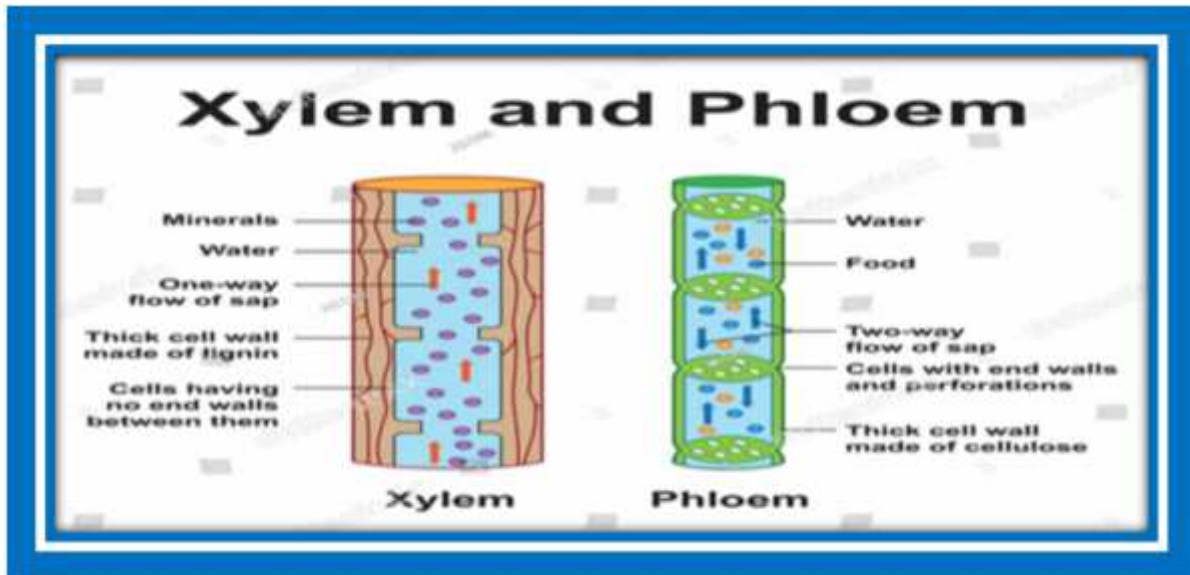


The suber consists of dead cells, rectangular in shape, very joined and filled with air, hence its lightness. Their wall is impregnated with suberine (lipid polymer associated with waxes, waterproof). It is this substance that, by preventing exchanges, leads to the death of the cell. To allow the survival of the rest of the organ, we observe locally areas with meatus whose cells are not joined. They are lenticels allowing gas exchange between the atmosphere and deep tissues.

4. Conductive tissues:

The conductive tissues of the Angiosperms are the xylem, woody tissues or vascular tissues essentially ensuring the conduction of the raw sap and phloem, screened tissues ensuring the conduction of the elaborate sap.

4.1 The primary xylem:



The xylem consists of:

- ♣ Of two types of sap conductive cells: the vessels consisting of rows of dead cells whose walls are impregnated with lignin; depending on the degree of lignin impregnation, we distinguish the punctuated or reticulated vessels. Tracheas, which are less rich in lignin, are called ringed or spiral. Tracheas never turn into vessels.

Woody fibers made of dead cells.

- ♣ Woody parenchyma formed of living cells that group the vertical parenchyma and the horizontal parenchyma. The first is mainly present in the secondary xylem and plays a reserve role, the second form of woody rays and results from the activity of the libero-woody cambium (secondary meristem).

Xylem allows the circulation of raw sap consisting of water and mineral salts drawn from the soil by the roots. In the vessels the circulation is essentially done vertically, while in the tracheas the presence of transverse wall causes a circulation in chicanes. Xylem also has a supporting role. The primary xylem comes from the differentiation of the primary meristem. In the organ in the process of elongation appears procambium, meristematic tissue of which some cells differentiate into tracheids capable of elongation (protoxylem) and others into vessels (metaxylem).

The differentiation of the procambium is not identical in the stem and in the root. It is centripetal in the roots and centrifugal in the stems. This difference makes it possible to distinguish a root from a stem. Xylem (from the Greek xylon, "wood") or xylemic tissue, is a constituent of plant

tissues formed by the association of vessels, dead or living supporting cells and associated cells. Xylem vessels consist of bundles of dead cells aligned and surrounded by lignin. They have the ability to transport large amounts of water and nutrients from the soil to the photosynthetic plant: the leaves. The xylem therefore conducts the raw sap (mineral).

Xylem is composed of dead cells. Thus, the solutes do not need to cross a plasma membrane to transit in the plant which allows it substantial energy gains by avoiding the use of dependent ATP pump.

In some primitive plants, such as cryptogams plants and gymnosperms, conductive vessels are called tracheids (protoxylem). They consist only of narrow cells, elongated, beveled and superimposed without perforations between the vessels or disappearance of the transverse partition separating the cells.

In more advanced plants, and in particular angiosperms, we find next to tracheas, other cells specialized in the transport of raw sap: vessel elements (metaxylem). These are usually old large and short cells in which the walls of the ends have completely disappeared, thus creating "open" tubes.

The vessel elements ensure a more efficient transport of raw (mineral) sap than tracheas.

4.1.1 Conductive Elements:

The study of the xylem of vascular plants led to the distinction between two kinds of conductive elements: tracheid, primitive elements, little differentiated and woody vessels, more specialized, better adapted to the conduction role.

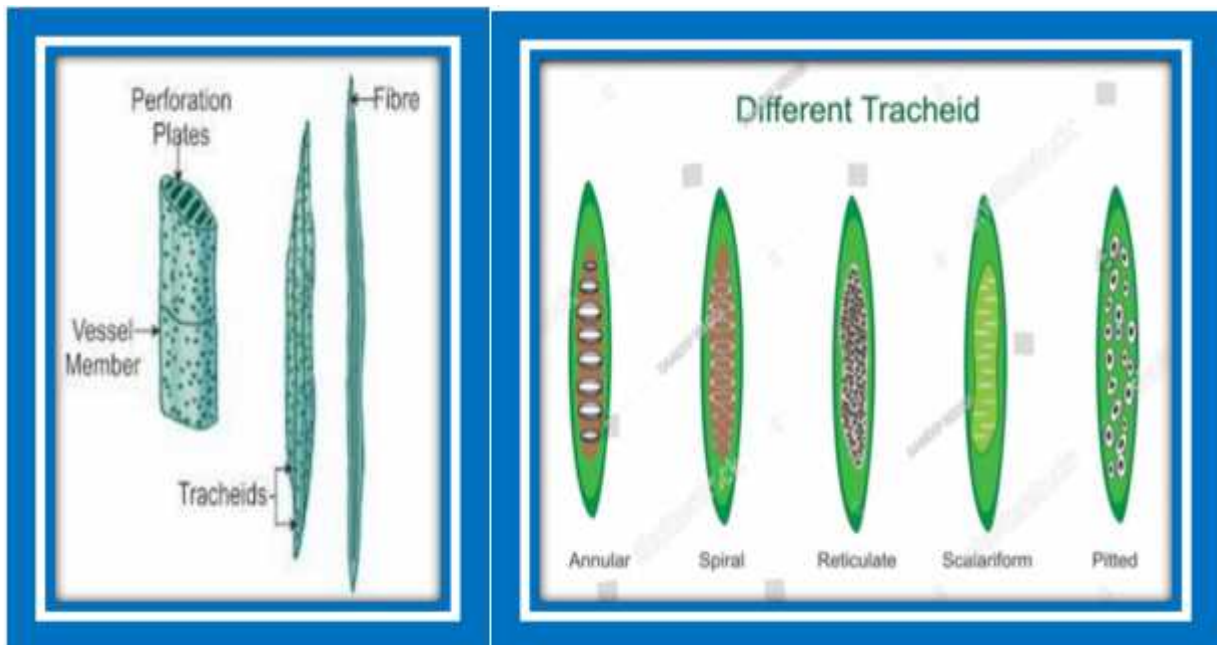
4.1.1.1 Tracheid:

They are relatively little specialized conductive elements, which constitute almost all the xylem of the least evolved vascular plants.

These are elongated cells, with beveled ends, devoid of protoplasm when they are completely differentiated. Their walls are rigid, their secondary walls are lignified, thin and the lumen of the tracheas is relatively large.

Tracheids communicate with each other and with neighbouring parenchymal cells by means of punctuations, depending on the form and organization of these punctuations, two types of tracheids can be distinguished:

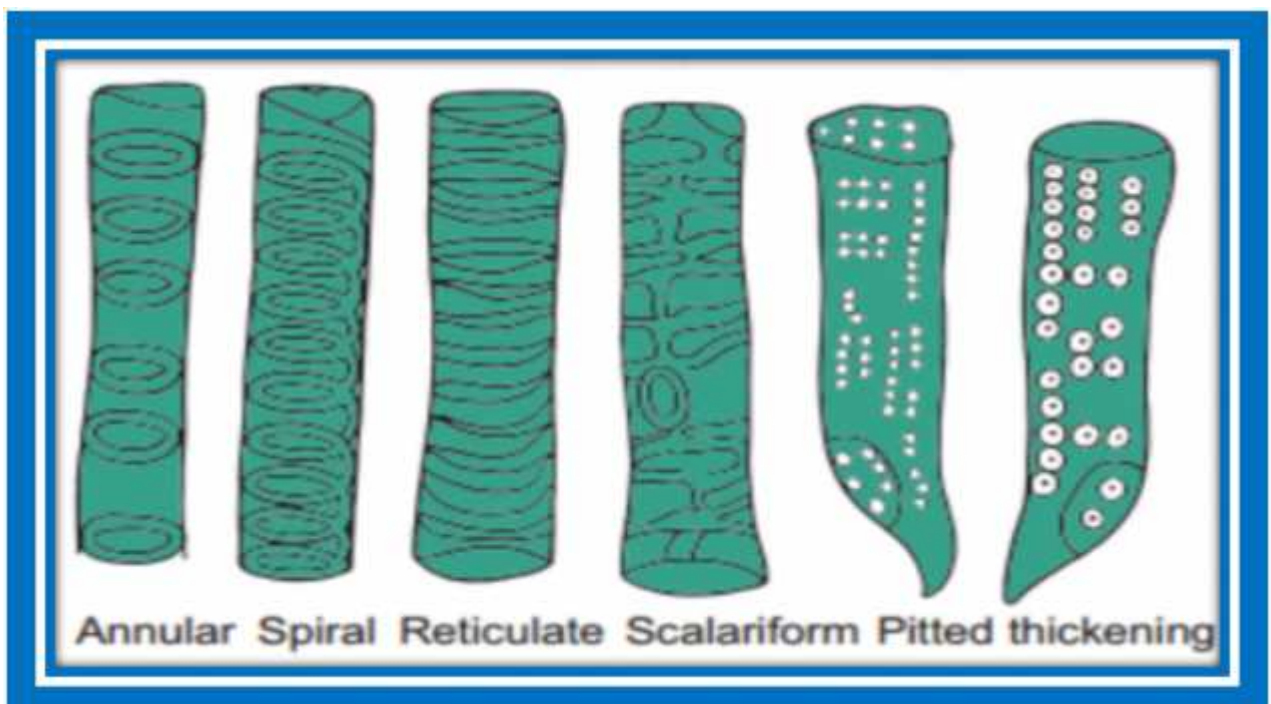
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4.1.1.2 Woody vessels:

Are characteristic conductive elements of the most advanced vascular plants such as angiosperms. These are long tubes whose wall presents towards the interior lignified thickening, of various arrangements. These thickenings correspond to a lignified secondary wall doubling inward the cellulose primary wall. Vessels can be:

- * Rings closer to least (ringed vessels).
- * More to tighter turns (spiral vessels)
- * Transverse bands more or less irregular, very close to each other (striped vessels). If the scratches are numerous and irregular, networked (reticulated vessels).
- * A continuous lignin coating except at the punctuations where the membrane is cellulosic is alone (punctuated vessels: pitted).



The lignin coating makes the vessel wall solid and holds the gaping (widely open) openings. In fact, are dead elements (no cytoplasm and nucleus).

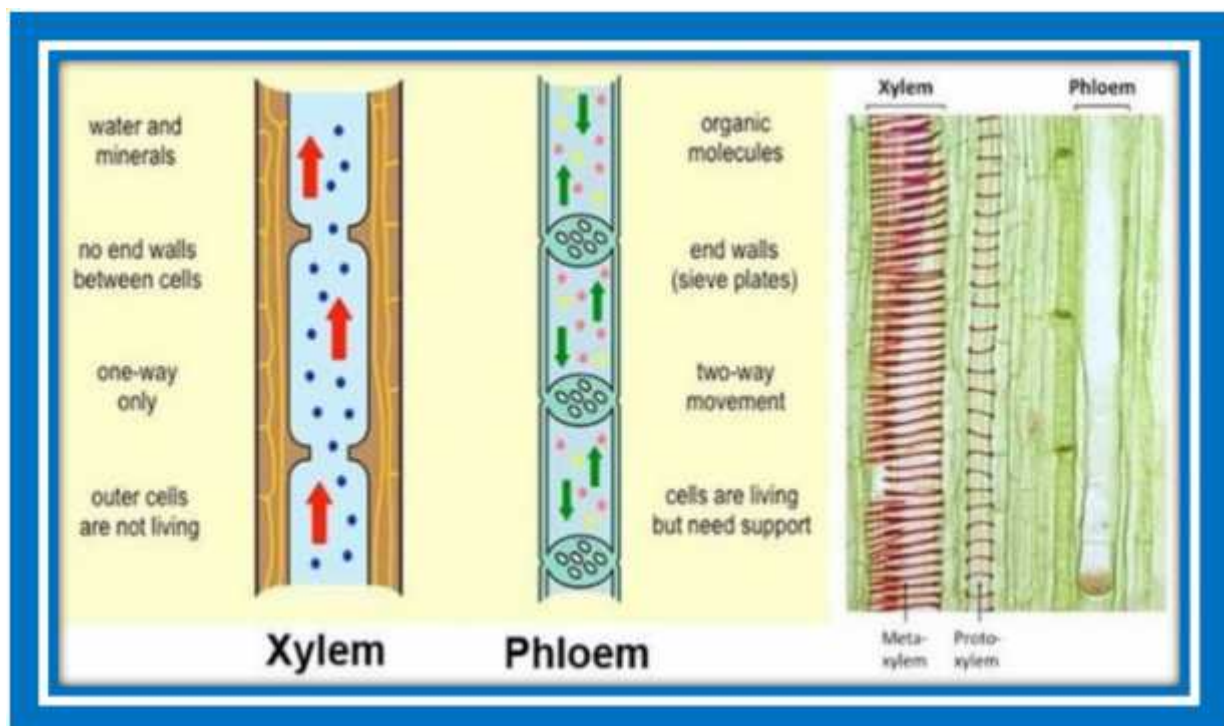
A woody vessel differs from a line of living cells that lengthen, whose side wall forms woody thickenings secreted by golgi bodies, the cellular content disappears and the partitions penetrate completely to form a perfect tube.

In the first differentiated woody elements in an organ, the transverse partitions remain cellulosic, may remain imperfect vessels, but in the true «perfect» vessels, the transverse partitions disappear. In the place of each partition is one or more perforations making directly communicated between them the elements constituting a vessel. Unlike a tracheal that is formed from a single cell, a vessel is formed by an assembly of differentiated cells.

The conductive elements of the primary xylem are arranged in plant organs in characteristic clusters called vascular or woody beams. Their arrangement in plant organs is an important element in defining the primary structure of these organs.

Depending on the time of their differentiation, during the formation and elongation of an organ, we distinguish two categories of conductive elements in the primary xylem: protoxylem and metaxylem.

* The protoxylem:



It is formed by conductive elements appearing at the beginning of xylem differentiation, when the growth of the part of the organ that contains them is not yet complete (stem or root). These are ringed or spiral tracheas of small calibers. They are observed in all vascular plants (including pteridophytes and gymnosperms).

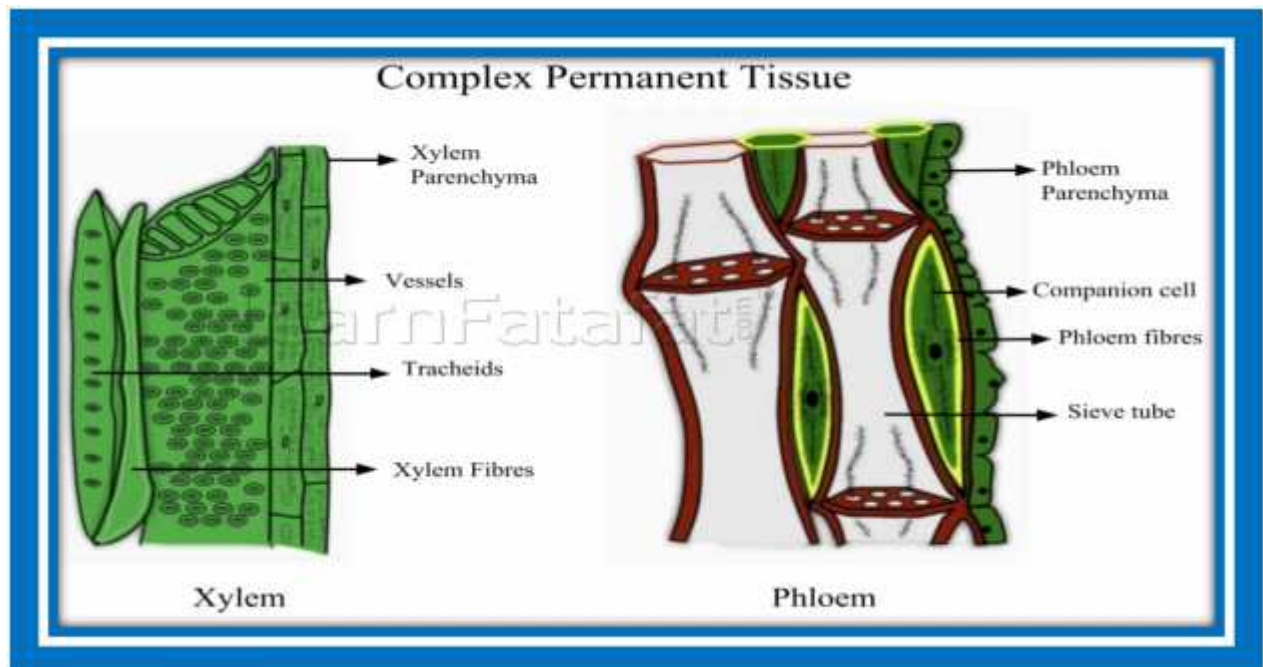
The vessels of the protoxylem can lengthen during the growth of the organ by spreading rings and turns of turns, they are stretched and crushed. In the parts of the stems and roots whose growth is completed, we observe that traces of the protoxylem in the process of resorption.

*** The metaxylem:**

It is formed by differentiated conductive elements when the growth of the part of the organ that contains them is completed. They are tracheids in pteridophytes and gymnosperms, vessels of strong calibres, striped, reticulated, punctuated, in angiosperms. These elements are not subjected to any stretching and persist for a long time only those of the protoxylem. When all the elements of the primary xylem are differentiated, the oldest are the narrowest (ringed and spiral tracheas), the most recent are the widest (scalariform and areolate tracheads, striped or punctuated vessels).

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4.1.2 Fibers:



These are elements ensuring only the supporting role and which constitutes a large part of the wood of the angiosperms (50 to 80%). Fibers are elongated, narrow cells with tapered ends. Their walls, lignified, very thick and the cellular light is very reduced. These walls have punctuations of small calibres and fewer. The fibers are then dead elements devoid of protoplasm.

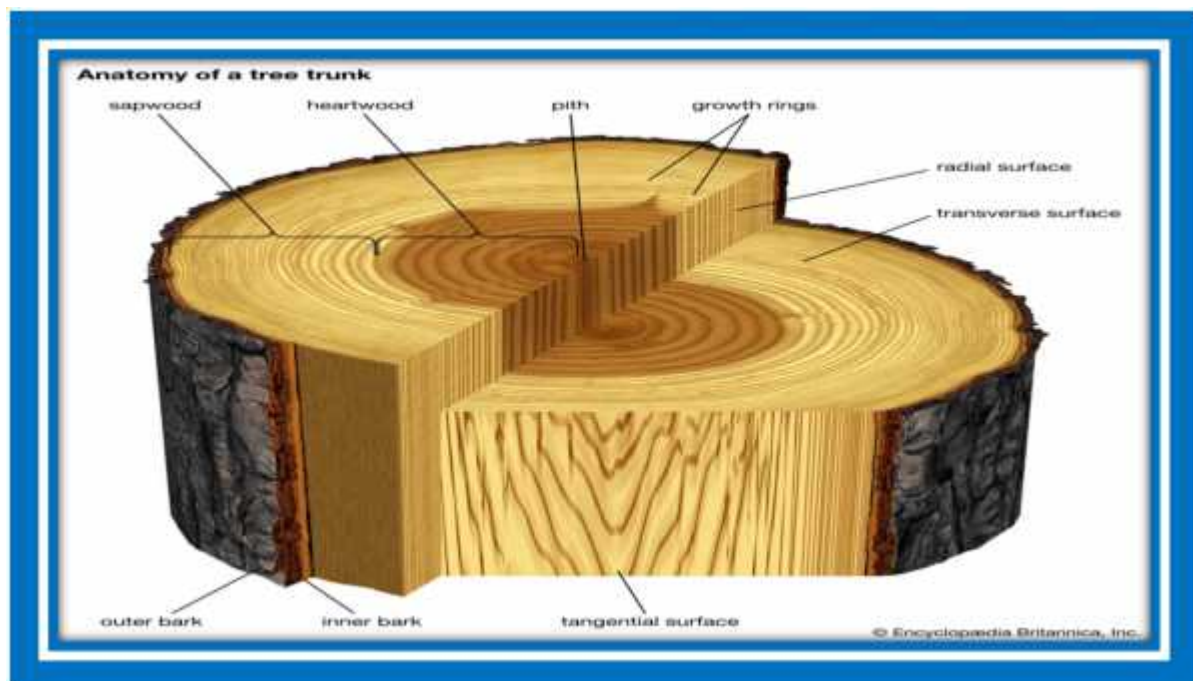
4.1.3 Parenchymal cells:

In addition to conductive elements and fibers, which are dead elements, xylem contains living parenchymal cells that frequently accumulate in their cytoplasmes starch grains and rarely oils, which are later used by the plant, parenchymal cells are therefore a reserve tissue (woody parenchyma).

The distinction of the longitudinal parenchyma in wood varies according to the species. The cell lines can be arranged within the other components of the wood (diffuse parenchyma, example of the genera *Malus* and *Quercus*) or grouped around the vessels (perivascular parenchyma example of the genus *Fraxinus*).

The thickness of the woody rays varies according to the species; uniseriated rays (a single layer example of willow, poplar), multiseriated rays (several layers example apple tree, oak) and one can also find very broad woody rays and uniseriated rays (example of beech).

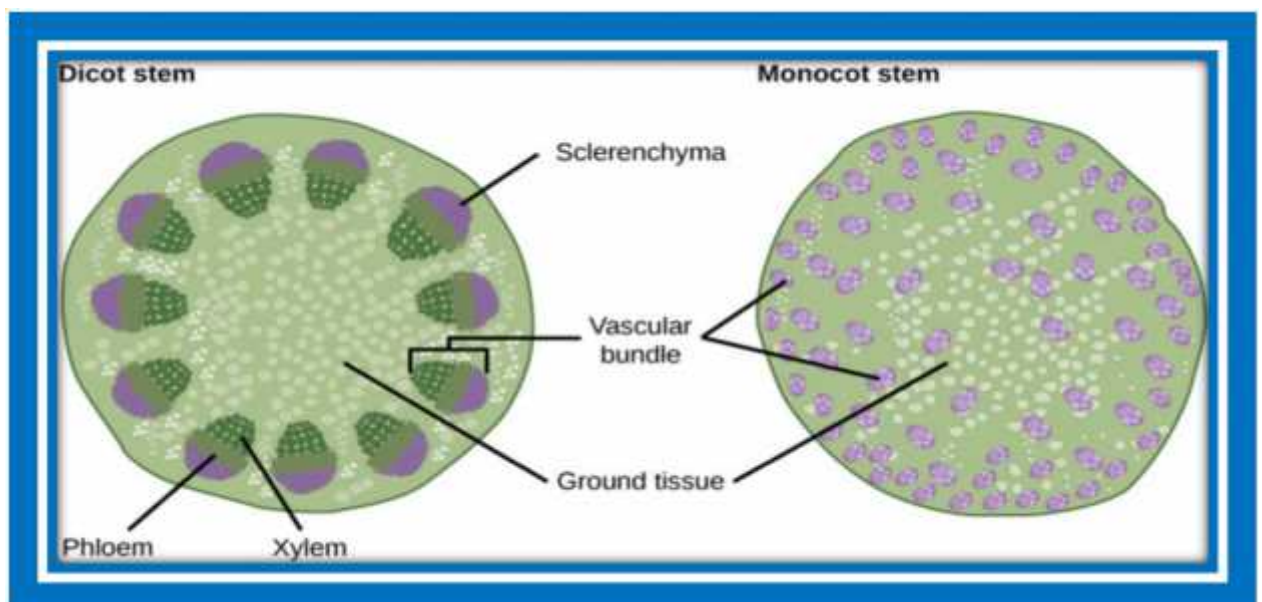
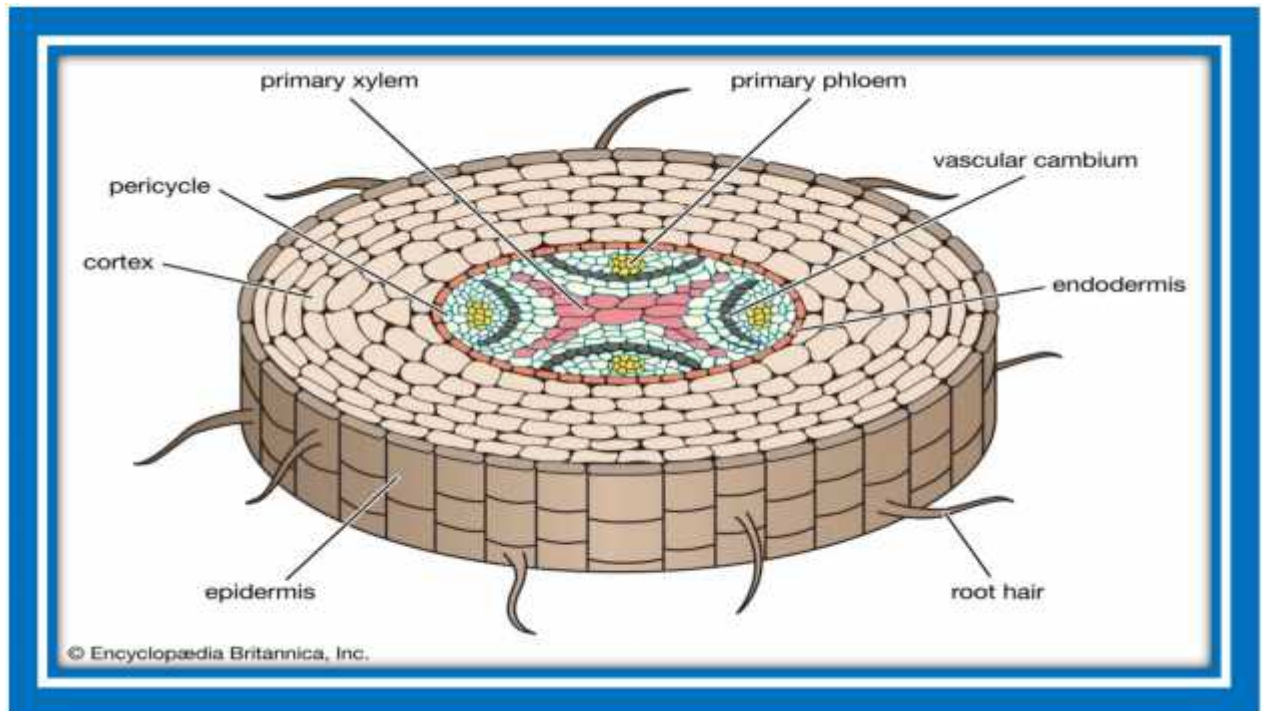
4.2 Secondary xylem or wood:

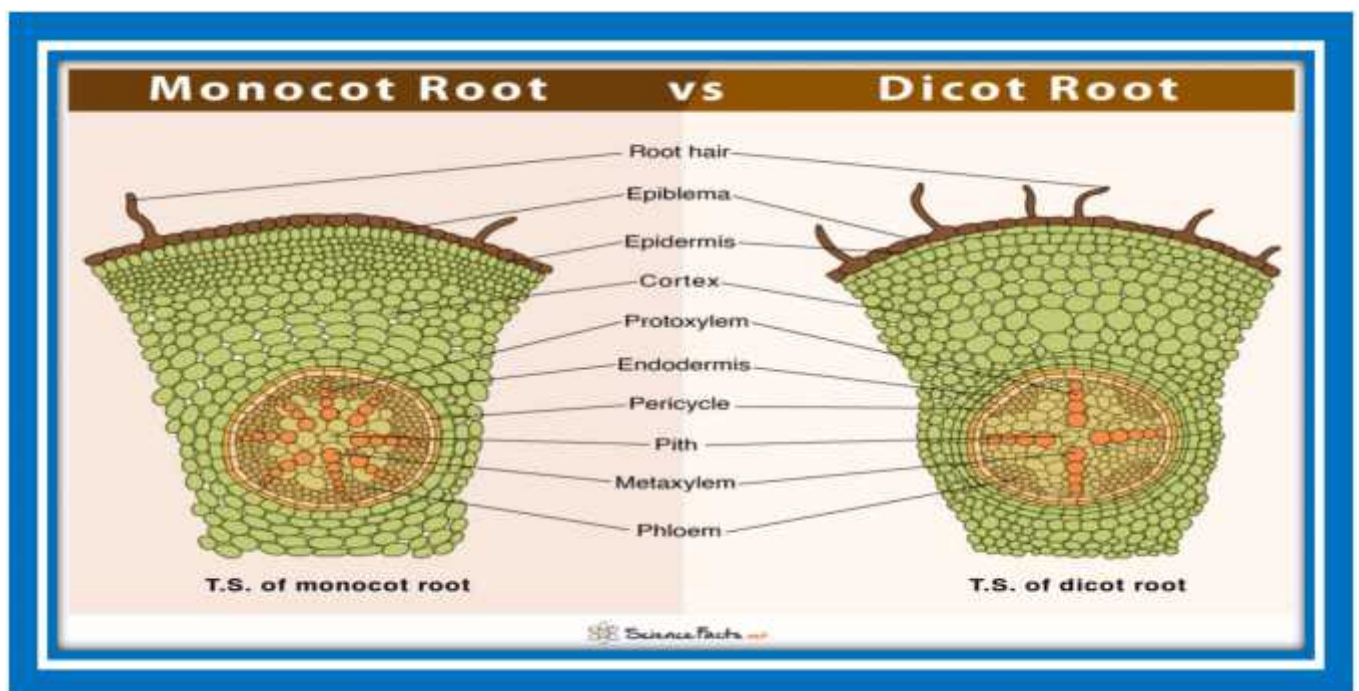
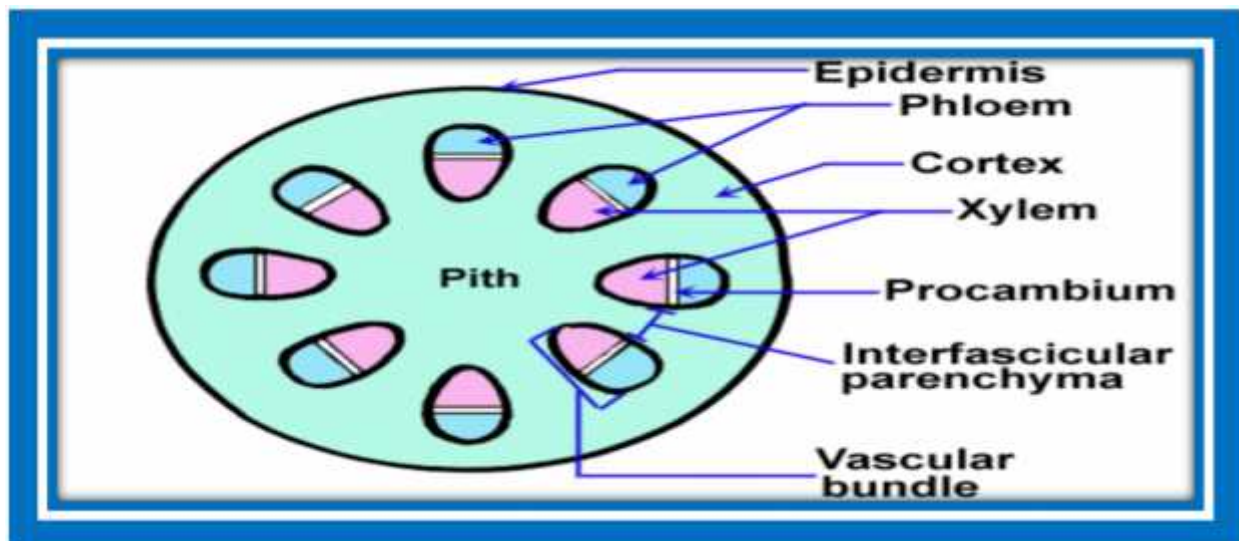


Secondary xylem or wood, located in secondary growth areas and deriving from secondary meristem. It is characterized by a radial alignment of its cells due to the functioning characteristics of the cambium liberia-ligneux (secondary meristem): it forms in internal position with respect to the cambium and leads to the formation of vessels, fibers, vertical and horizontal parenchymes.

The wood is formed of well visible concentric layers, the dark outer edge contrasting with the next layer inner edge which is lighter. Each layer is a woody ring or ring corresponding to an annual formation of wood; the light part is the initial wood or spring wood. The dark part is the final wood or autumn wood. The woody rays can be observed with the naked eye.

In some species, the deep part of the wood, the heart or heartwood is darker and more so than its external part; the sapwood which is a living wood of the trunk that ensures the conduction of the raw sap, while the heartwood is a dead wood. The transformation of the deep layers of the sapwood into core wood during trunk growth is marked by an accumulation of tannins, resins in the walls and cell cavities. Thus the wood of the heart becomes more durable rot-proof. The vessels are frequently blocked by tyloses that oppose the passage of substances. Finally, parenchymal cells die.





4.2.1 Angiosperm Wood

The structure of angiosperm wood is more inhomogeneous and variable than that of gymnosperms. It can be of two different vessel arrangement patterns: it belongs either to wood with statistically scattered pores or to wood with ring-shaped pores. Angiosperm wood does also contain rays. They are often considerably larger than those of gymnosperms.

A special case: Monocotyledon wood is characterized by a building plan that differs completely from that of the gymnosperms or dicots. This difference results in a strongly enhanced flexibility.

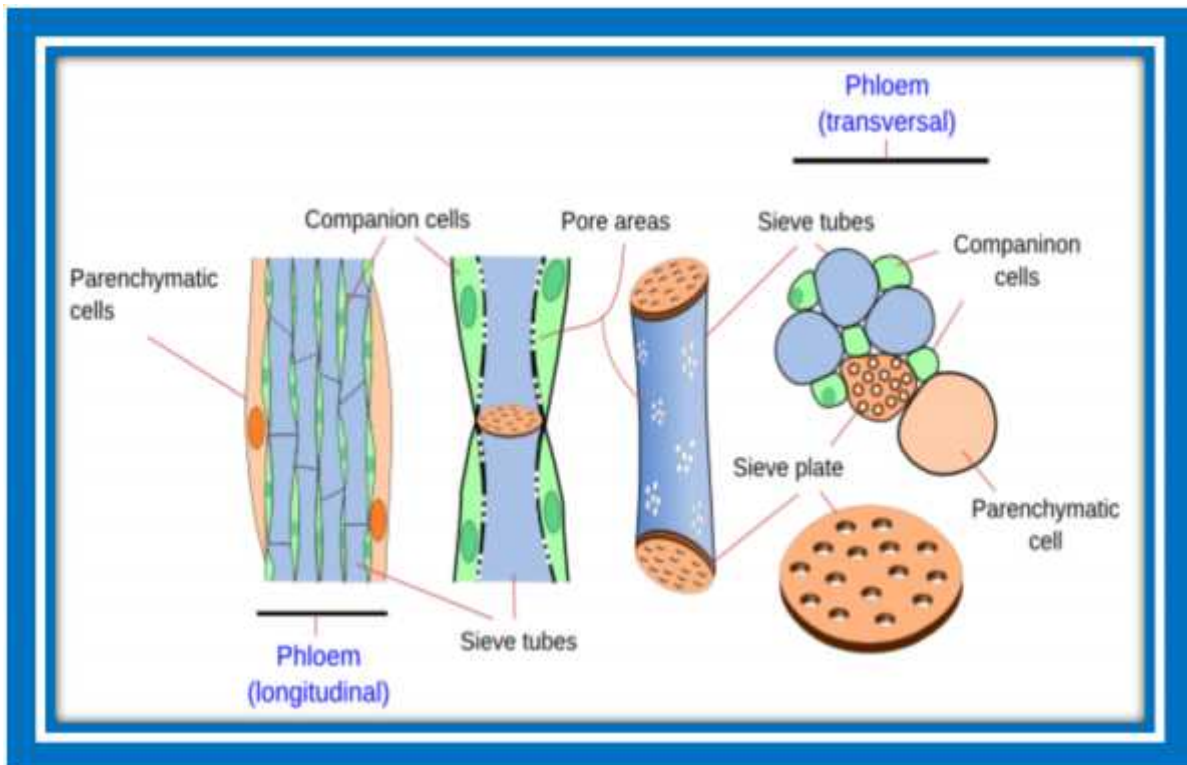
4.2.2 Gymnosperm Wood:

It is simpler, more homogeneous than angiosperms. It is essentially composed of tracheas and is fiber-free.

In the initial wood or spring wood, the tracheids are wide and provided with abundant punctuation with wide openings. The final wood or autumn wood presents only narrow tracheas with thick walls crossed by reduced punctuations.

The wood of the gymnosperms, devoid of fibers and presents as lignified element only trachedides is said homoxylated. The parenchymal cells are dispersed through the tracheas. The woody or medullary rays generally have a thickness formed by a single line of cells; are uniserized rays. These cells are living with cellulosic wall with some with lignified and irregular membranes are devoid of protoplasm. All have punctuations.

4.3 The primary phloem:



Phloem has a conductive role; it allows the vertical conduction of the elaborate sap which is a solution rich in organic matter. It also has a reserve role with parenchymes and a support role with Liberian fibers. The primary phloem formed by differentiation of procambial cells. Phloem can be part of the bark, for this reason its name comes from a derivative of the Greek word phloos which means bark. The primary phloem resulting from the differentiation of the procambium.

Several cell types make up phloem tissue:

- Screening tubes, long living cells, with longitudinal and transverse walls with pores called screens. These cells have no nucleus but a particular hyaloplasmic content with elongated proteins. Plasmalemma persists allowing exchanges.
- Companion cells attached to the screened tubes.
- Vertical and horizontal parenchymal liberian cells acting as a reserve, forming liberian rays and liberian fibers.

- Bast fibers, cells with thick, lignified or cellulosic walls.
- Companion cells attached to the screened tubes.

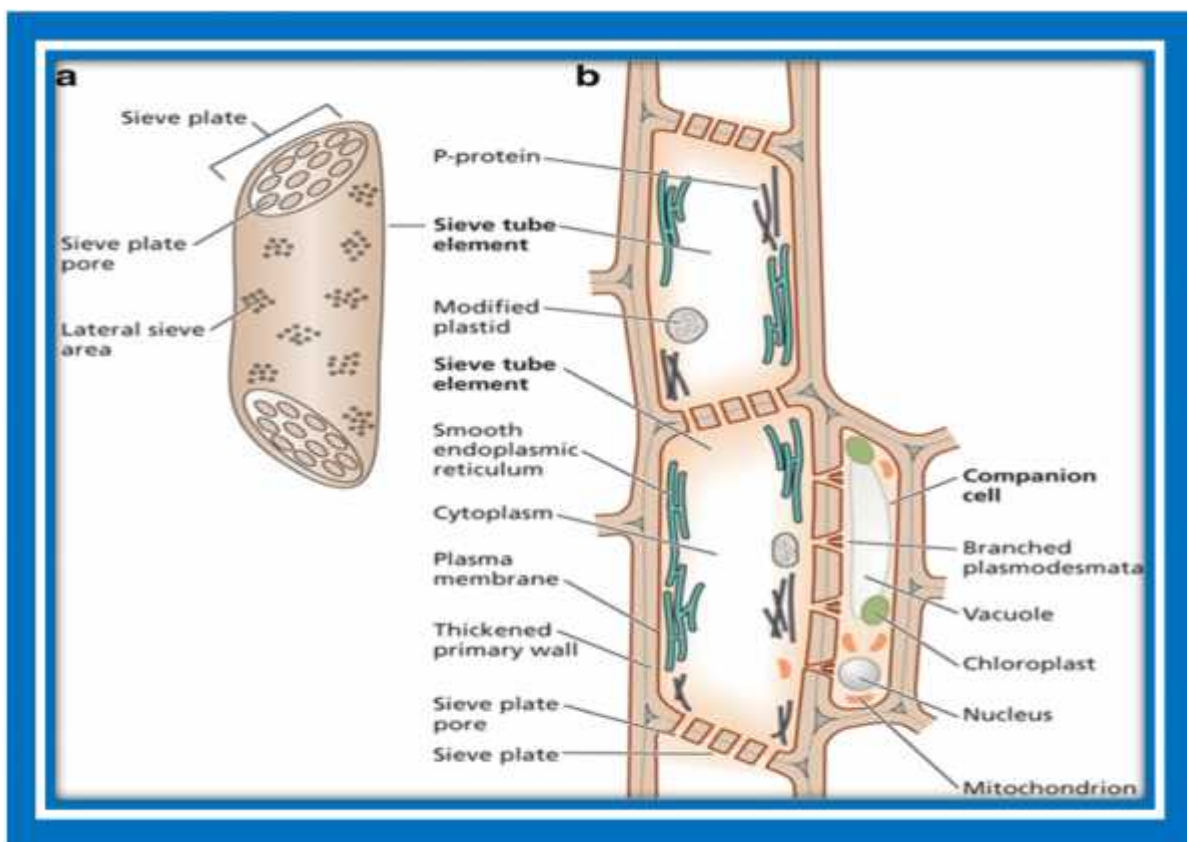
The movement of the sap developed in the phloem is bidirectional, while in xylem cells it is continuous (ascending).

4.3.1 Screening tubes:

The transverse walls of the cells of the screened tube are completely crossed by numerous walls or orifices interrupting the cellulose membranes as well as the medium lamella. The transverse partitions are therefore screens (screened tubes).

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Phloem vascular system. A Sieve element. B Sieve tube consisting of sieve elements

In gymnosperms screens are distributed on all the walls of the screened cells (transverse and longitudinal wall), but in most angiosperms have pores only on their transverse wall, their longitudinal walls are imperforated. For this type of plant, there are two modes of distribution of pores, simple screens (example squash) where the pores are distributed over the entire cross surface and compound screens (example tobacco, vine) where screens are divided into screens separated by poreless areas.

The screened cells are alive with cytoplasm without vacuole; the nucleus disappears in case of complete differentiation of the cells. The cytoplasm of the screened cells merge to form a finally screened tube.

The operation of a screened tube is of short duration, before the death of the screened cells a callose deposit constitutes a callus that is formed on either side of each screen or of each screened range and the screened cells then die case of the annual plants. In perennial plants, the screened tubes remain alive for more than a year, however in the autumn when the sap river stops, calluses appear on the screened beaches, in spring the cytoplasm of the screened cells dissolves the calluses and the passage through the pores is again free (temporary calluses). Companion cells or accessory cells accompany along the screened cells, they are elongated, narrow and separated from the screened cell by thin cellulosic membrane. These cells have large nuclei and do not contain starch. The anucleated riddled cells have a short life; when they die the companion cell divides lengthwise and provides two cells one of which differentiates into a riddled cell replacing the dead riddled cell which will then be resorbed.

The elements of the primary phloem are arranged in the plant organs in characteristic clusters called screened beams.

In stems, roots and leaves, the arrangement of screened bundles associated with woody bundles allows to define the primary structure of these organs. Depending on the time of their differentiation during organ formation, two categories of conductive elements in the primary phloem are distinguished:

4.2 Protophloem and Metaphloem.

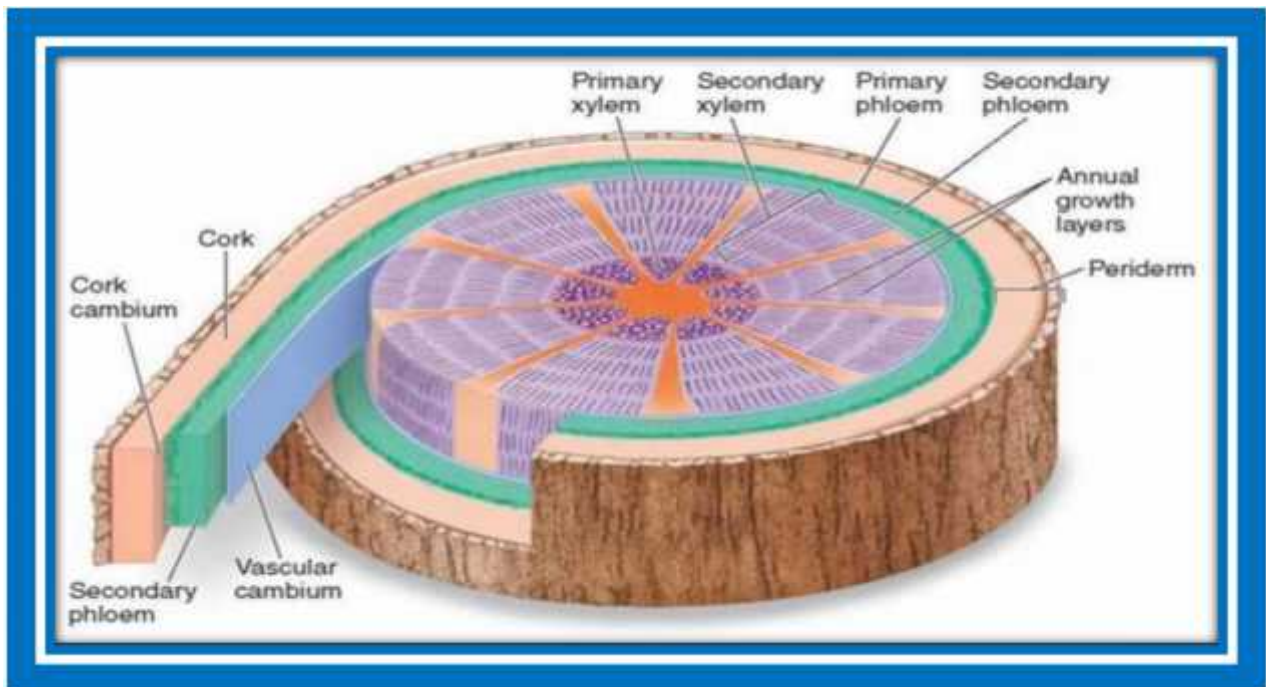
Protophloem	Metaphloem
Definition	
Protophloems are the first structures that are produced as a result of primary growth in the phloem.	Metaphloems are formed after the formation of protophloem.
Growth	
It is formed even before the maturation of plant organs.	It is formed after the maturation of plant organs.
Composition	
It is composed of sieve tubes, phloem fibres and phloem parenchyma.	It is composed of sieve tubes, phloem fibers, companion cells and phloem parenchyma.
Companion Cells	
Companion cells are absent.	Companion cells are present.
.0	
The protophloems have smaller cells and are therefore less prominent structures.	They have bigger cells and are more prominent structures.
Sieve Elements	
The sieve elements are narrow and thin.	The sieve elements are wide and long.

Life	
They are short-lived and get crushed in the later stages of growth.	They are longer living than protophloem but may get crushed during secondary growth.
Stretchability	
The cells are more stretchable.	The cells are less stretchable.

4.4 Secondary phloem or liber:

The secondary phloem (or liber) resulting from the differentiation of cambium (libero-ligneous generating seat). In the roots this formation is centripetal, while in the stems it is centrifugal.

That is: for a centripetal formation the phloem will form from the outside to the inside of the central cylinder and vice versa for a centrifugal formation (inside to outside). The same type of formation is found for xylem.



4.4.1 Freedom of Gymnosperms:

It is formed of screened tubes devoid of companion cells, mixed with cells of the longitudinal liberian parenchyma that frequently contain starch grains and vacuoles rich in tannins.

Depending on the plant family, bast fibers can be present (example of pine) or missing (example of cypress). In case of their presence, they are arranged in concentric strata. Like the woody rays they pass through the cambium, the Liberian rays are uniseriated (a single cell base).

4.4.2 Liber of angiosperms:

It is more complex and diverse. The screened cells are associated with companion cells, their transverse walls more or less inclined according to the species have simple or compound screens.

The cell lines of the longitudinal parenchyma can be dispersed in the liber or form thin concentric layers alternating with layers of screened tubes.

The diversity in the organization of the liber is due to the availability of fibers; when they are scarce, they are dispersed in the screened tubes and the Liberian parenchyma. When they are numerous, they constitute concentric strata alternating with the strata of the screened tubes and the Liberian parenchyma (stratified liber, example of the vine).

Liberian rays have the same organization as woody rays; uniseria rays (example of willow) or multiseria rays (example of oak).

4.5 Liberian parenchyma and bast fibers:

Screen tubes and companion cells are frequently associated with parenchymal cells whose cellulosic walls are thinner than those of the screen tubes.

The fibers are less abundant in the phloem than in the xylem, they are distinguished by their thick wall and their narrow light. They may be missing in several species.

5. Support Tissues

The supporting tissues ensure the rigidity and strength of the organs that contain them (mainly aerial organs). It is a modification of the cell wall that gives the supporting tissue cells their properties and from the characteristics of this wall we distinguish two categories: collenchyma and sclerenchyma. The diversity in the organization of the liber is due to the availability of fibers; when they are scarce, they are dispersed in the screened tubes and the Liberian parenchyma.

When they are numerous, they constitute concentric strata alternating with the strata of the screened tubes and the Liberian parenchyma (stratified liber, example of the vine).

Liberian rays have the same organization as woody rays; uniseria rays (example of willow) or multiseria rays (example of oak).

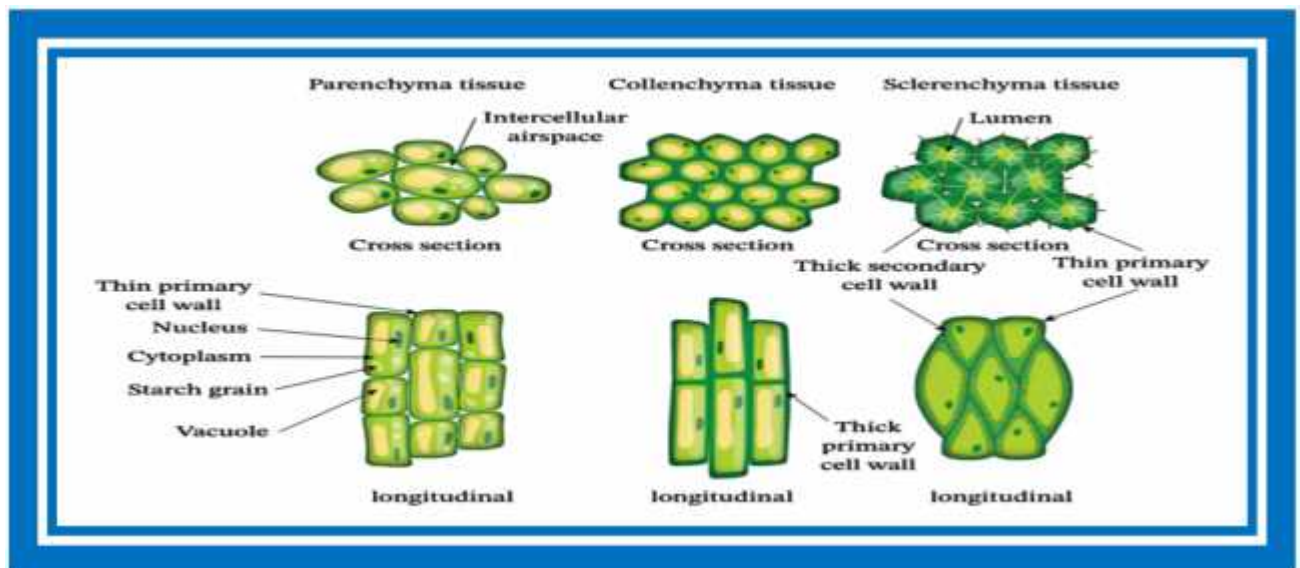
4.5 Liberian parenchyma and bast fibers:

Screen tubes and companion cells are frequently associated with parenchymal cells whose cellulosic walls are thinner than those of the screen tubes.

The fibers are less abundant in the phloem than in the xylem, they are distinguished by their thick wall and their narrow light. They may be missing in several species.

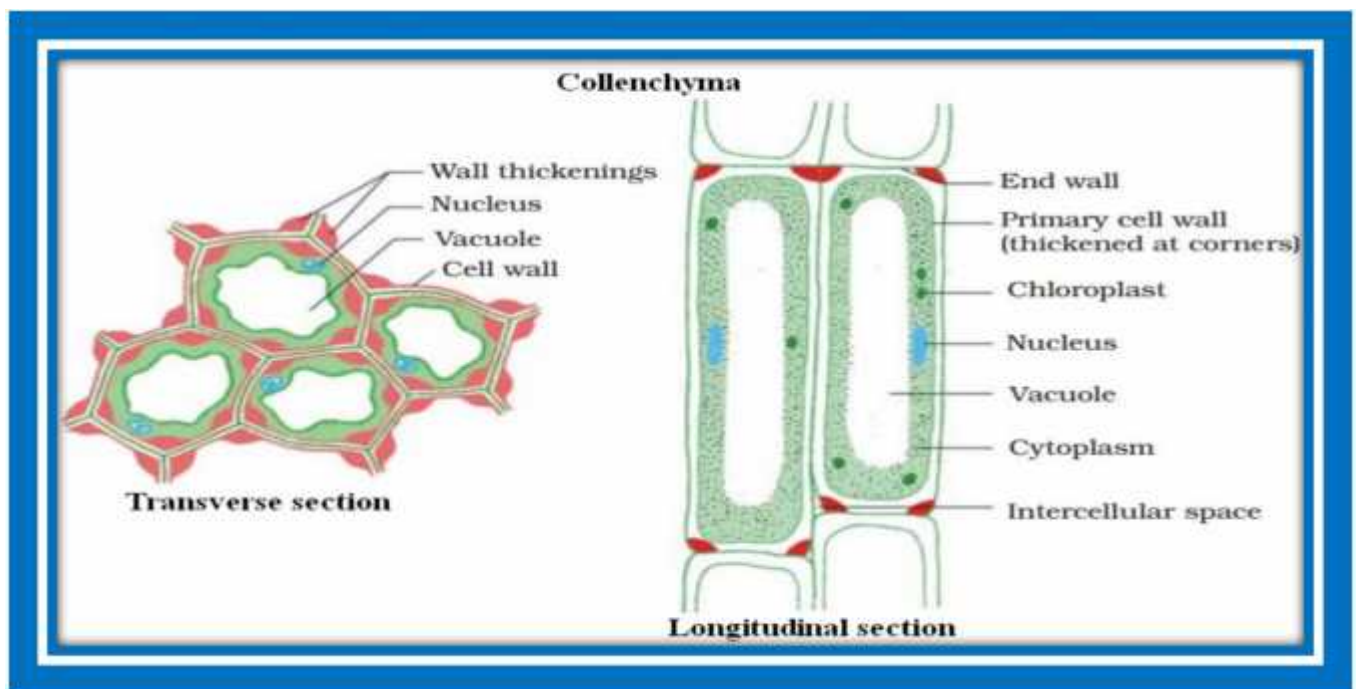
5. Support tissues:

The supporting tissues ensure the rigidity and strength of the organs that contain them (mainly aerial organs). It is a modification of the cell wall that gives the supporting tissue cells their properties and from the characteristics of this wall we distinguish two categories: collenchyma and sclérenchyme.



5.1 The collenchyma:

It is a primary tissue consisting of living cells with significant cellulosic pecto wall, a nucleus and a voluminous vacuole. Collenchymal cells are often elongated and closely connected to each other. The collenchyma usually occupies external positions, and especially plays a supporting role.

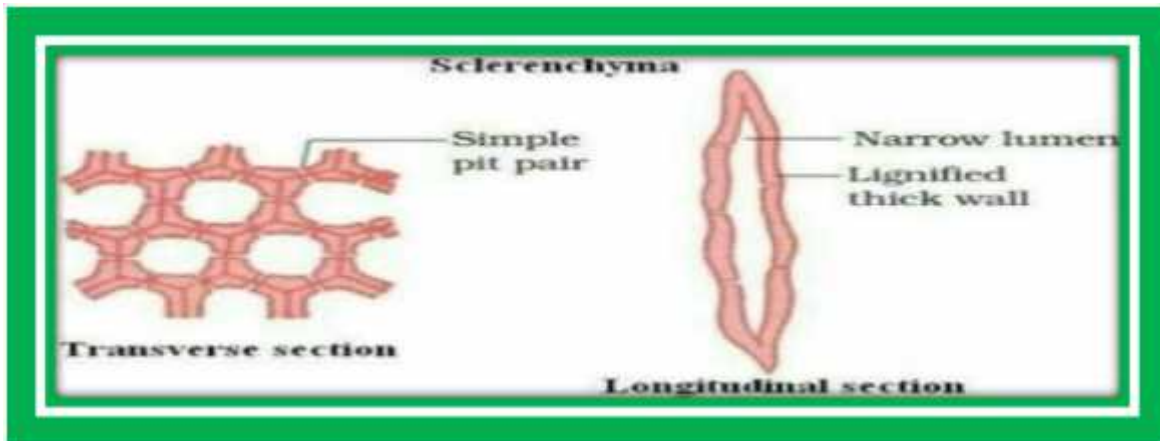


When the thickening of the wall is uniform over the entire extent of the wall – the collenchyma is called annular (the membranes appear as rings on the cross sections). If the cellulosic thickening is located at the corners of the cells, it is an angular collenchyma. When thickening affects only the tangential walls of cells (wall parallel to the edges of the organ), the collenchyma is said to be tangential.

The collenchyma exists in the aerial organs of herbaceous plants; it is generally located at their periphery forming independent bundles or a continuous sleeve immediately under the epidermis

or separated from it by a few layers of parenchymal cells. The walls remain cellulosic and the collenchyma retains certain elasticity and the organs that contain it remain flexible.

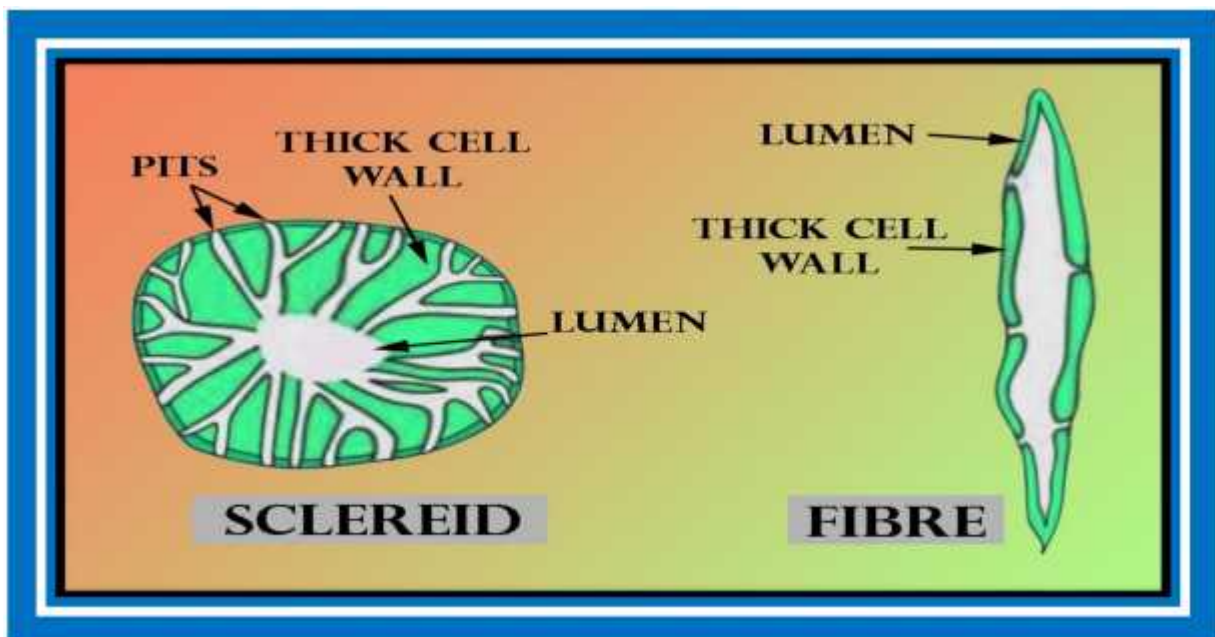
5.2 The sclerenchyma:

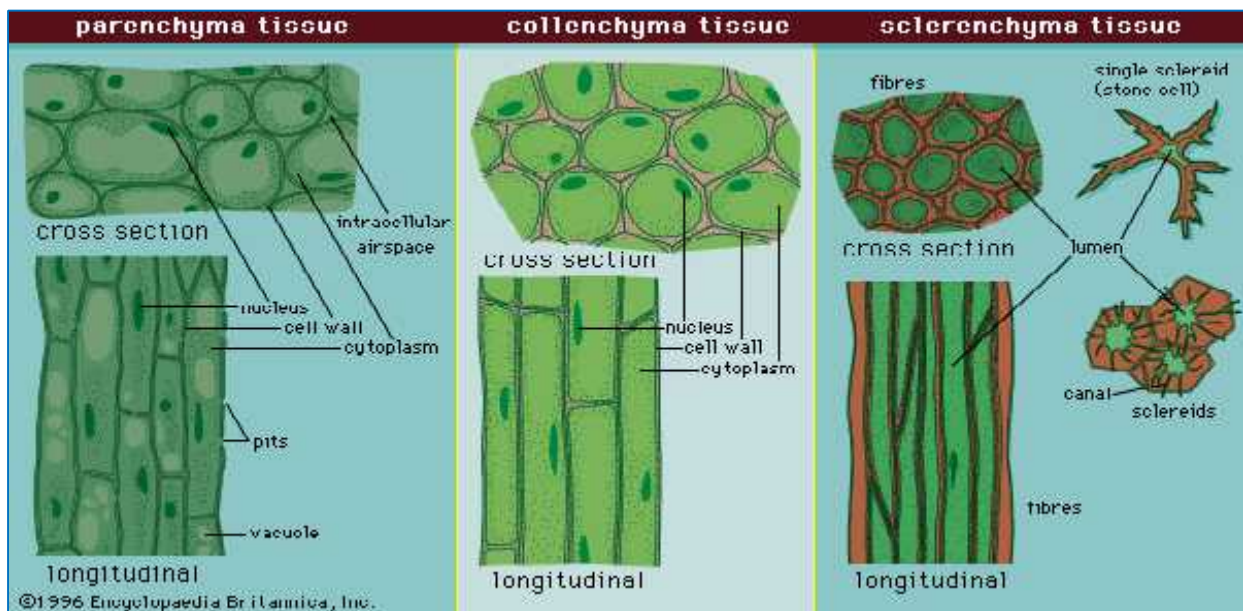


It is a primary tissue. It is the set of dead cells, elongated with thick wall, impregnated with lignin and present in the form of fibers. Sclerenchyma is usually found deeper than collenchyma. The cell walls are lignified and impermeable; these sclerified cells are devoid of protoplasm. These tissues provide support for the plant. They are therefore found mainly in the aerial parts such as the stem and leaf and rarely in the roots.

Depending on the shape and dimensions, there are two types of cells:

Fibers very elongated cells and sclerites, short cells of irregular shapes.





5.2.1 Fiber:

They are fusiform cells, very elongated (in some species arriving at a few centimeters). Very elongated cells with little or no lignified wall are also referred to as fibers; this is the case for flax fibers (not lignified), hemp (partially lignified). These essentially cellulose fibers are textile fibers.

Xylem and phloem fibers differ from sclerenchymal fibers by their presence in the conductive tissue and have the same origin, while sclerenchymal fibers are local differentiations within the parenchyma.

5.2.2 Sclereid: These are short cells with very thick and lignified walls. Sclerites can be isolated within the parenchyma (example of sclerites from the leaves of the tea tree), grouped into clusters (example of sclerites from pears), or assembled into a continuous bed (example of the seed coat of the bean seed).

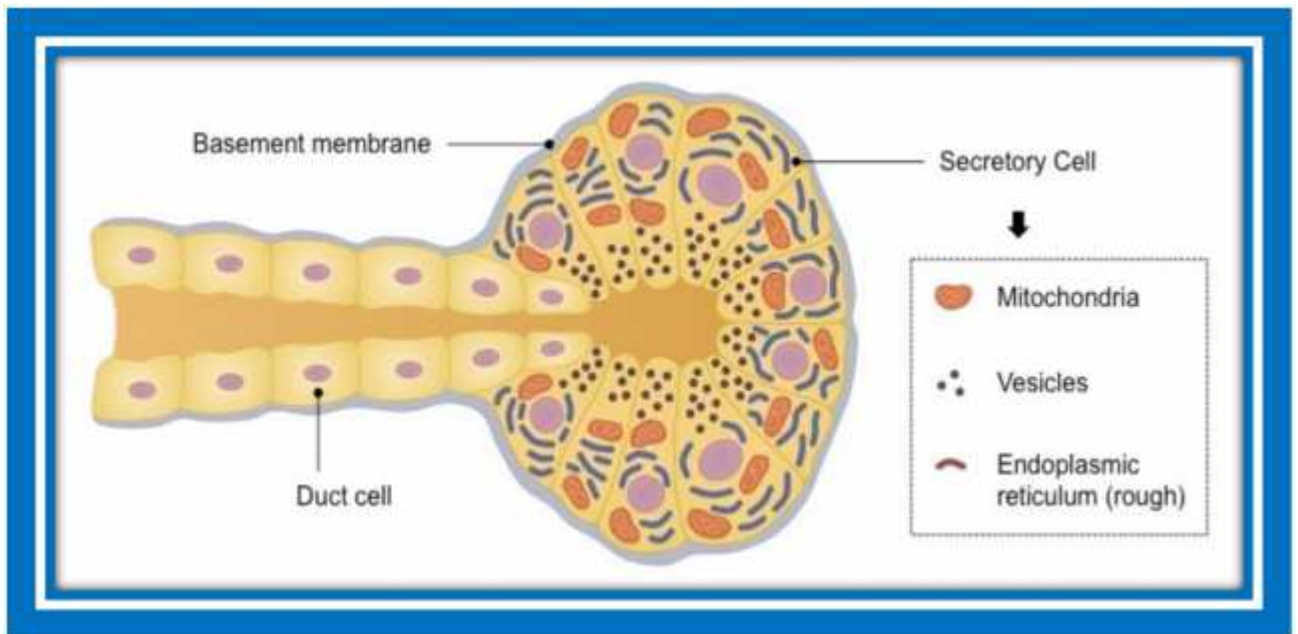
6. Secretory tissues:

These tissues are specialized in the synthesis of certain substances (essences, tannins, resin, latex, etc.). This power of synthesis defines a secretion.

Secretory tissues can accumulate the synthesized products within their cells or reject them out of their cells into cavities in plant organs. In this case we speak of excretion of the secreted products.

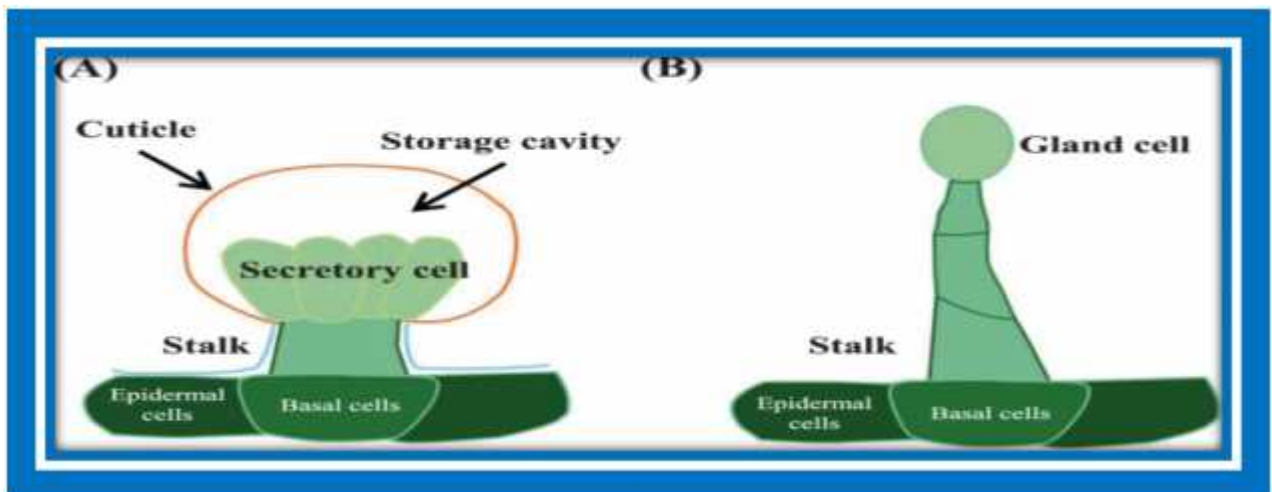
We distinguish different categories of secretory tissues: secretory cells, secretory epidermis, pockets and excretory channels and laticifers.

6.1 Isolated secretory cells:



They are located within the parenchyma, dispersed, isolated and accumulate in their vacuoles the product they secreted; case of dispersed tannin cells in the cortical parenchyma (bark) or in the medullary parenchyma of the stems of many plants and in the parenchyma of camphor leaves that accumulate camphor.

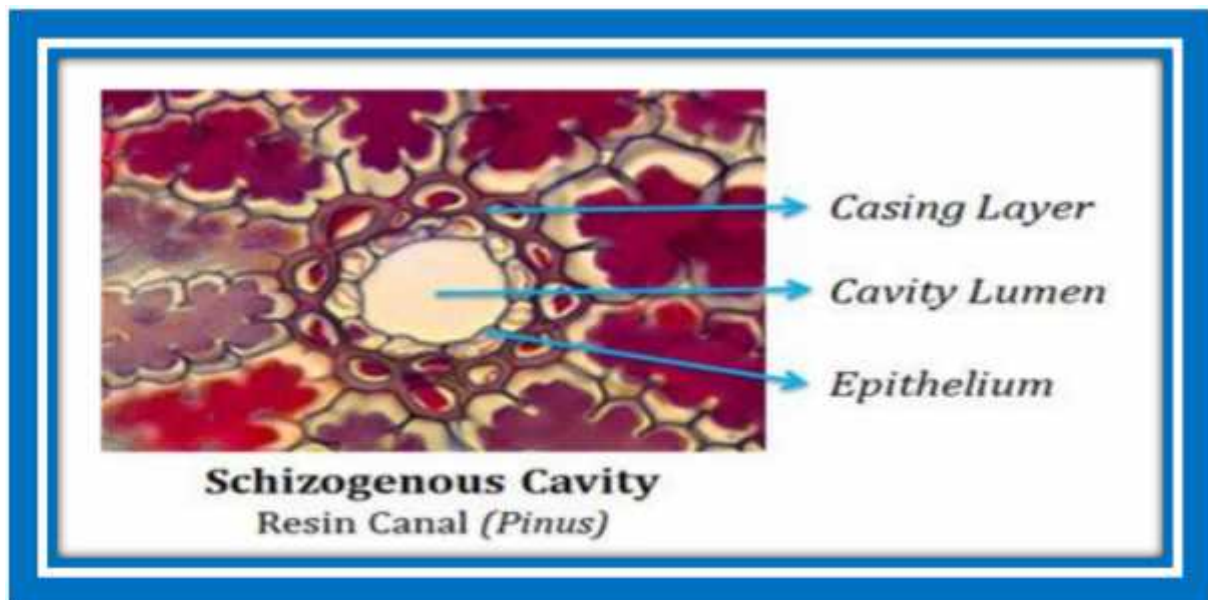
6.2 Epidermis and secreting hair:



The epidermal cells can develop and accumulate in their cytoplasm volatile essences, by vaporizing through the cuticle, quite thin of these epidermis, producing perfumes, pleasant or not, of certain plants (example of epidermis of rose petals, violet, etc.).

The secretion function can be reserved for certain epidermal hairs (secreting hairs). These are compound hairs whose terminal cells accumulate essences. In certain secretory hairs (example of thyme, lavender) the secreted essence is accumulated between the cellulosic wall and a cuticle which is detached from it: the rupture of the cuticle then releases the essence which vaporizes.

6.3 Pockets and excretory channels:

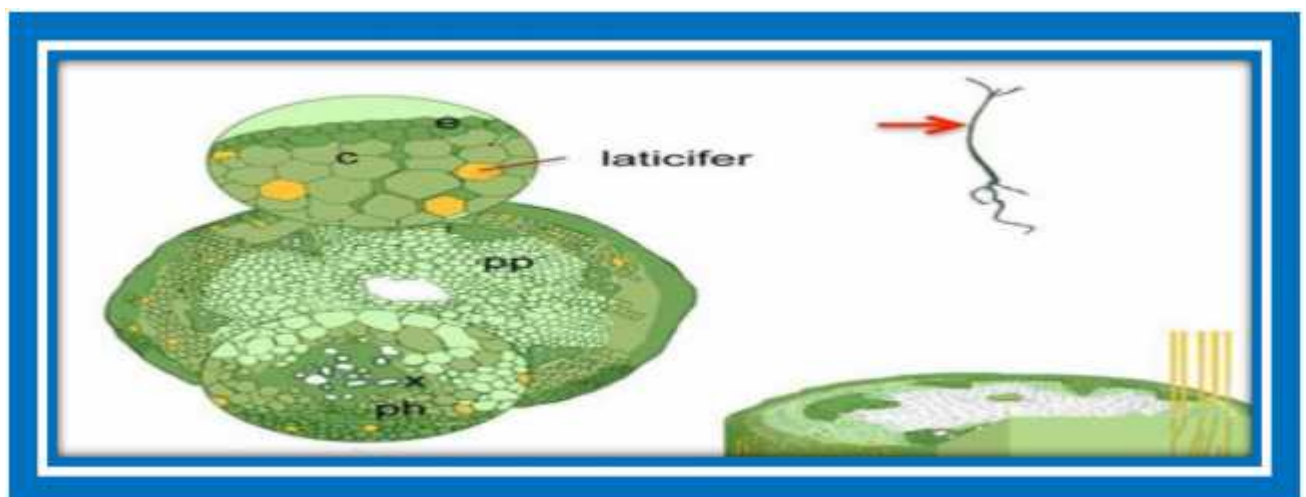


These are cavities located in the parenchyma of leaves, stems and fruits. In some species, these cavities are lined with cells that excrete the products they have developed.

Excretory pockets are numerous in the pericarp of oranges, tangerines, lemons, etc. where they can be detected with the naked eye in the form of small translucent masses. It shows itself under an optical microscope as a spherical cavity containing the essence and surrounded by small secretory cells.

The excretory ducts are very elongated secretory pockets, tubuliform and oriented in the direction of the length of the organ (leaf, petal and stem). A cross-section shows a circular cavity, limited by one or two bases of small secretory cells very regularly arranged, frequently doubled externally by a sheath of protective cells.

6.4 Laticifers:



At each drop of latex (viscous liquid, milky or clear and white appearance in most cases) from a lettuce leaf, euphorbia

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