

## Lecture 3

## Plant anatomy

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### Plant histology:

Plant tissues can be either meristems or permanent tissues.

**1-Meristems or (Meristematic tissues):-** The term meristem means cell division activity as a characteristic of a meristematic tissue. Some of the products of cell division in the meristems do not develop into adult cells but remain meristematic. Those cells that maintain the meristem as a continuing source of new cells are referred to as the **initiating cells** or **meristematic initials** or **simply initials**. Their products, which after a variable number of cell divisions give rise to the **body cells**, are the **derivatives** of the initials.

**Classification of meristems:** - A common classification of meristems is based on their position in the plant body:

- 1) **Apical meristems:** They are located at the apices of main and lateral shoots and roots
- 2) **Lateral meristems:** They are arranged parallel with the sides of the axis, usually that of stem and root. The vascular and cork cambia are lateral meristems.
- 3) **Intercalary meristem:** The best-known examples of intercalary meristems are those in internodes and leaf sheaths of monocots, particularly grasses.

### Characteristics of Meristematic Cells:

- 1- Meristematic cells are similar to young parenchyma cells.
- 2- The cell wall of meristematic cells at shoot tips are relatively thin-walled.
- 3- They are poor in storage materials.
- 4- Their plastids are in proplastid stages.
- 5- The endoplasmic reticulum is small in amount and mitochondria have few cristae.

6- Golgi bodies and microtubules are present as is characteristic of cells with growing cell walls. Generally, larger meristematic cells have smaller nuclei in proportion to cell size.

**2- Permanent tissues:** The tissues are derived from meristematic tissue and are composed of cells, which have lost the ability to divide.

### **Types of Permanent Tissue**

**Simple:** They are parenchyma, collenchyma and sclerenchyma.

**Complex:** which are xylem and phloem.

### **\*\*\*Distribution of permanent tissues in plant body**

The vascular plant is composed of three systems: -

**A- Dermal:** The dermal system is initially represented by the epidermis containing various cell types.

**B- Ground tissue system:** - The ground system surrounds the vascular tissues and comprises parenchyma, collenchyma and sclerenchyma.

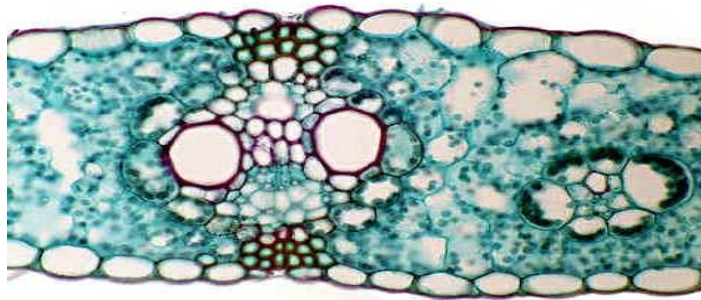
**C- Vascular tissue systems:** - It consists from the phloem and xylem which are called the conducting tissues.

### **Dermal Tissue Epidermis: -**

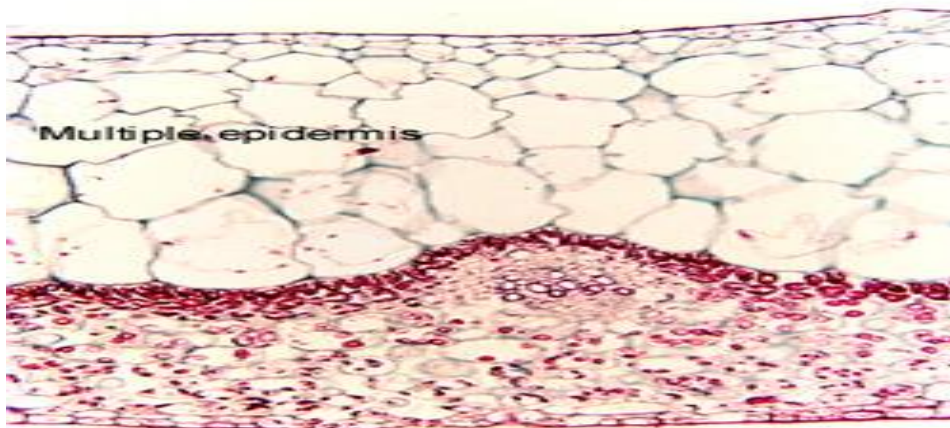
It is a system of cells, variable in structure and function, it is the outermost layer on all parts of the primary plant body, including roots, stems, leaves, flowers, fruits and seeds and compact with cuticle consisting of cutin which is effectively protects the plant from water loss and as barrier against pathogens. In the plants that undergo secondary growth is replaced by periderms but an exception is found in long-lived monocots that have no secondary addition to the vascular system but replace the epidermis with a special kind of periderm.

## Classification of epidermis according to layers of cells:

1- **Uniseriate epidermis:** The epidermis is usually one layer of cells in thickness.



2- **Multiseriate or multiple epidermis:** It is consisting of several layers of ontogenetically related cells; this is resulting from the division of protodermal cells in some leaves.



## Function of epidermis:

1-Restricts transpiration (contains cutin(fatty material) within outer wall and on its surface (cuticle))

2-Gas exchange (presence of stomata)

3-Mechanical support (compact arrangement of cells and presence of tough cuticle layer)

4-Absorption (thin walled and presence of root hairs)

5-Water storage (xerophyticplants)

6-Site of light perception involved in circadian leaf movement and photoperiodic induction.

**Composition of epidermis:** The epidermis is a complex tissue composed of a wide variety of cell types, which reflect its multiplicity of functions.

**1- Unspecialized cells (the ordinary epidermal cells):** the main features of these cells are:-

**A-** They are ground cells and tabular.

**B-** They have little depth but the palisade-like epidermal cells of many seeds are much deeper than they are wide.

**C-** In elongated plant parts like stems, petioles, vein ribs of leaves of dicots and leaves of most monocots, the epidermal cells are elongated parallel with the long axis of the plant part.

**D-** Epidermal cells have living protoplasts and may store various products of metabolism.

**E-** They contain plastids that usually develop only few grana, deficient in chlorophyll. The Starch and protein crystals may be present in epidermal plastids and anthocyanins in vacuoles.

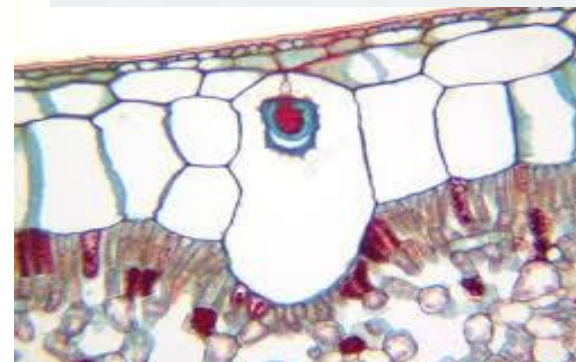
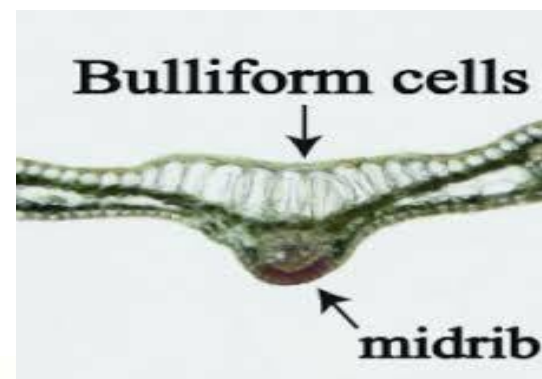
## **2- Specialized epidermal cells:**

A diverse types of plant epidermal cells can occur on the young stem and different foliar organs.

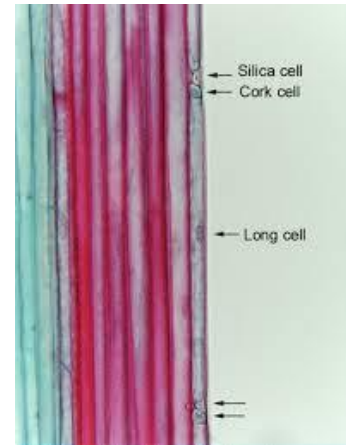
### **1- Bulliform (like ballons) cells:**

They are long, thin walled, highly vacuolated cells usually present in the stem of many monocots, where are thought function to rolling up or unrolling leaves following the loss or uptake of water.

**2-Lithocysts:** They are large cell produces a calcified body (**cystolith**) composed largely of calcium carbonate attached to a silicified stalk; the stalk is a cylindrical in growth of the cell wall.



3- **Silica cells:** They are short cells, deposited in large quantities in the shoot system of grasses, when they are fully developed; their lumina are filled with isotropic bodies of silica. The shape of the silica bodies formed in the short cells over the veins can be used to strengthen cell walls and improve resistance to stress like drought and pests.



4- **Stomata:** - They are special type of epidermal cells and considered as openings in the epidermis, each bounded by two guard cells, which by changes in shape bring about the opening and closing of the pore. Stomata occur on all aerial parts of the primary plant body but are most abundant on leaves. In leaves, stomata may occur on both surfaces (amphistomatic leaf) or on only one, either the upper (epistomatic leaf) or more commonly on the lower (hypostomatic leaf). In some species, the stomata are surrounded by neighboring cells these cells are called **guard cells**. In others, the guard cells are bordered by one or more cells subsidiary cells (distinct cells that are differing in size, shape, arrangement, and sometimes in content from the ordinary epidermal cells). The primary role of stomata is to regulate the exchange of water vapor and of CO<sub>2</sub> between the internal tissues of the plant and the atmosphere.

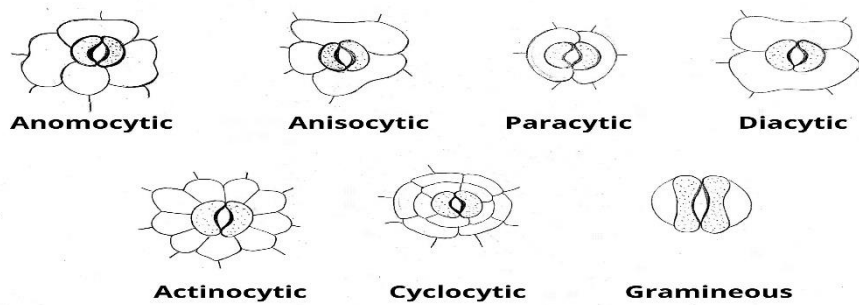
**Classification of stomata according to position:** Stomata vary in the level of their position in the epidermis:

- 1- They may occur at the same level as the adjacent epidermal cells.
- 2- Raised above the epidermis as in *Prunus*
- 3- Sunken below the surface of the epidermis, like in gymnosperm, they help prevent transpiration and loss of water vapour as they are more protected from external conditions.
- 4- In some plants, like oleander (*Nerium oleander*) stomata are restricted to depressions called **stomatal crypts** (area where the epidermis is depressed into the leaf), which often contain prominently developed epidermal hairs.

**Guard cells:** They are specialized cells in the epidermis of leaves, stems and other organs that are used to control gas exchange. The guard cells are covered with a cuticle. As mentioned previously, the cuticle extends through the stomatal aperture(s) and into the substomatal chamber. Apparently the guard cell cuticle differs in chemical composition from that of ordinary epidermal cells and is more permeable to water than the latter. Each guard cell has a prominent nucleus, numerous mitochondria and poorly developed chloroplasts, in which starch typically accumulates at night and decreases in amount during the day with increasing stomatal opening. The guard cells of eudicots are generally crescent-shaped with blunt ends (kidney-shaped) in surface view; the guard cell nucleus in the Poaceae is dumbbell-shaped, being almost thread-like in the middle and ovoid at either end.

**Classifications stomatal complexes:**

- 1) **Anomocytic:** subsidiary cells are lacking, so the epidermal cells around the guard cells are not distinguishable from other epidermal cells, E.g.: *Vicia*.
- 2) **Anisocytic:** In which the stoma is surrounded by three subsidiary cells, with one distinctly smaller than the other two, E.g. *Arabidopsis*.
- 3) **Paracytic:** In which the stoma is accompanied on either side by one or more subsidiary cells parallel to the long axis of the guard cells. E.g.: *Ricinus*.
- 4) **Diacytic:** In which the stoma is enclosed by a pair of subsidiary cells whose common walls are at right angles to the guard cells. E.g.; *Dianthus*
- 5) **Actinocytic:** the stoma is surrounded by a circle of radiating cells whose long axes are perpendicular to the outline of the guard cells. E.g.: *Rosa*
- 6) **Cyclocytic (encyclocytic):** In which the stoma is surrounded by one or two narrow rings of subsidiary cells, numbering four or more.



**5- Trichomes:** They are highly variable epidermal appendages. They may occur on all parts of the plant and may persist throughout the life of the plant part or may fall off early.

**Functions of trichomes:**

- 1-Studies of arid-land plants indicate that increase in leaf pubescence (hairiness) reduces the transpiration rate by increasing the reflection of solar radiation, which lowers leaf temperatures.
- 2- Some hairs on fruits are shaped as hooks so that the propagation unit easily sticks to animals for dispersal.
- 3- Water absorption has been done by root hairs, which actively absorb waters and minerals from soil.
- 4- Defense against insects and herbivores, like stinging hairs on *Urtica*.

**Division of trichomes into different morphological categories:** Some morphological trichome categories are

- 1-**Non-glandular hairs:** They are diverse in morphology and anatomy; they may be unicellular or multicellular, both of them may be branched or unbranched. Unbranched multicellular hairs can be uniseriate or multiseriate.
- 2- **Glandular hairs:** They composed from (unicellular or multi-cellular) head composed of cells producing the secretion and borne on stalk of non-glandular cells. They vary in the following ways: chemical composition of substances, they secrete, accumulate or absorb, mode of production, secretion, location and

function.

