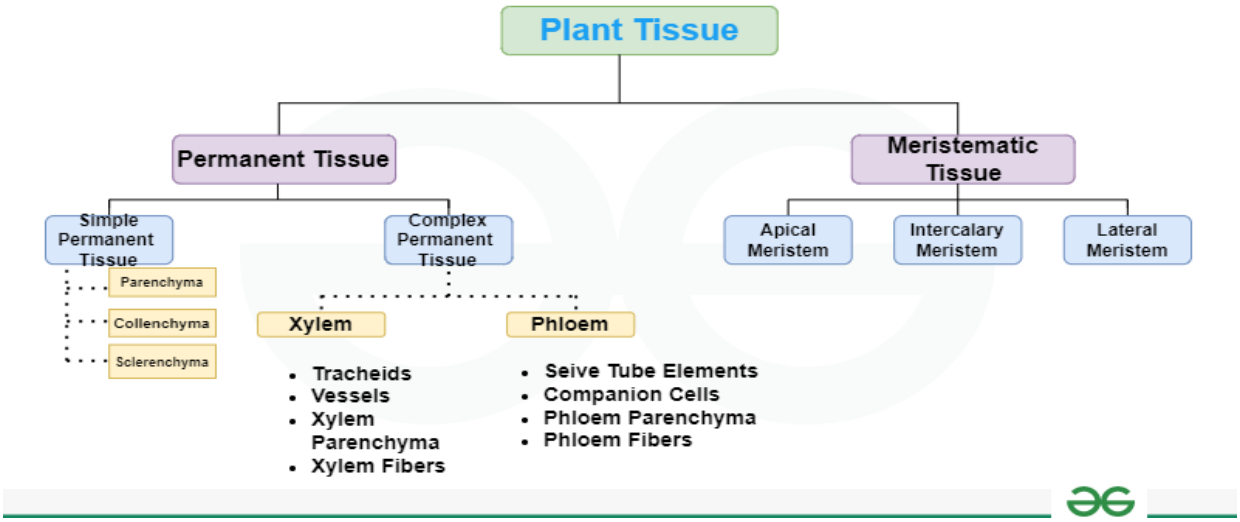
Practical Plant Anatomy

Plant tissue

Is a group of cells similar in shape and structure specialized to do one or more specific functions.



1.Meristematic tissues:

Consist of undifferentiated cells which were capable of continued cellular division, as a result the meristematic cell represent the site of cell division in plants. This tissue founds in zones of plant where growth take place and keep the plant growing.

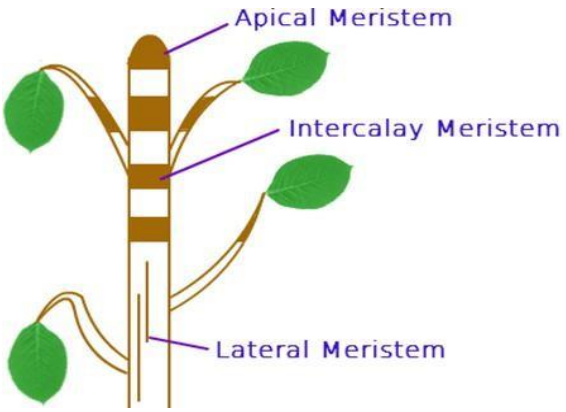
Characteristices of meristematic tissue:

1- Small in size
2-Thin primary cell wall
3-Have the ability to divide
4-Have dense cytoplasm, few vacuoles or absent
5-Large nucleus
6-Contain dense protoplast
7- Lacking intercellular spaces between cells

Meristematic tissues can classified according to:

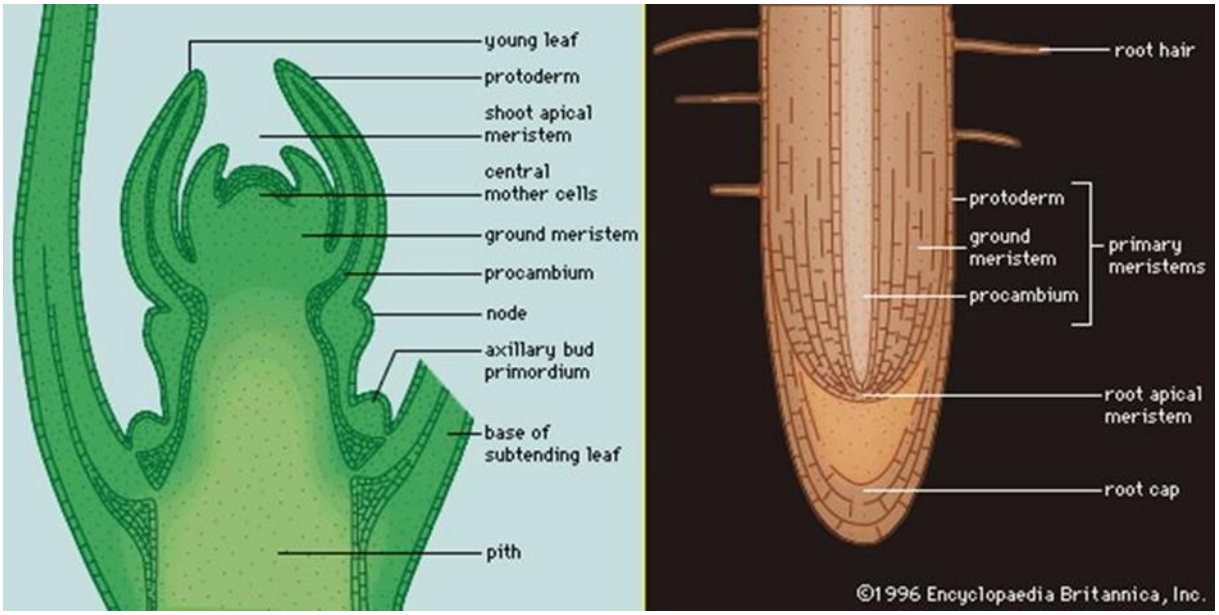
a. **Their position in plant body**
b. **The origin**

a. Meristimatic tissues according to their position in plant body

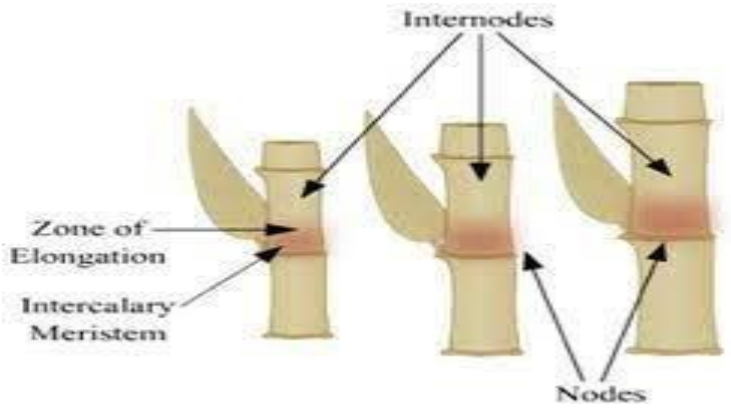


1-Apical meristems: Meristematic cells location near the tips of roots and shoots and produce primary tissues which plays an important role in the elongation of roots and shoots. Examine L.S.in *Vicia faba* root or in Ricinus sp. stem.

Shoot meristem **Root meristem**



2-**Intercalary meristems:** it is located in between permanent tissue faraway from apical, it is usually present at the base of leaves and above the node and at the base of inter node in many monocot stems and grasses, it is responsible for the elongation of the internodes regions and the formation of branches at the nodal regions.
Examine L.S.in *Zea mays* stem.



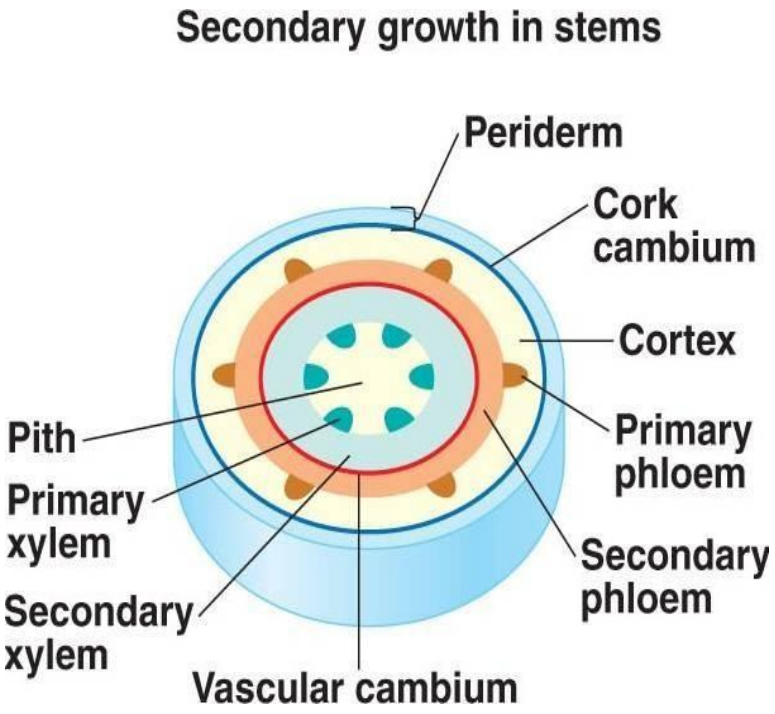
Intercalary meristems

3-**Lateral meristems:** Cylindrical tissue parallel to the epidermis which form in mature regions of roots and shoots, this meristems produce secondary growth which increases the width of the plant by **vascular cambium** and **cork cambium (phellogen)**.

A-Vascular cambium: Lateral meristem present between xylem and phloem tissue, activity of vascular cambium will increase the diameter of root and stems, found in the plant which produces secondary tissue at the secondary growth. Examine C.S. in Pinus , C.S. in Helianthes stem and C.S. in Cucurbita stem.

B- Cork cambium (phellogen): which is divided to form cork and secondary cortex in root and stem that get into secondary growth, the result of this activity of cork cambium will form (periderm) in old stem which consist of the following tissues:

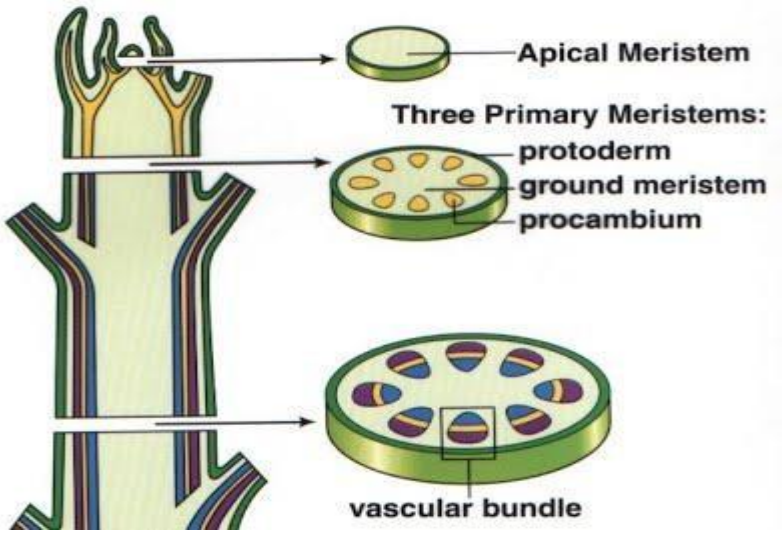
1- Cork
2-Cork cambium
3-Secondary cortex (phelloderm)
Examine C.S. in Tilia sp.



b. Meristematic tissues according to origin

1-Primary meristems: tissues that form primary plant body and originate from promeristem so it consist apex in stems and roots and leaf primordium, which consist of: **Protoderm , Procambium , Ground meristem** . see L.S. *Vicia Faba* leaf.

2-Secondary meristems: tissues that form secondary part in plant as like as vascular cambium and cork cambium see in Tilia sp.

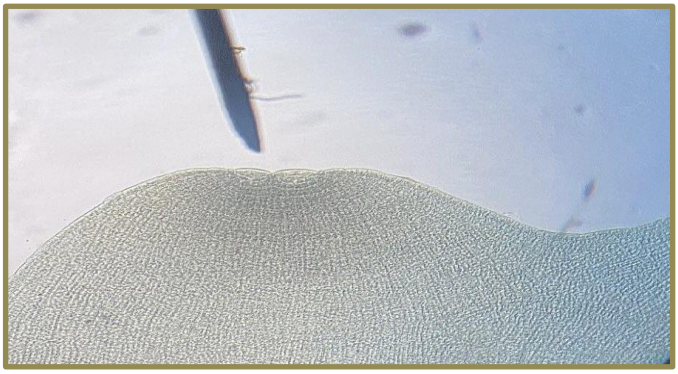


Primary and secondary meristems

The theory of meristematic tissues are :

1-single apical cell:

We observed it in most low lying vascular plants there will be many vacuoles contrary to what is the case in many meristematic cells in higher plants , where the apex cell have lenticular in shape or two sided in some algae like dictyota or some mosses or some tridia , in this case the cell divided in one direction which repeated several times to gives one or two layers or multiple layers.



L. s in dictyota

2-promeristem theory:

Promeristem divided in three regions

1- protoderm :

by division perpendicular to the surface to gives the epidermis of the stem or peliferous layers in root or it may be periclinal divisions to gives multistriate epidermis or epidermis and hypodermis **,**

2- procambium :

it appears as many long scattered bands in monocotyledons stems or strips arranged in hollow cylinder in dicotyledones **.**

3- Ground meristemis :

the division in all sides and the cells gives the ground tissues in stem or root from cortex of pith and pith rays.

3-Tunica-corpus theory:

According this theory two different areas can be distinguished in appearance and composition in apex of stem .

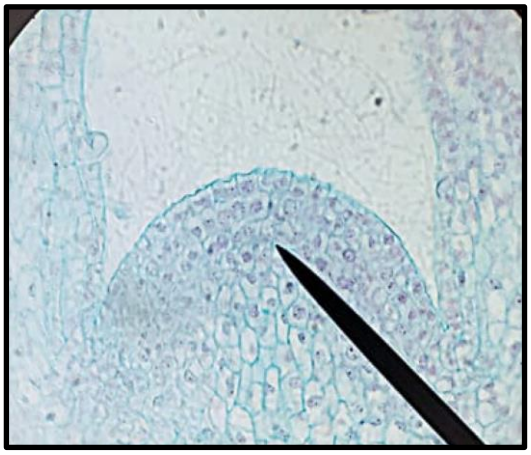
1-Corpus

It is an area located in the middle of apical meristem and it is Characterized by the large size of its cells and its divided in several directions . thus the top of stem increases in size which its cells divided anticlinal or periclinal or opligue divides .as a result the vascular cylinder is formed or the vascular cylinder and the cortex together ,In the corpus there is single initial one,

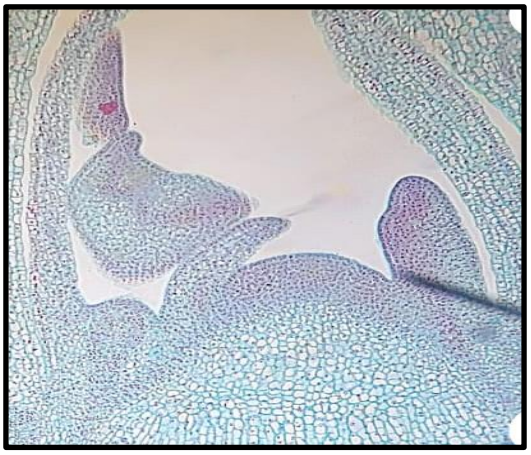
2-Tunica

Is the layer that covers the cells of the corpus ,is the cells are smaller than the cells of body ,it may consist of one layer or several layers , if the layer is one it represents the epidermis only or cortex and some other layers ,if there are several layers it includes the epidermis and cortex together,

The number of layers ranges from (1-3) in monocotyledons ,and (2-5) in dicotyledones,



L.S. in *coleus* sp.

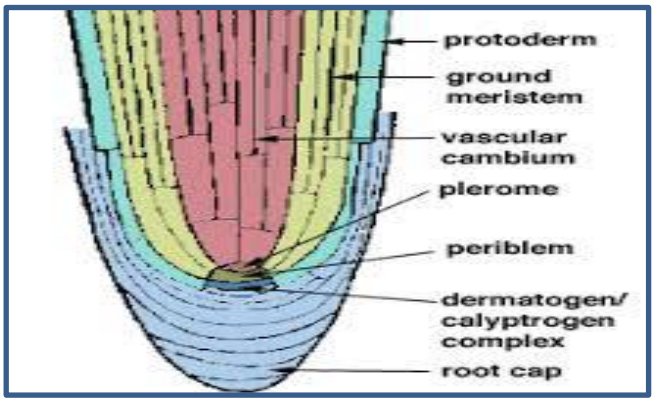


L .S. in *Ricinus commnunis* stem

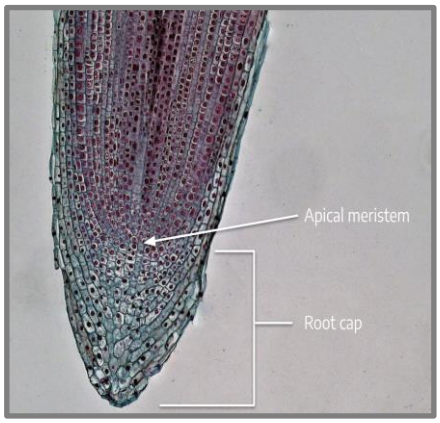
4-Root Apex

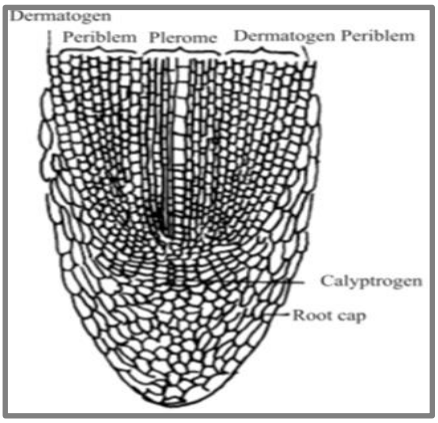
In lower plant there may be only one apical cell as a stem or a group of cells arranged in one row or there could be common meristematic layer and permanent primary tissues arise from them .

In *Allium cepa* we notice the presence of common structural area and the primary epidermis ,procambium and ground meristems arises from it,



In *Tradescantia* we notice that the growing peak is divided into several structural areas like calypterogen ,plerome periblem and dermatogen





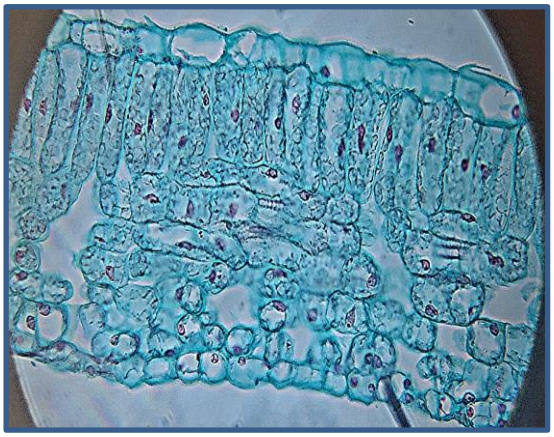
Dermal tissues

Dermal tissuess it includes all the tissues surrounding the body ,s organs to protect the plant from various environmental conditions and excessive loss of water encludes epidermis in the primary growth stages and periderm in plant organs that have suffered secondary thickening and rupture of the epidermis **.**

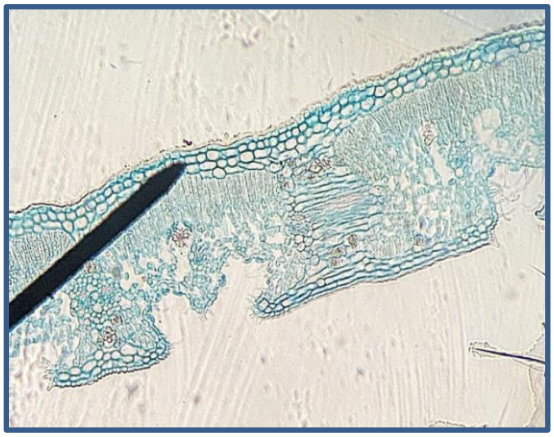
The epidermis

It is the outer layer of cells which covers the primary body of plant for all organs like (stems ,roots ,leaves , flowers , fruits and seeds) ,adult epidermis cells there is clear nuclear ,the cytoplasim is thin and vacuoles wide ,it has primary walls only and has no interspaces ,the cells of the epdermis are distinguished in the aerial parts it is saturated with cutin material which gives the cuticle later which absent in the non aerobic parts like the roots ,It may spread between normal epidermis cells another important type of cells like guard cells, trichomes and cystolith,In *Vicia faba* and *Portulaca sp* the epiderm cells have zigzag walls with no interspaces or it may be an equal dimensional polygon and the epidermis cells arranged as single row and covered with cuticle **,**

1- In monocotyledons the epidermis cells are polygonal like *Zea mays* .
2- In oleander leaves the epidermis cells consist more than one row of cells(multiple layers).



1



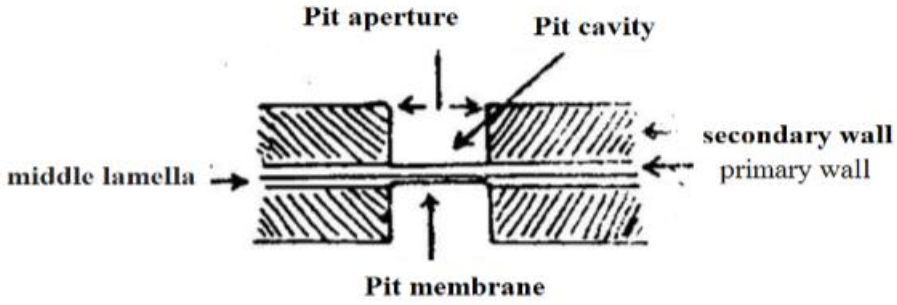
2

The Pits

Pits are relatively thinner portions of the cell wall that adjacent cells can communicate or exchange fluid through .

it arises in the form of so-called primary pits fields, which appear in the primary wall when it is expanded as a result of protoplast growth .It is usually opposite in adjacent cells and separated from each thin membrane composed mainly of the middle plate. In other words, pits are composed of three parts:

1. **Pit membrane**: It consists from the middle lamella and some part of the primary wall.
2. **Pit cavity**: It located between the pit membrane and cell cavity.
3. **Pit aperture**: opening at the end of the pit cavity where it meets the cell cavity



Parts of pits

Types of pits

1. **Primary Pits Fields**

It appears like prayer beads, The primary wall consists of thin areas called Primary Pits Fields and thick areas respectively, clearly appear in live cells that have not yet been a secondary wall, these fields are characterized presence of plasmodesmata passing through from it.

- Examine a cross-section of *Capsicum sp*. The primary pits fields are observed in the walls of the parenchyma cells.

2. **Simple Pits**

Presence in secondary wall such as vessels and fibers , have a semi diameter.

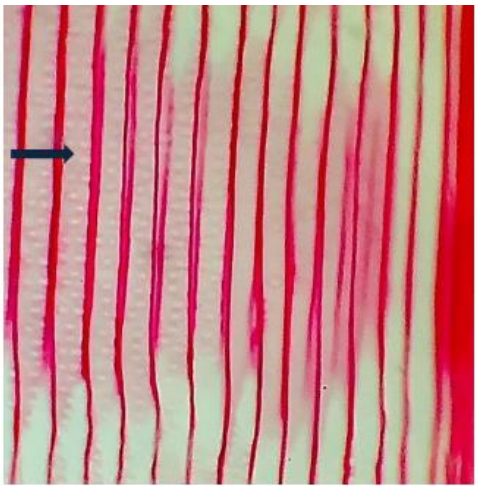
- Examine a cross section of the Yucca leaf to study the simple pit.

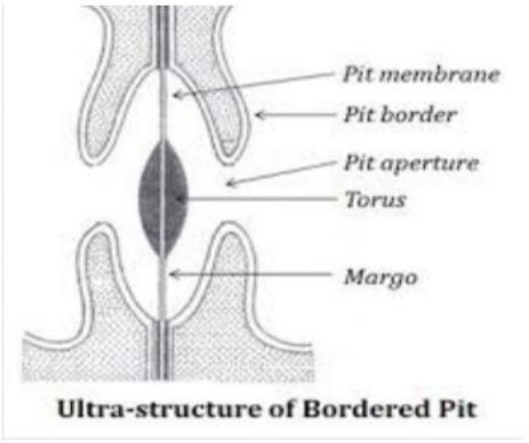
3. **Bordered Pits**

Which the secondary wall separated from the pit membrane and extends inside the cell constitutes the border, the edges of border don't meet in middle to formed pit aperture. The Pit membrane thickening in the middle to formed torus. The space formed between border and pit membrane called pit chamber. The

diameter of torus little larger than the diameter of pit aperture. The torus presence in bordered pits pairs and there is no in half bordered pits.

- Examine the cross section in the Pinus wood and note the presence of bordered pits.



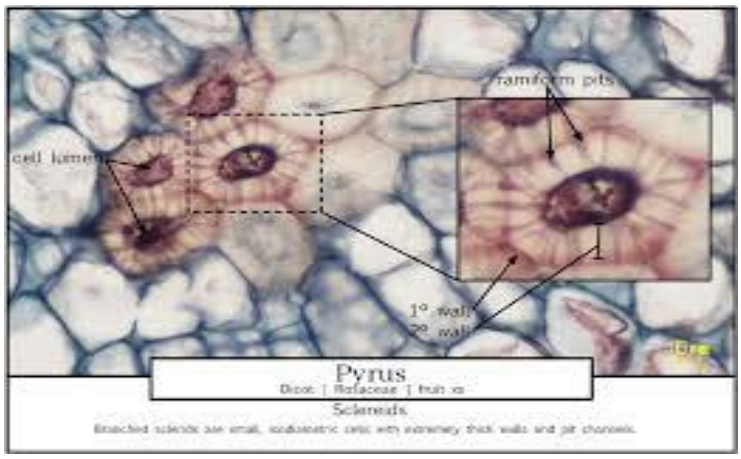


Ultra-structure of Bordered Pit

4. Branched pits(Ramiform)

It appears when increasing wall thickness, then pits become very deep and form channels between the cavity of the cell and its surface.

- Prepare a slide of stone cells from the core of *Pyrus communis* and note the branched pits.



Plasmodesmata

They are fine protoplasmic filaments that pass through the primary pits fields to connect the protoplast of neighboring cells. They may not only exist in the primary pits fields but may also be found throughout the primary wall of the cell.

- Prepare a cross-section in date-seed endosperm Observe the plasmodesmata.

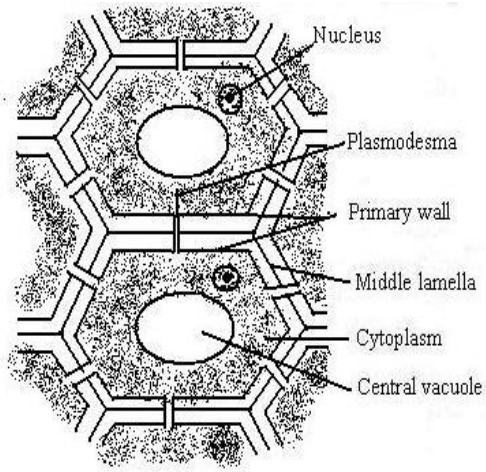
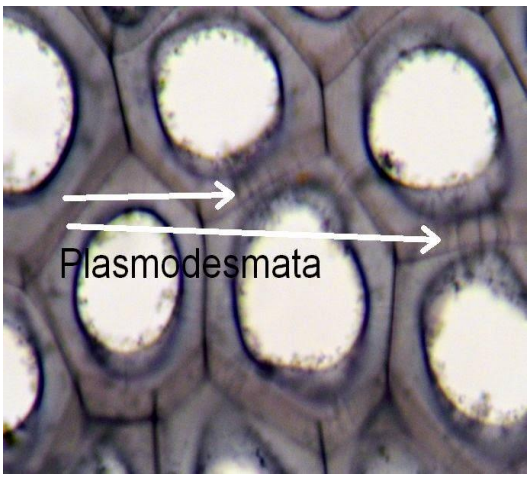


Fig7 T.S of a cell showing plasmodesmata between two adjacent cells



plasmodesmata.

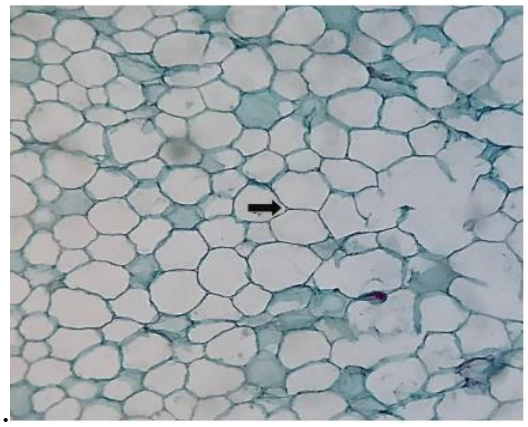
Intercellular Spaces

It arises in vascular plants, in a way schizogenously, or lysigenously, or both ways. Therefore, these intersections differ according to their origin and function as follows:

1. **Ordinary Schizogenous Intercellular Spaces**

This type arises by the separation of neighboring cells, and their size varies in different tissues of plants.

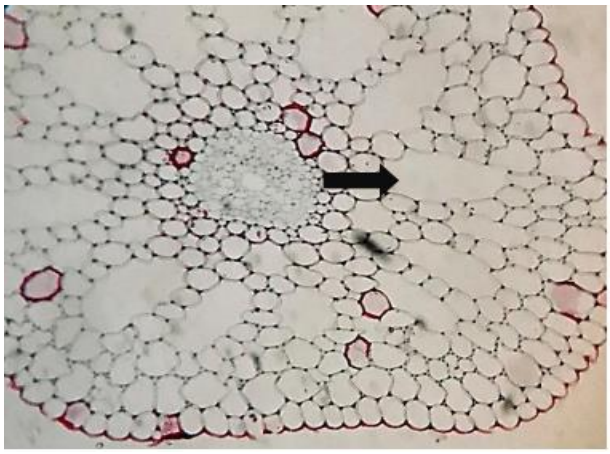
-Examine a cross section of the stem of the sunflower plant *Helianthus annus*. You notice the presence of this kind of normal brown spaces spread between the parenchyma cells



Ordinary Schizogenous Intercellular Spaces in C. S of sunflower (*Helianthus annus*) stem

The intermediate spaces between the parenchyma cells may expand, forming what is known as the air lacunae or air cavity.

-Examine a cross-section of Elodea sp. The diffuse Intercellular spaces are observed between the parenchyma cells forming the air chambers



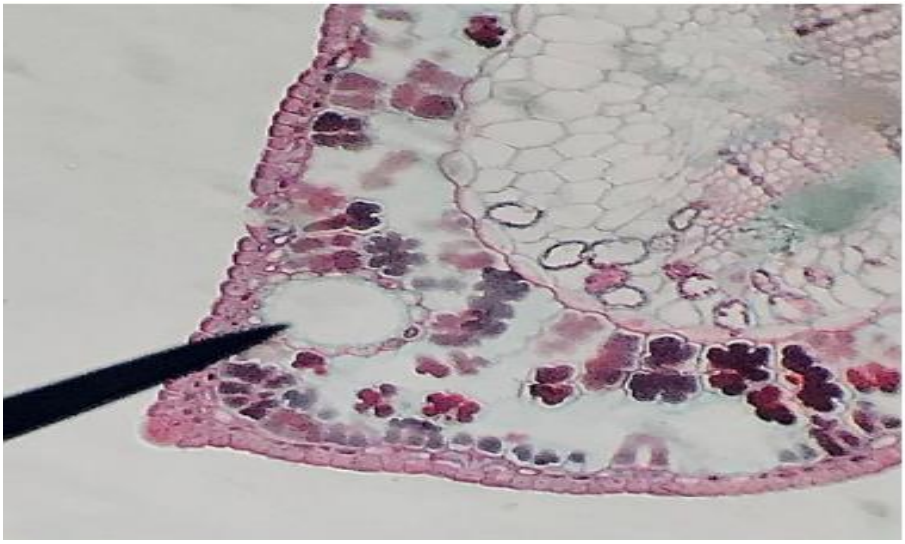
C. S Elodea sp.

2. Specialized Schizogenous Intercellular Spaces

Some types of separating interstitial spaces are specialized structures to perform a specific function, such as the Secretory ducts in compositae or Resin ducts in Pinus sp.

Resin ducts: It is a tubular structure consisting of a layer of secretory cells with thin walls which surrounds a central space. These cells are called epithelial which surrounded by a row or more of thickened walls called Sheath cells.

-Examine a cross-section of Pinus sp. To study the resin ducts that represent Specialized Schizogenous Intercellular Spaces.

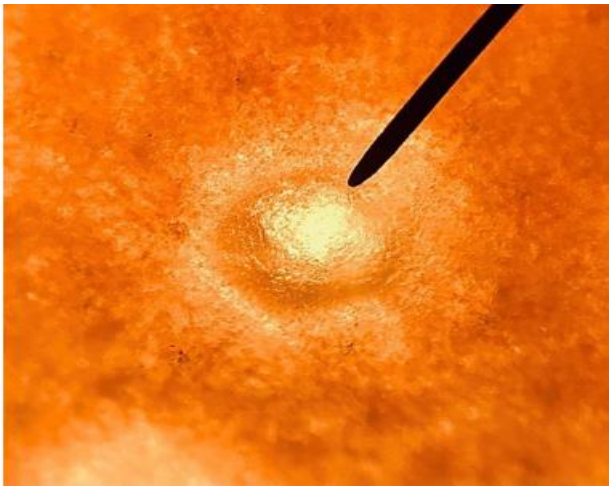


C.S. in Pinus sp. To study the resin ducts that represent Specialized Schizogenous Intercellular Spaces.

3. Lysigenous Intercellular Spaces

This type of total dissolution of the secretory cells arises after the process of secretion and thus the cavity appears to be surrounded by the dissolved remnants of the cell walls that remain attached to the adjacent cell walls. for example citrus oil glands (orange) .

-Prepare a slide of orange peel or tangerine (Citrus spp.) clear cavities filled with oily excretions are noted as these cavities represent the Lysigenous Intercellular Spaces.

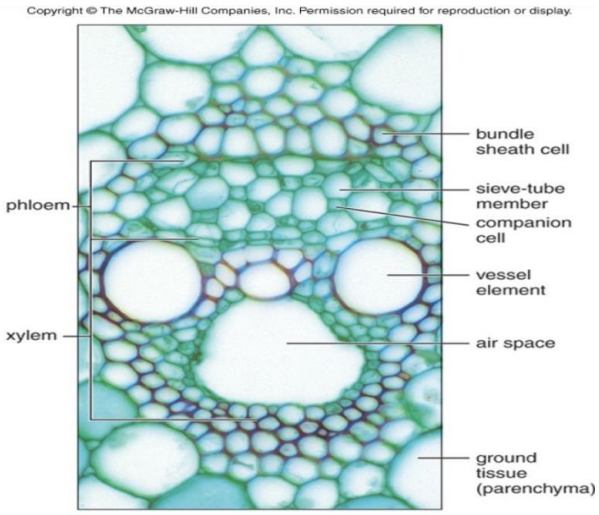


C.S. in orange peel noted the Lysigenous Intercellular Spaces.

4. Schizo- Lysigenous Intercellular Spaces

These cavities arise from the separation and dissolution of the cells together. In leguminous stems, the first woody container often dissolves، leaving a channel or space called the protoxylem space that represents schizo- lysigenous intercellular spaces.

-Examine a cross-section of the corn stalk *Zea may s*, and notice the presence of schizo- lysigenous intercellular spaces (the first wood space) in the vascular bundles.



Types of epidermis cells:

1- Ordinary epidermis cells:The most common types of epidermal cells in most plants. Typical cell shapes and sizes vary among plants and organs. In general, they often tend to have an isodiameteric, elongated, or zig-zag shape.

2- Guard cells: They are highly specialized living cells, kidney-shaped in dicotyledons and dumbbell-shaped in monocots, with primary walls. The term **stoma** is applied to the two guard cells and the opening between them.

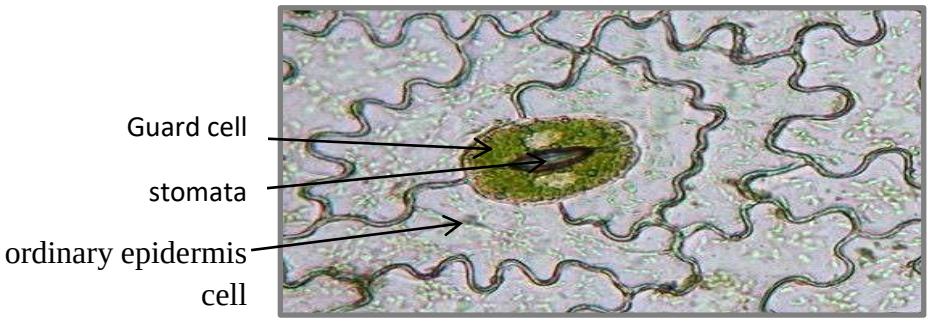
3- subsidiary cells: These cells are accompany to the guard cells (or stomata). Subsidiary cells may support guard cell function by offering a mechanical advantage that facilitates guard cell movements, or by acting as a reservoir for water and ions. In other cases, subsidiary cells introduce or enhance certain morphologies (such as sunken stomata) that affect gas exchange.

Types of stomata according to pattern of guard cells

1- Monocot – Dicot type:

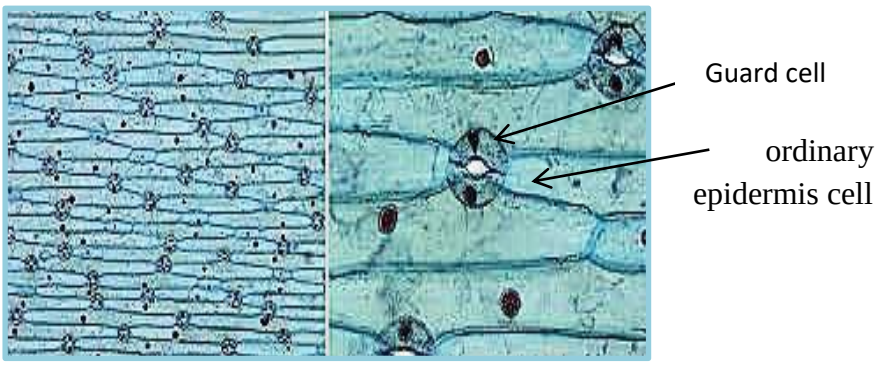
This type found in the epidermis of all monocot and dicot **excepting** Graminea and Cyperaceae families.

a) Dicot plant , leaf of ***Vicia faba*** . the ordinary epidermis zigzag walls, with equal dimension and guard cells have kidney shape.



S.s in lower epidermis ***Vicia faba*** leaf

b) Monocot plant, leaf of ***Iris sp***. The ordinary epidermis appearing ribbed and longitudinal shape and guard cells have kidney shape.

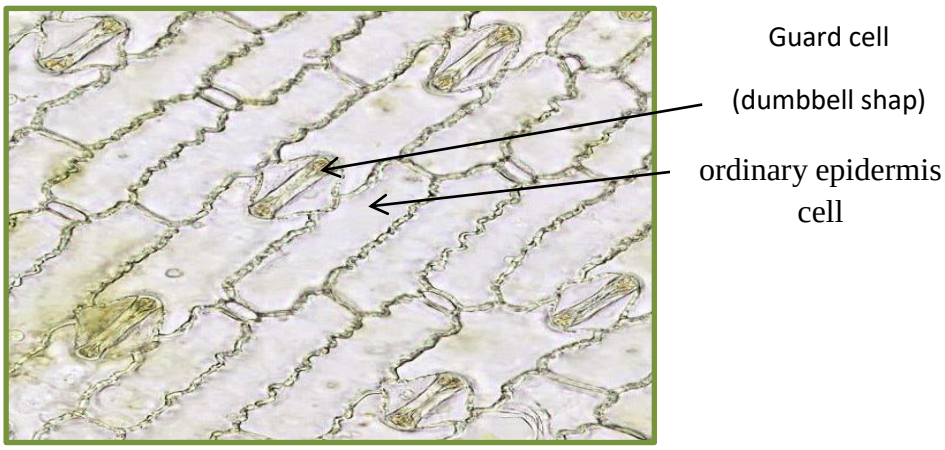


S.s in leaf of ***Iris*** sp.

2- Graminae - cyperaceac type:

It is found in Graminae and cyperaceae families only.

The ordinary epidermis cell appearing with rectangle shape, guard cells are dumbbell shaped and surrounding with two subsidiary cells that different from epidermis ordinary cells.

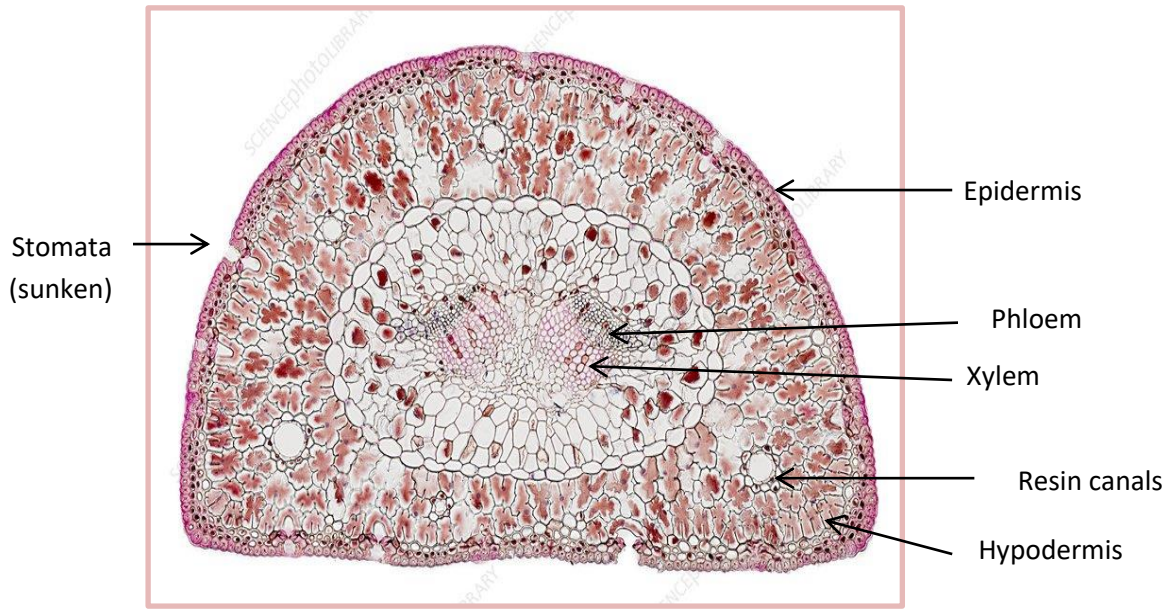


S.s in leaf of ***phragmitis*** sp.

3- Gymnosperm type:

This type found in coniferales plants such as ***pinus*** **sp**.

The stomata are sunken shape and the epidermis cells thickening with lignified , guard cells surrounding with subsidiary cells.



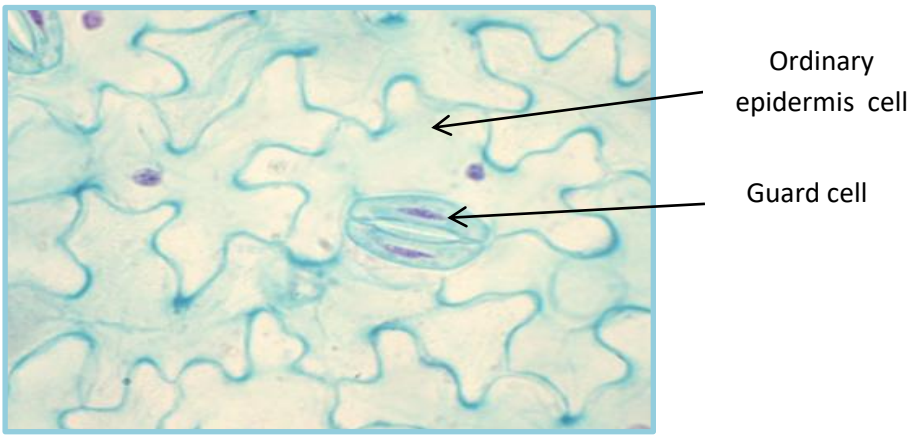
C.s in needle leaf of ***pinus*** sp.

Type of stomata according to subsidiary cells

Stomata can be classified according to subsidiary cells into :

1. Anomocytic type:

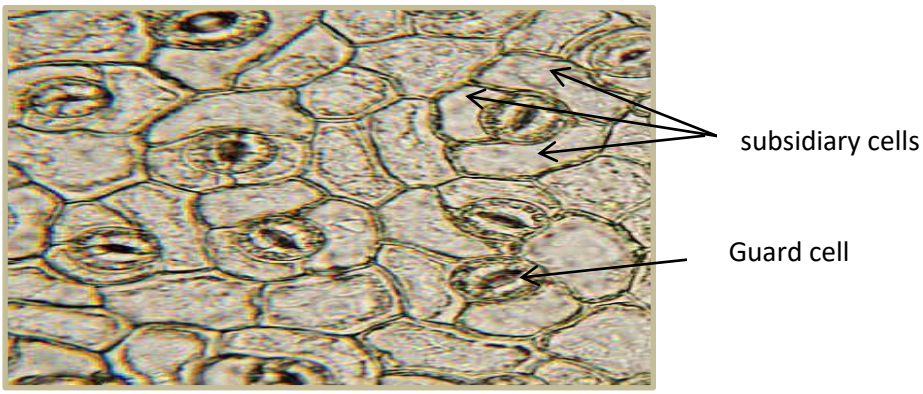
In this type the subsidiary cells **absence**,guard cells kidney shape and the stomata surrownding with ordinary epidermis cells only.



S.s in lower epidermis ***Vicia faba*** leaf.

2. Anisocytic type:

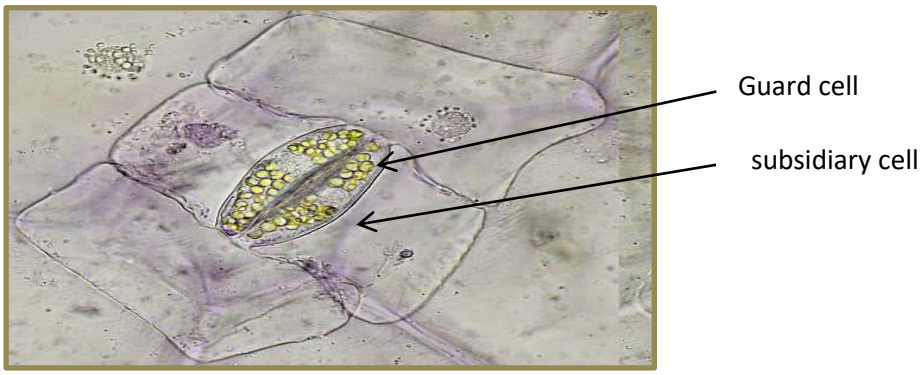
It is characterized by the presence of three or more subsidiary, one is small and others are vary in size. Guard celle have akidney shape.



S.s in lower epidermis cells of ***Raphanus*** sp.

3. **Paracytic type**:

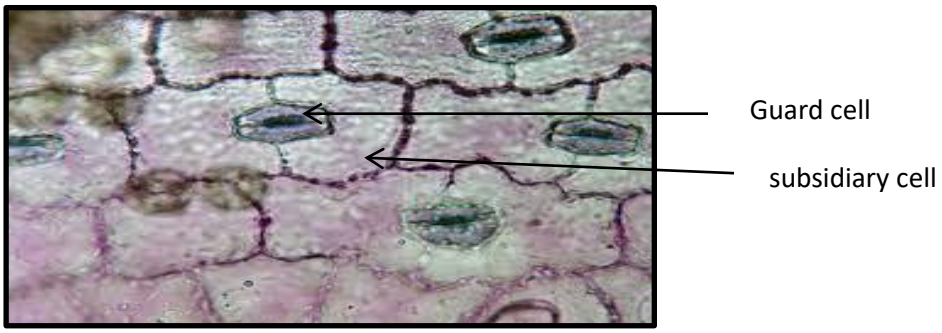
In this type, the two subsidiary cells are **parallel** to guard cells and to the stomatal pore. Guard cells have a kidney shape.



S.s in leaf of ***Tradescantia*** sp.

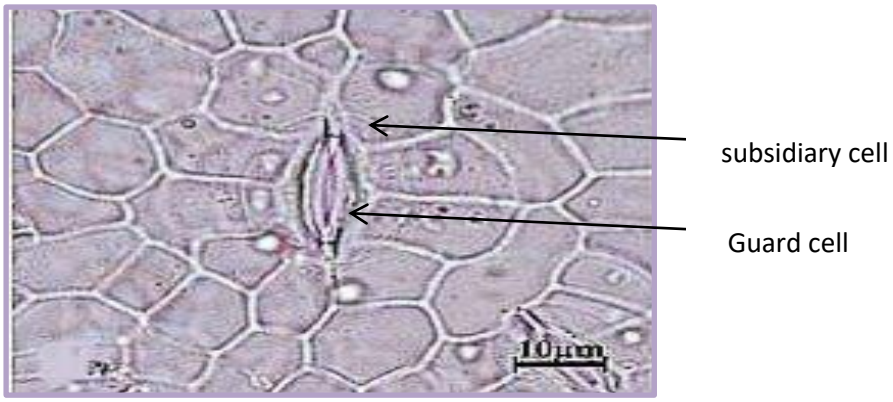
4. Diacytic type:

In this type, the common walls of two subsidiary cells **Perpendicular** with guard cells on direction of stomatal pore.



S.s in lower epidermis cells of ***Dianthus*** sp.

5. Actinocytic type: In this type, the stoma is surrounded by a number of subsidiary cells that are arranged astral



S.s in lower epidermis cells of ***Alnus subcordata***.