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**قسم علوم الحياة**

**المرحلة الاولى**

# علم النبات العملي Practical Botany

# LAB1
# Plant Cell Structure

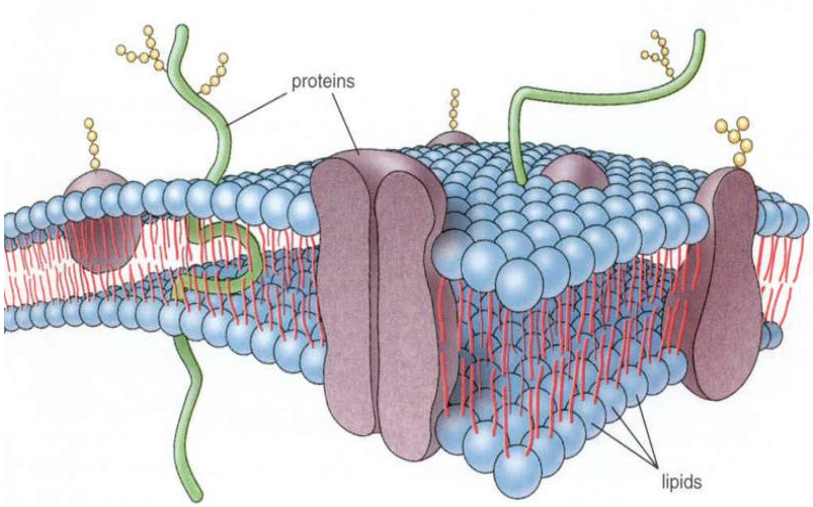
- The term cell is derived from the Latin ‘cella’ means storeroom or chamber
- The term cell was first used by the English botanist Robert Hooke in 1665, to describe the individual units of the honeycomb-like structure in cork under compound microscope
- Botany the scientific study of plants
- Plants are multicellular organisms composed of millions of cells with specialized function.
- All plant cells have the same basic eukaryotic organization
- The Plant Cell consists of a more or less rigid cell wall
- The protoplast consists of the cytoplasm and a nucleus
- The cytoplasm includes distinct membrane-bound organelles such as plastids and mitochondria; systems of membranes (endoplasmic reticulum and dictyosomes); nonmembranous entities such as ribosomes, actin filaments and microtubules
- The rest of the cytoplasm is a liquid matrix in which the nucleus, various entities and membrane systems are suspended - it is typically referred to as the cytosol or ground substance

## Living Components of plant cell

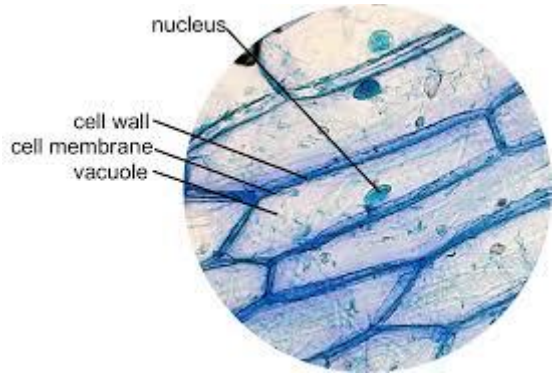
## Plasma Membrane

The plasma membrane has several functions

1. it mediates the transport of substances into and out of the protoplasm
2. it coordinates the synthesis and assembly of cellulose microfibrils
3. it relays hormonal and environmental signals involved in the control of cell growth and differentiation




Figure




**Microscopic slide**

## Cell Nucleus

The nucleus is usually the most prominent structure in the protoplast of eukaryote cells

1. it controls the ongoing activities of the cell by determining which protein molecules are produced by the cell and when they are produced
2. it stores genetic information, passing it onto daughter cells during cell division

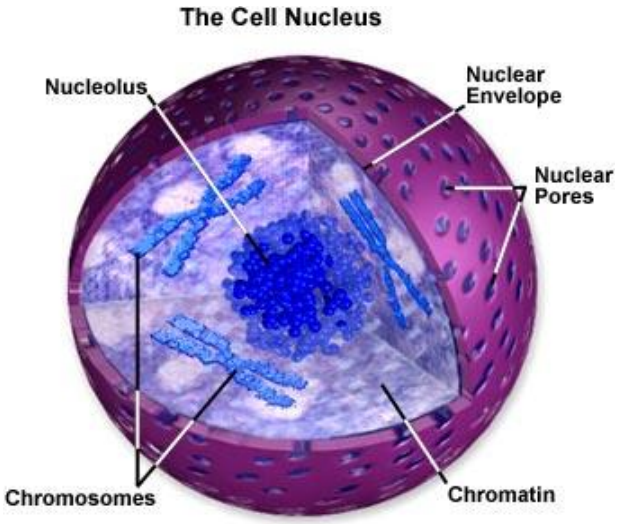
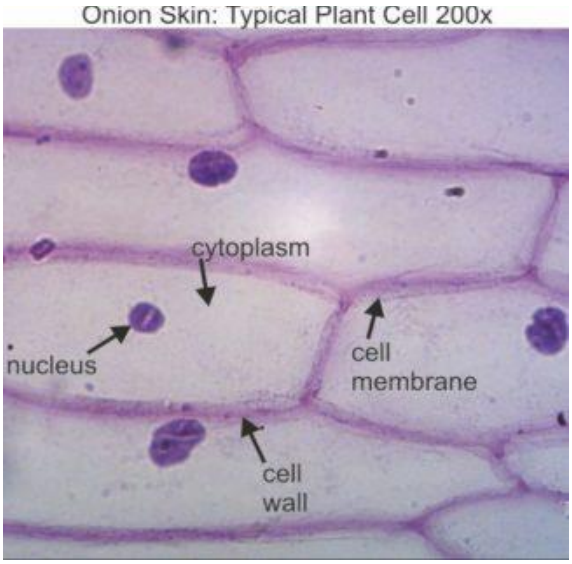



Figure 1

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## Plastids

- Plastids are a characteristic component of plant cells
- Plastids are classified and named based on the kinds of pigments they contain

## Chloroplasts

- Each plastid is surrounded by two membranes and internally the plastid has a system of membranes which form flattened sacs called thylakoids and a ground (fluid) substance called stroma
- Contain green pigment (chlorophyll)

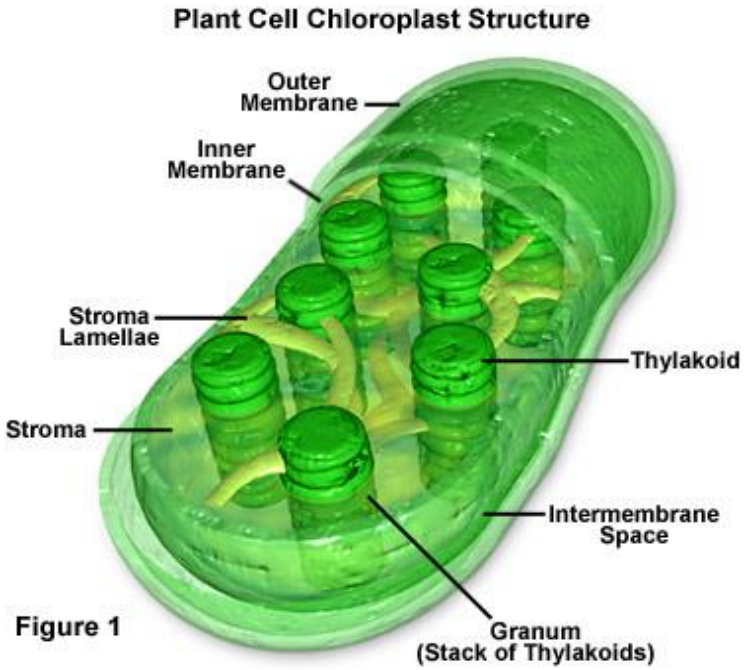
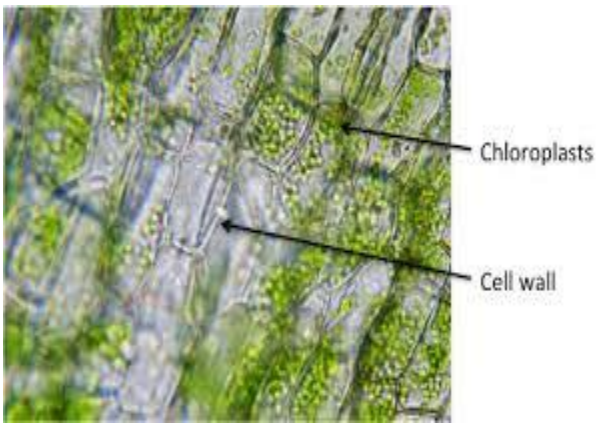



Figure 1

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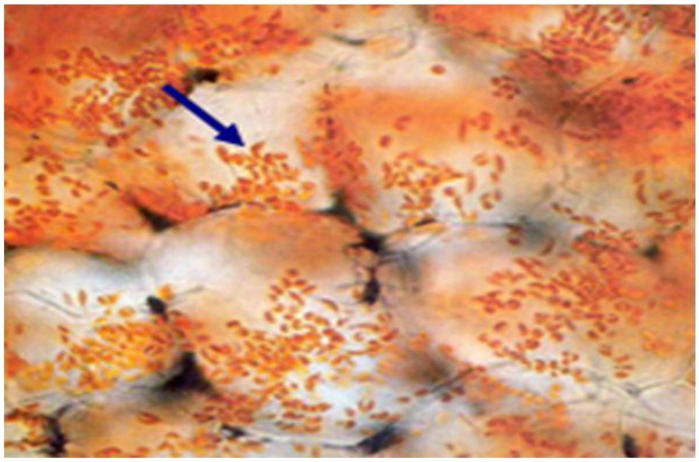
# LAB2
# Chromoplast

Chromoplasts lack chlorophyll but synthesize and retain carotenoid pigments which are responsible for the yellow, orange or red colors of many flowers, old leaves, some fruits and some roots

**Chromoplast– responsible for carotene(orange), xanthophylls (yellow) and red pigments.**



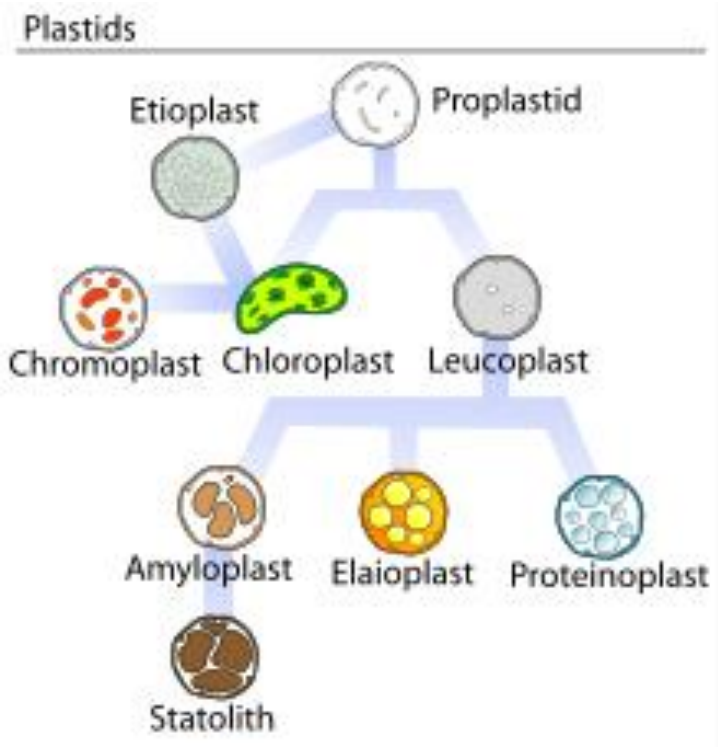
**Microscopic Slide**

## Leucoplasts

- Leucoplasts are nonpigmented plastids some of which synthesize starch while others produce oils or proteins
- Upon exposure to light they may develop into chloroplasts

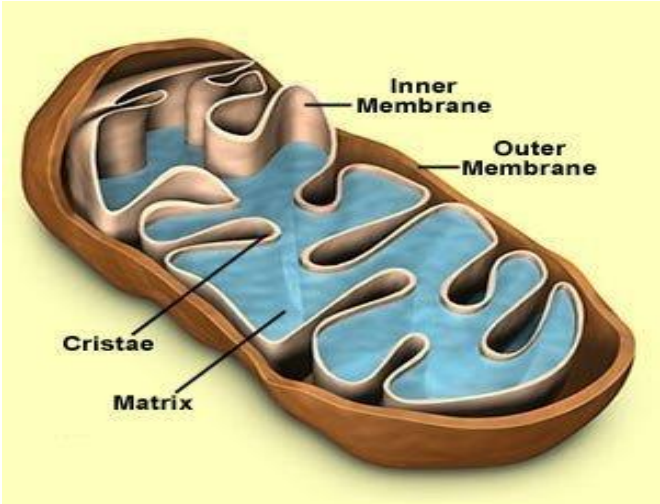
## Roplastids

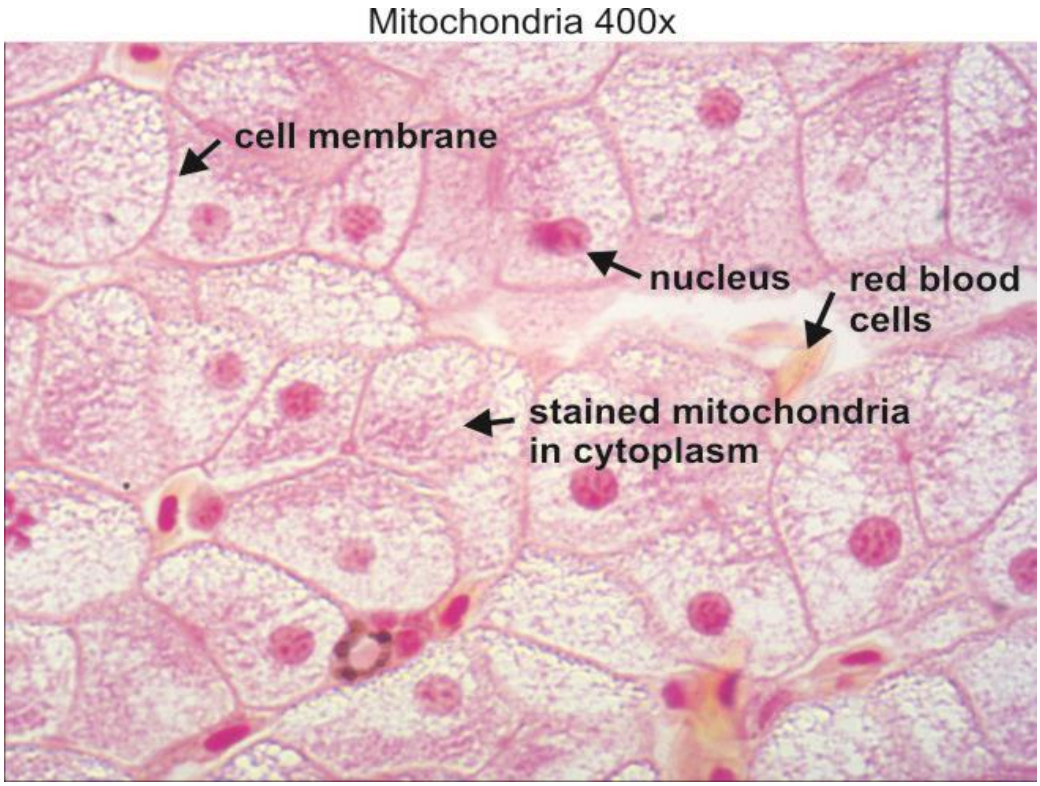
- Proplastids are small, colorless or pale green undifferentiated plastids that occur in meristematic cells of roots and shoots - they will eventually develop into other, differentiated plastids such as the chloroplasts, chromoplasts or leucoplasts




## Mitochondria

- Mitochondria are another organelle bounded by two membranes
- The inner membrane is folded into many pleats called cristae
- Mitochondria are the sites of cellular respiration - converting organic molecules to ATP the main immediate energy source for living eukaryote cells - plant cells may have hundreds to thousands of mitochondria



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## Endoplasmic reticulum:

Cytoplasm contains an extensive network of membrane enclosed spaces .these spaces along with the membranes enclosing them are known as endoplasmic reticulum (ER).

Functions:

1) It provides structural base for protein, lipid and phospholipids synthesis.

2) It sorts proteins according to their destination.

3) It provides a control passage for the export of mRNA molecules from nucleus to rough endoplasmic reticulum.


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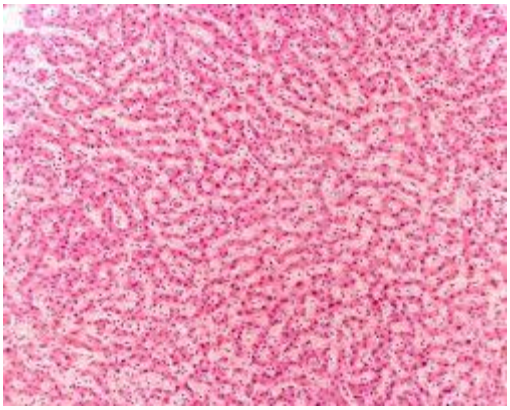
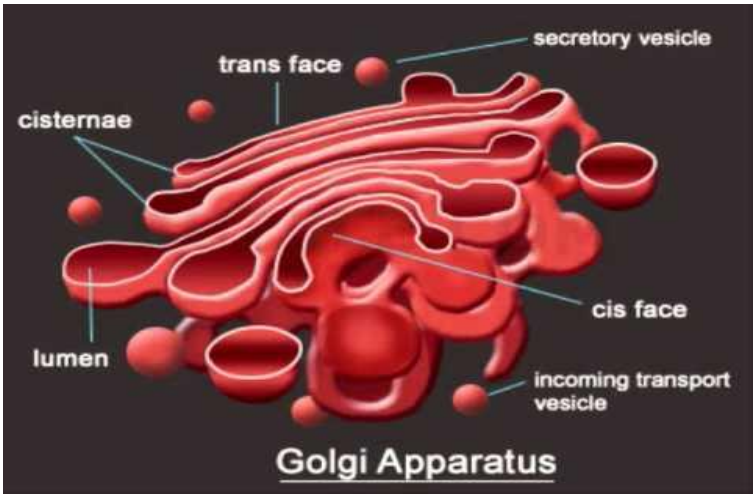


**Slide of endoplasmic reticulum**

## Golgi body:

It consists of 2-7 flat cisternae stacked close to each other. Golgi bodies originate from ER elements.

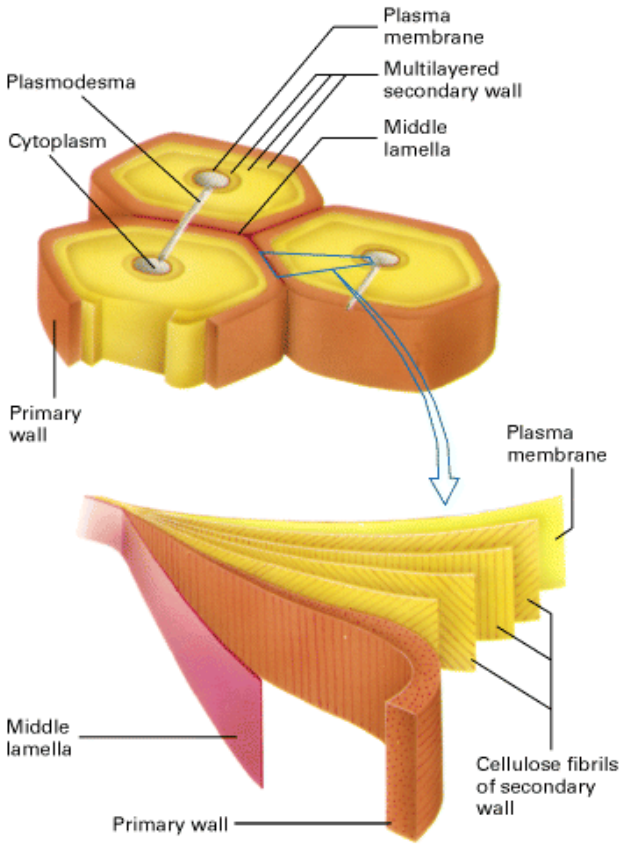


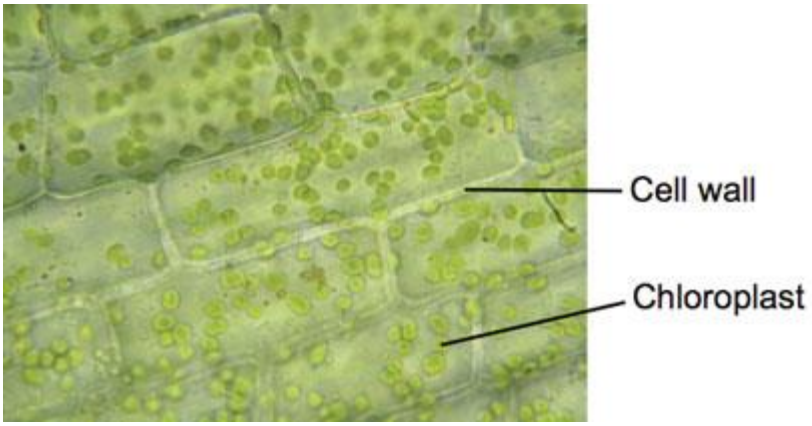
# LAB 3

## Cell Wall :

- The primary cell wall is deposited before and during growth of the cell
- Actively dividing cells typically only have primary cell walls
- Secondary cell walls are usually formed after the cell has stopped growing and the primary cell wall is no longer increasing in surface area

The secondary cell wall forms between the primary cell wall and the protoplast



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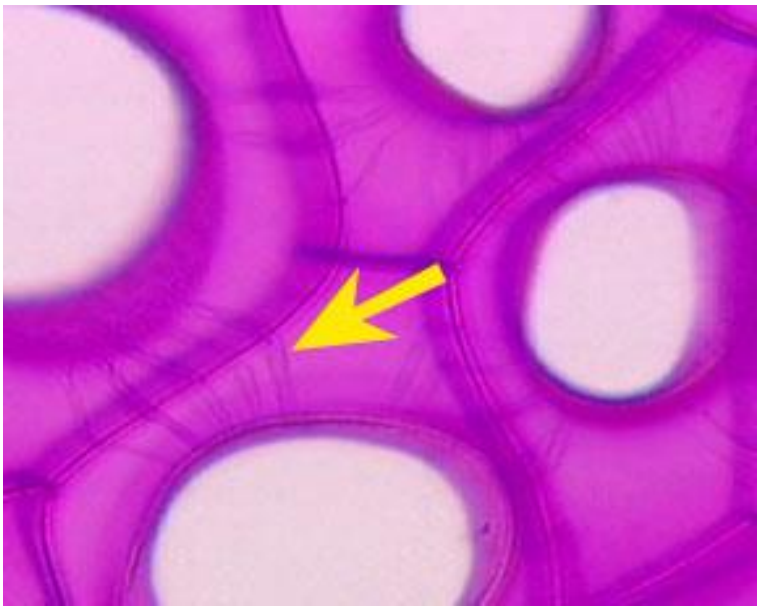
## Plasmodesmata:

- Plasmodesmata allow the transport of substances from one cell to the next
- They are cytoplasmic threads which connect the living protoplasts of adjoining cells

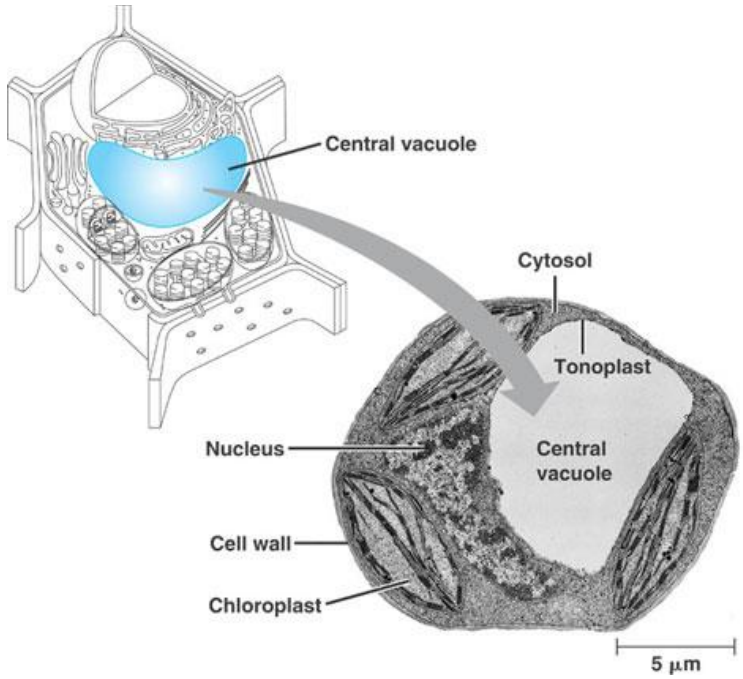


## Non -Living Components of plant cell

## Vacuole:

- Vacuoles are membrane bound organelles filled with cell sap
- The membrane is referred to as the tonoplast

- Different kinds of vacuoles may have different functions within the same cell
- Along with water based cell sap, vacuoles typically contain salts, sugars and some dissolved proteins



# LAB 4

## Starch:

It is an insoluble carbohydrate of polysaccharide type formed by the condensation of simple sugars like glucose. The starch is usually found in the form of starch grains of various shapes. The starch grains are abundantly found in the storage organs of plants, e.g., tuberous roots, underground stems, cortex of stems, endodermis, grains of cereals, banana fruits, etc. The starch grains vary in their shape and may be used for the identification of plants. The starch grains are not found in fungi and certain algal groups. The starch grains have different shapes that are characteristic of the plant types, e.g., they are oval-shaped in potato; flat in wheat; polygonal in maize; spherical in pulses and dumbell or rod-shaped in the latex cells of some Euphorbias. The starch grains vary from 5-100μ in size. The starch is always derived either from chloroplasts of green cells or from leucoplasts (amyloplasts) of storage tissue.

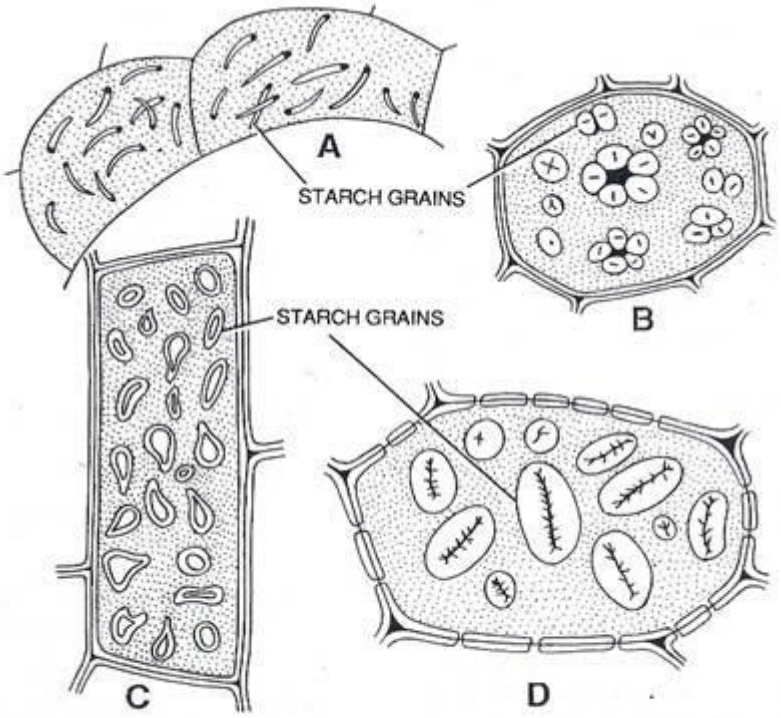



Fig. 33.47. Starch grains. A, starch grains in outer pericarp of *Musa*, B, starch grains in cotyledon of *Pisum*; C, starch grains in ray cell of phloem of *Ailanthus*; D, starch grains in cotyledon of *Phaseolus*.

The structure of the starch grain usually exhibits conspicuous concentric layers formed around a dark roundish spot, the hilum. The layering may

be conspicuous in some grains whereas inconspicuous in others. Most of the starch grains show this layering and are known as stratified starch grains. If the concentric layers of the starch are formed on one side of the hilum of starch grain, the grain is said to be accentric (e.g., potato) and when the layers are deposited concentrically around the hilum (e.g., wheat) the grain is known as concentric. Concentric types of starch grains are quite common in most of the plants. If the starch grain possesses a single hilum, it is known as simple. Sometimes two, three or many grains, arranged in a group with as many hila as the starch grains, they are known as compound grains. Compound grains are commonly found in potato, sweet potato, rice and oats. The starch is turned blue or black in aqueous solution of iodine.

Grains consists of Carbohydrate substance. This grains different in size and number depends on the plants. The grain Characterized by it's contain Contains the hilum that converted by starch layer , it may be contain one or more Hilum , The Hilum may be central like Rice and Maize or non-central like Potato or Cracked like Bean, the starch grains classify to three types:.

A-Simple Grain contain one Hilum  accumulate around it starch layers.

B-Semi-compound Grain contain more than one Hilum and the starch layers accumulates around it and then a common layers accumulates around the Hilum .

C- compound Grain contain more than one Hilum and the starch layers accumulates around it in separating shape from each other.

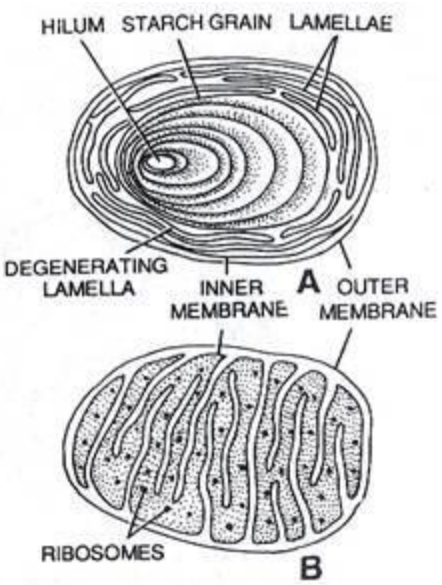
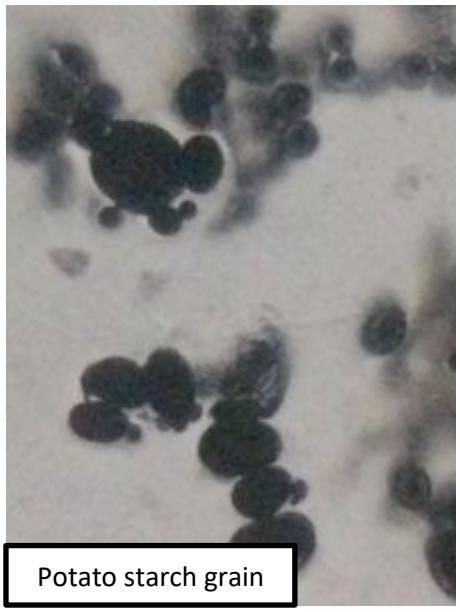
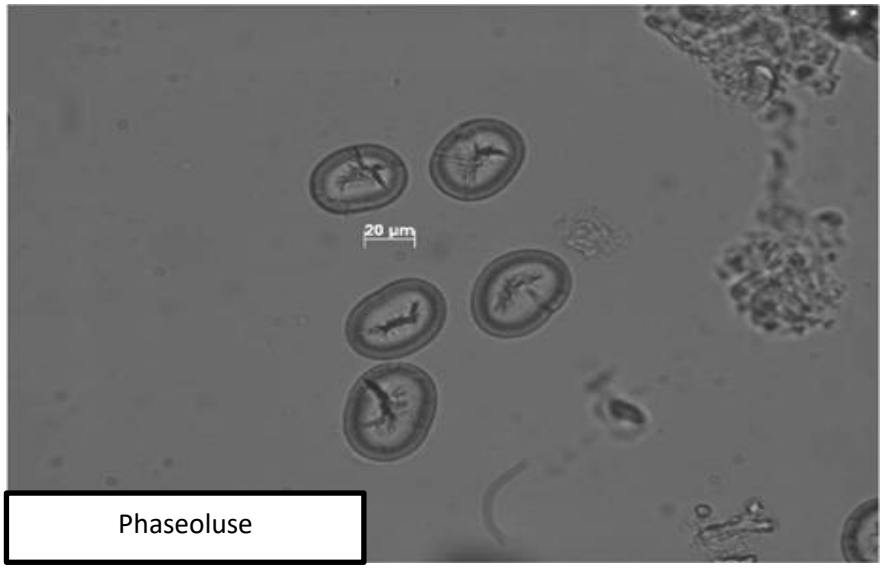



**Fig. 33.48.** Plastids. A, amyloplast with a starch grain; B, a leucoplast.

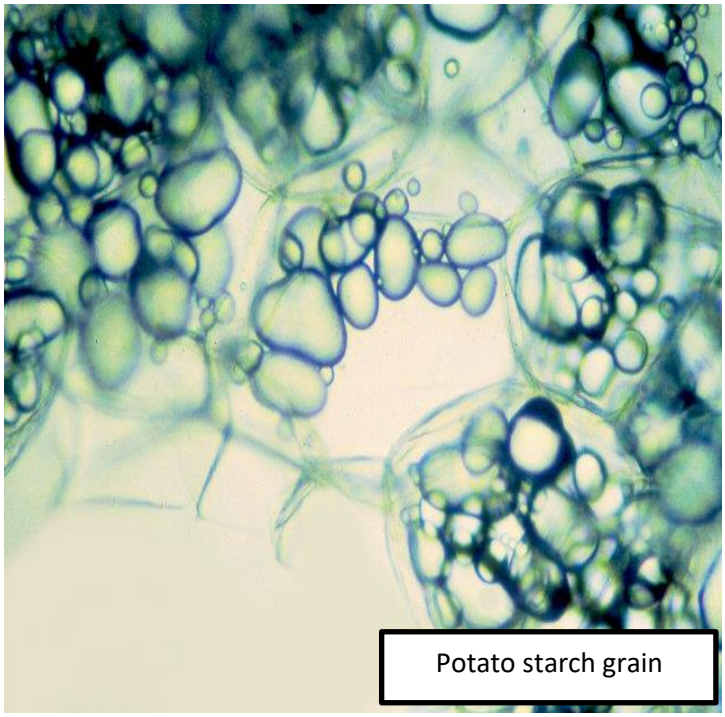


Potato starch grain




Phaseoluse

Wheat starch grain




## Non -Living Components of plant cell

## 1-Vacuoles

## 2- Starch Grains

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C- compound Grain contain more than one Hilum and the starch layers accumulates around it in separating shape from each other.

## LAB 5

## 3- Crystals

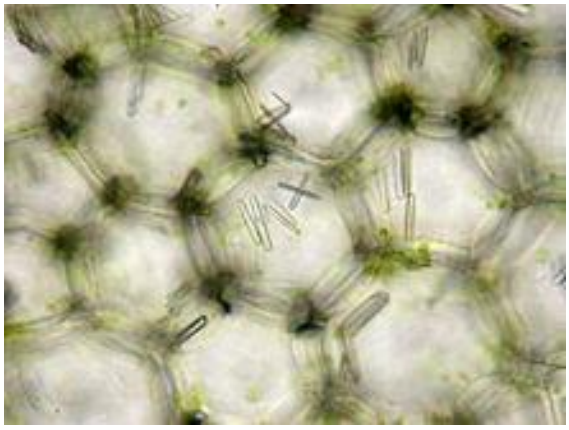
It's exist in many types of plant cells and different in size and Chemical composition. The most part of crystal composited from calcium salts , In spite of the differing forms of it but it create from single crystals which Accumulates with each other to form Specific shape. There is many type of crystals :.

## A- Calcium Oxalate Crystals

It's important for cell as the oxalic acid Considered a one of toxic acids. The cell working on transmute the oxalic acid to insoluble compounds For the purpose of reduce the toxic effects of oxalic acid. Therefore it transfer it as crystal form. Some type of Calcium Oxalate crustal

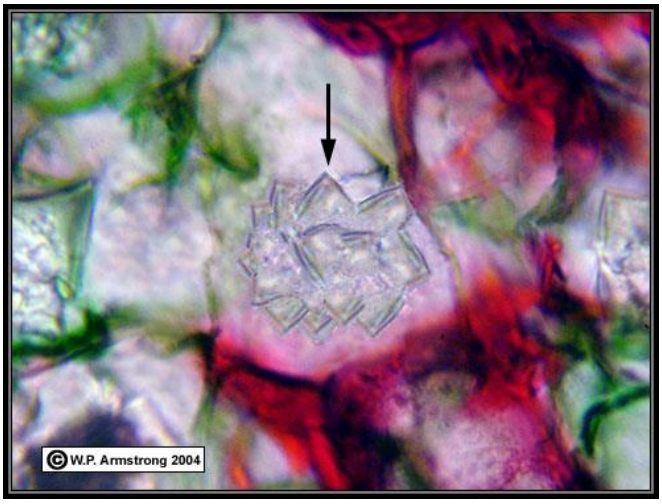
## 1- Prismatic Crystals

Which be in the form of prism or pyramid in it's note in citrus and allium.



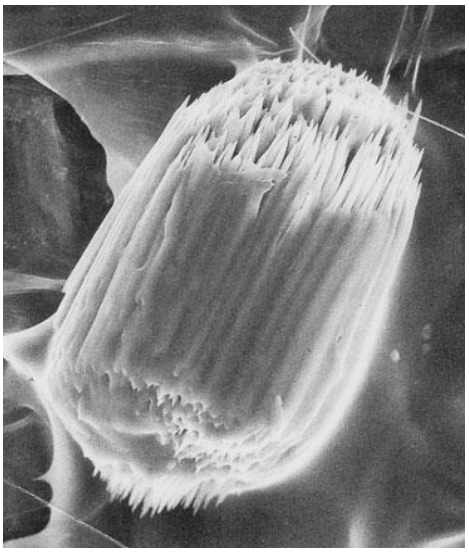
## 2- Druses Crystal

It's Semi-spherical gatherings from Pyramidal or prismatic crystals , which notes in Middle tissue for some Leaf like : Nerium and Tilia and Salix.



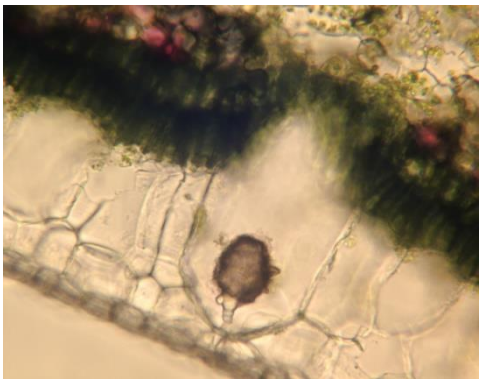

## 3- Raphides Crystals

It's long cruystal , thin and Tapered ends , Accumulate in packages form , Are abundant in Monocotyledon plants , and cane seen in Stems and leaves of the grape (Vitis) .



## 4- Calcium Carbonate

Crystals are outstanding or vesicular or stone, and is composed from the crystal body, The crystal body consists of carbonate Calcium, either the neck consists of cellulose, Which known as lithocyte or lithocyst which are larger than adjacent cells and can be observed in the skin an leaves cells of fig (Ficus)



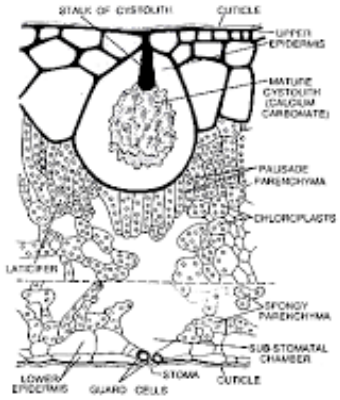



Fig. 37.5. Epidermis. Multiple epidermis in T.S. of *Ficus elastica* leaf. A mature cystolith with calcium carbonate deposited on its stalk in the epidermal cell.

## 4- Aleurone grains

It's storage protein materials, the grain composed from Crystalline protein which is the crystal body , and amorphous protein which is spherical body. The grain surrounding by membrane. This grains exist in seeds endosperm and embryo.

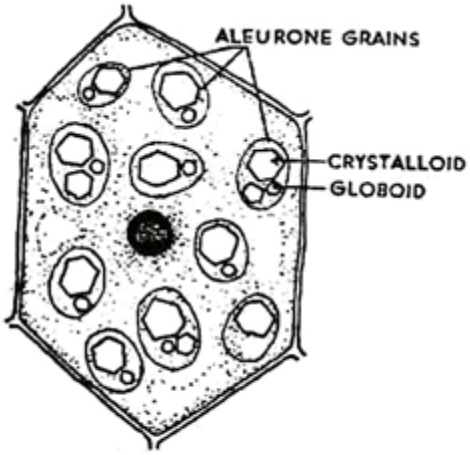



Fig. 126. Aleurone grains in a cell from endosperm of castor-oil seed.

## 5- Oils and Fats

They are widespread in plant cells , the fats be solid and the oils liquid , they are stored as a foodstuffs in Seed tissue like Helianthus annuus Seeds . This oils or fats are originate from Elaoiplasta or Spherosomes.

## 6- Tannins

Complex organic compounds, believed to be the sources of aromatic compounds, are found in the bark of trees and mature fruits and leaves.

## LAB 6

## Pits

Cavities or thin areas within the thick secondary wall are called pits. Pits are left during process of secondary wall formation. Such cavities or are also found in the primary wall. These are called primary pit fields Plasmodesmata are formed through primary pit fields. Generally each pit has a complementary pit opposite of it in the neighboring cell. These complementary pits are called "pit pairs.. The two opposite pits are separated by a thin layer of secondary wall. It is called pit membrane. . Material passes through this pit pair from one cell to other through pit membraneand plasmodesmata

Pits are composed of three parts: **the pit chamber**, **the pit aperture**, and the **pit membrane**. The pit chamber is the hollow area where the cell wall is absent. The pit aperture is the opening at either end of the pit chamber. The pit membrane is the middle lamella, or the membrane between adjacent cell walls, at the middle of the pit chamber .

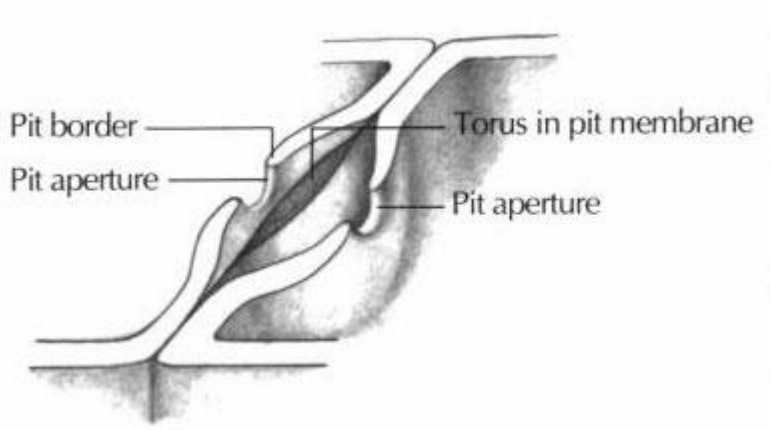
## Types Of Pits

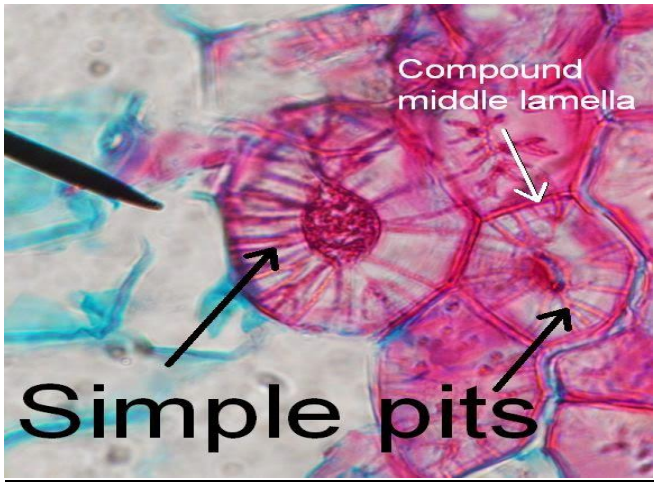
There are following types of pits:

1. Simple pits: The diameter of the pit cavity remains uniform in simple pit. two sides of the common wall form a simple pit. The simple pit may be circular, oval, polygonal, elongated or somewhat irregular in its facial view.
2. Bordered pits: In this case, secondary wall arches over the cavity of the pits. Thus the pit opening become narrow than the pit diameter. Bordered pits of the opposite cells form bordered pit pair. The cavity in the thick secondary wall is called pit chamber. The bordered pit opens in the cell lumen by pit aperture. The pit aperture is circular and much narrower than the diameter of pit chamber. In certain cases, the pit apertures are lenticular or linear or may the pit membrane of bordered pit develops an oval thickening in the middle. It is

called torus. Pit membrane is flexible.. Pit membrane pushes the torus. Thus the torus closes the bordered pit. It slums that torus control the passage of pit through bordered pit. Bordered pits are more complex than simple pits. These are found in the vessels. tracheids and fibers of xylem.

3. Half bordered pit pair: In some cases, bordered pit has a complimentary simple pit. Such a pit pair is called half bordered pit pair.
4. Blind pits: Some pits do not hate any complimentary pit. Such pits are called blind pits.
5. Compound pits: Sometimes, there is one pit on side. But there are two or more complimentary pits on opposite side. Such pits are called compound pits.





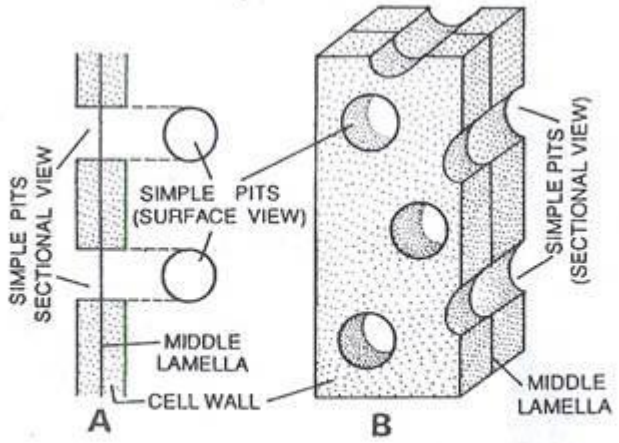




**Fig. 34.12.** Simple pits. A, cell-wall having two simple pits showing sectional and surface views; B, portion of a cell wall showing some simple pits—sectional view (right top) surface view (front).

# LAB 7

## The stomatal system

The stomata are minute pores which occur in the epidermis of the plants. Each stoma remains surrounded by two kidneys or bean shaped epidermal cells the guard cells. The stomata may occur on any part of a plant except the roots. The epidermal cells bordering the guard cells are called accessory cells or subsidiary cells.

Generally the term stoma is applied to the stomatal opening and the guard cells. The guard cells are living and contain chloroplasts in them. They also contain a larger proportion of protoplasm than other epidermal cells. Usually in the leaves of dicotyledons the stomata remain scattered whereas in the leaves of monocotyldons they are arranged in parallel rows.

The number of stomata may also range on the surface of a single leaf from a few thousand to hundreds of thousands per square centimeter. Stomata occur on both upper and lower surfaces of leaf, but especially they are confined to the lower surface. In floating leaves Stomata are confined only on the upper surface of the leaf.

Under normal conditions the stomata remain closed in the absence of light or in night or remain open in the presence of light or in day time. Structurally the stomata may be of different types according to the following

## A- subsidiary cells shape

### 1. Ranunculaceous or Anomocytic:

(Anomocytic = irregular celled). In this type the stoma remains surrounded by a limited number of subsidiary cells which are quite alike the remaining epidermal cells. The accessory or subsidiary cells are five in number (*Vicia*)

### 2. Cruciferous or Anisocytic:

(Anisocytic = unequal celled). In this type stoma remains surrounded by three accessory or subsidiary cells of which one is distinctly smaller than the other two. (*Nicotiana*)

## 3. Rubiaceous or Paracytic:

(Paracytic = parallel celled). In this type, the stoma remains surrounded by two subsidiary or accessory cells which are parallel to the long axis of the pore and guard cells.(*Ricinus* and *Phaseolus*)

## 4. Caryophyllaceous or Diacytic:

(Diacytic = cross celled)-In this type the stoma remains surrounded by a pair of subsidiary or accessory cells and whose common wall is at right angles to the guard cells. (*Dianthus*)

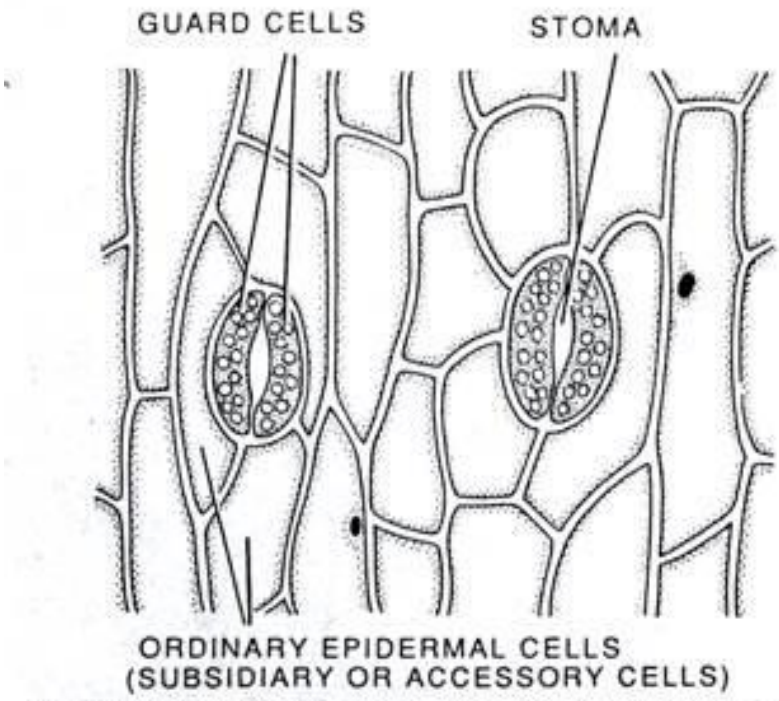



**Fig. 37.10.** Epidermis. Lower surface of leaf showing stomata.

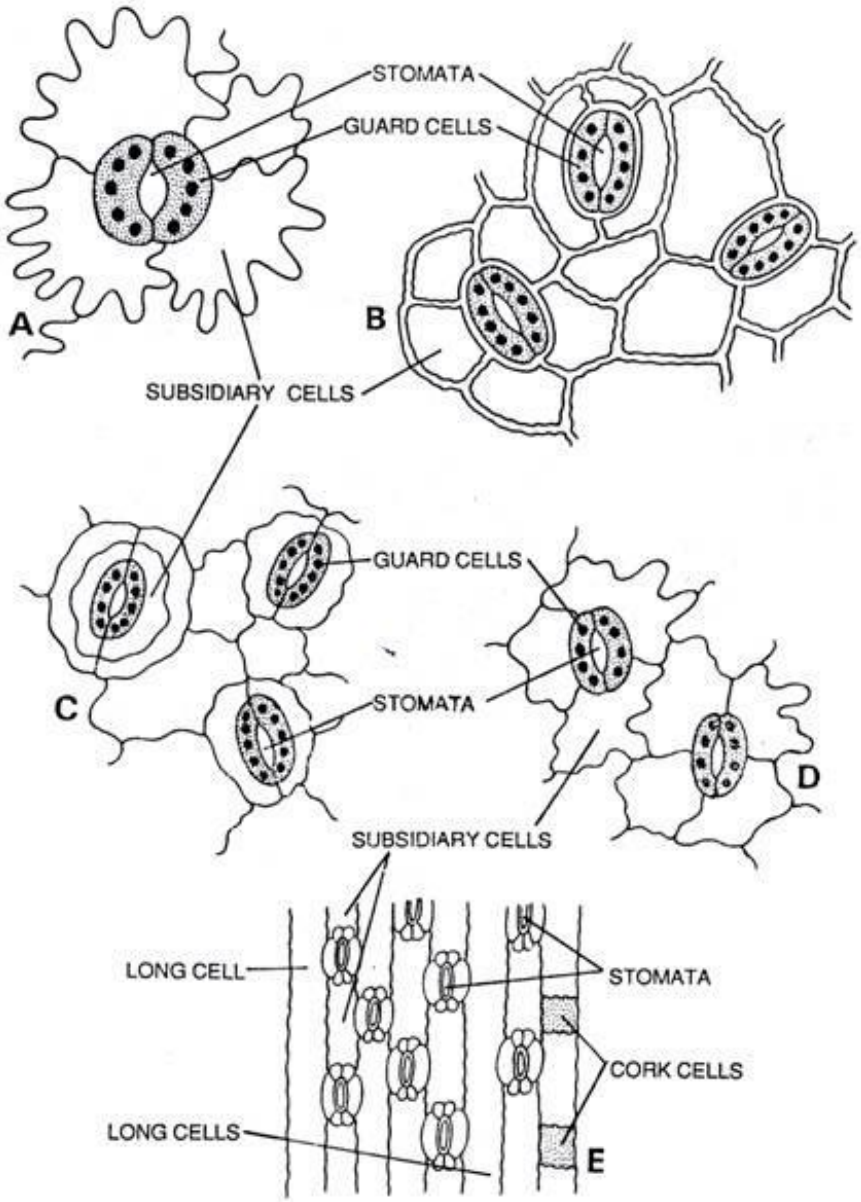



**Fig. 37.15.** Stomata—types of stomata. A, anomocytic or irregular celled type (ranunculaceous type); B, anisocytic or unequal celled type (cruciferous type); C, paracytic or parallel celled type (rubiaceous type); D, diacytic or cross-celled type (caryophyllaceous type); E, gramineous type.

## LAB 8

## 5. Coniferous Stomata:

They are sunken and appear as though suspended from the subsidiary cells arching over them. In their median parts the guard cells are elliptical in section and have narrow lumina. At their ends they have wider lumina and are triangular in section. The characteristic of these guard cells is that their walls and those of the subsidiary cells are partly lignified and partly non-lignified.

## 6-Tetracytic type

new stomatal type in monocotyledons. It is termed tetracytic where the guard cells are surrounded by four subsidiary cells —two laterals and two polar, each being present on the four sides. The two laterals lie parallel to guard cell. The two polar subsidiary cells are often smaller. new stomatal type in monocotyledons.

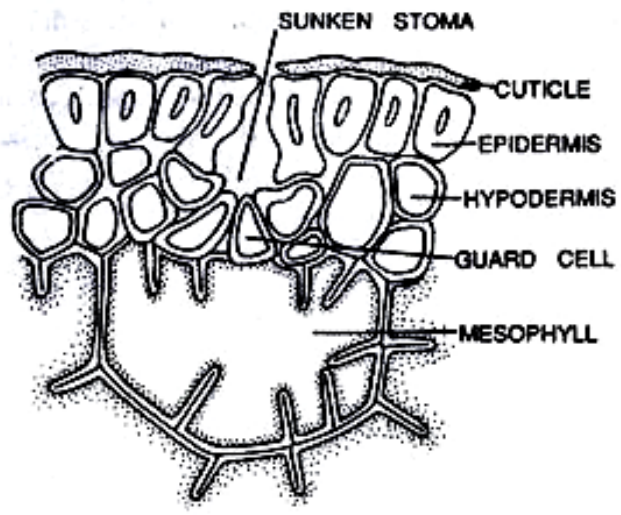
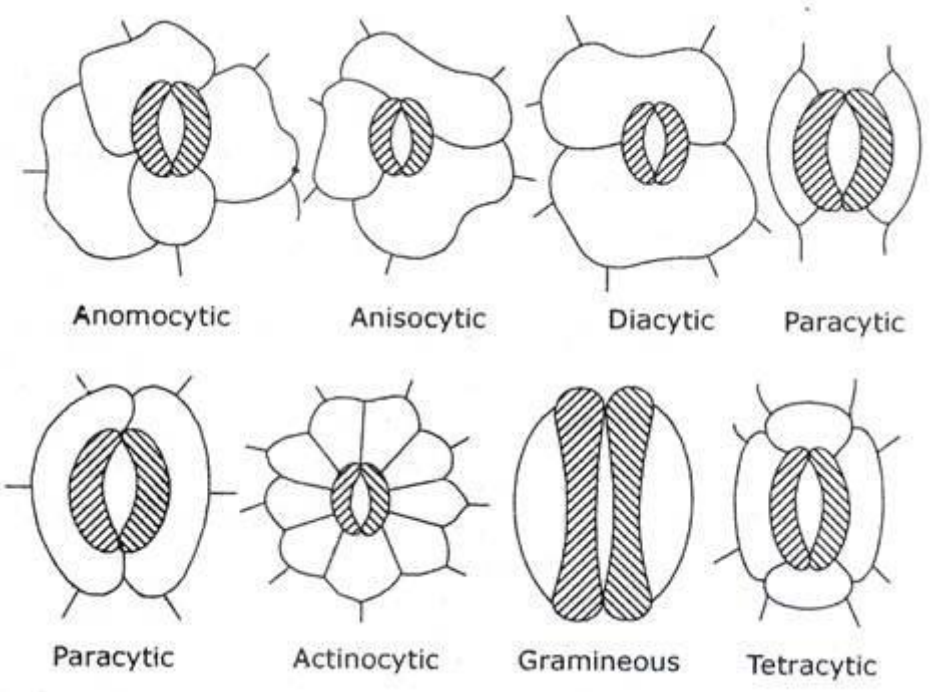



**Fig. 37.16.** Sunken stoma. Sectional view of a sunken stoma of pine leaf.




**Diagrammatic representation of different types of stoma in dicotyledons and monocotyledons. Guard cells are hatched. The other are subsidiary cells/epidermal cells.**

## 7. Actinocytic:

Actinocytic stoma remains surrounded by a circle of radiating cells. (*Rosa*)

## 8- Hemiparacytic

Stoma with a single subsidiary cell. The stoma is accompanied by a single subsidiary cell either shorter or longer than the guard cells and which mostly lie parallel to the long axis of the pore.

# B- Guard Cells Shape

## 1. Gramineae – Cyperaceae type

The gramineous stoma possesses guard cells of which the middle portions are much narrower than the ends so that the cells appear in surface view like dump-bells. They are commonly found in Gramineae and Cyperaceae of monocotyledons.

## 2. Dicot-Monocot type

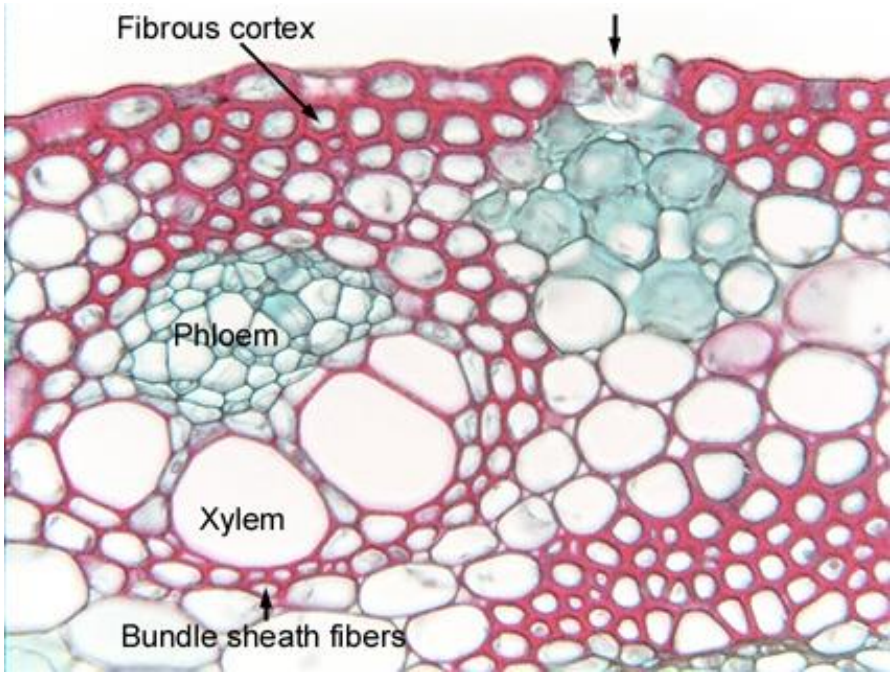
In this type, the guard cells as a kidney shape are in the surface, with external and internal outgrowth in the lateral view. In this case, there is a front cavity and a back cavity. This type is found in all the dicot and monocot cells, except Gramineae – Cyperaceae families.

### 3. Gymnosperm type :

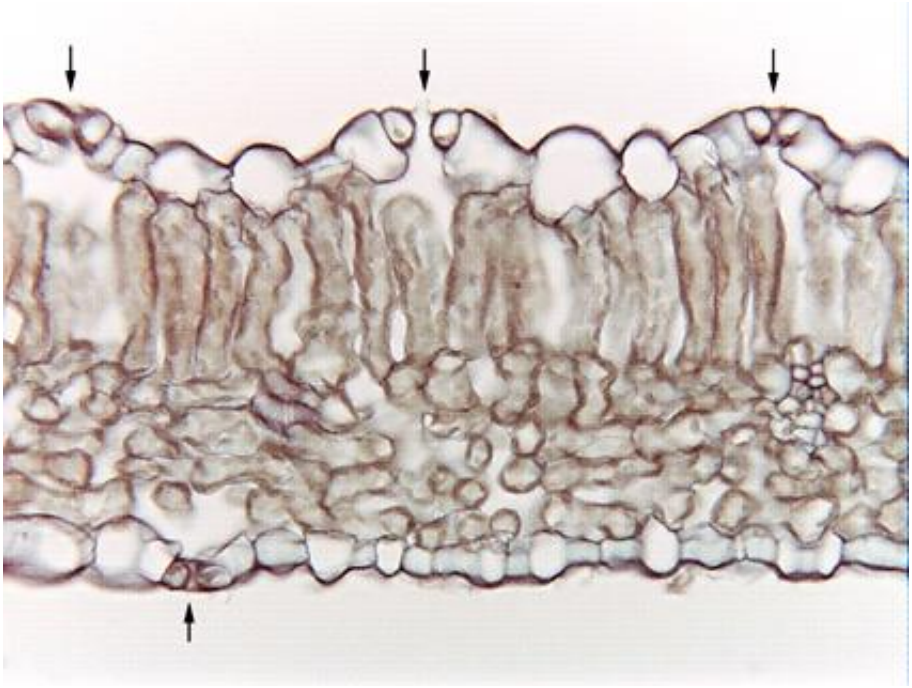
This type of stomata is found in the Coniferales, including *Pinus*, and this type are sunken.

## C- Stomatal Level with Epidermal cells

### 1.Ordinary stomata




### 2.Raised stomata (*Capisicum*)



## 3.Sunken stomata (*Pinus*)