

## Lecture 4

## Plant anatomy

Prepared by Dr. Hadeel Al-Newani, supervised by Dr. Raghad Dhyea, Dr. Dina Yousif and Dr. Zina Khaleel

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

### 1- Parenchyma:

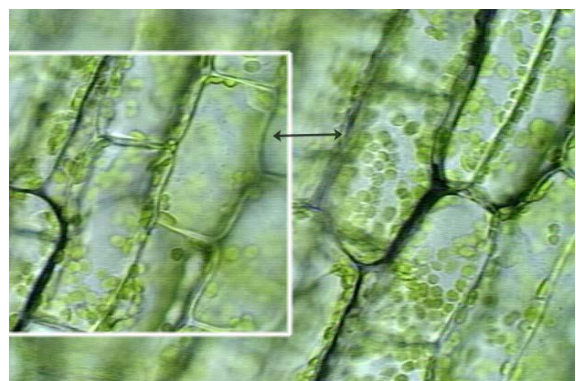
It is living tissue and the main representative of ground tissues, found in plant organs forming continuous tissue as in the (cortex of roots, pith, cortex of stems, mesophyll and petioles of leaves). This kind of tissue often fills spaces between other tissues or between.

#### \*\*\*Characters of parenchyma cells:

- 1) Parenchyma have living cells with central nucleus, cytoplasm and vacuoles surrounded by thin cell wall (0.2 to 2)  $\mu\text{m}$  in diameter.
- 2) Mature parenchyma cells of the stem and root may resume division and undergo partial dedifferentiation to form the lateral meristems of the phellogen and vascular cambium.
- 3) They have intercellular spaces or larger cavities for effective gas exchange.
- 4) They are isodiametric with many faces (14 polyhedral).
- 5) Some parenchyma cell develop secondary walls (lignified) make it difficult to distinguish from sclerenchyma.

#### \*\*\*Classification of parenchyma tissues according to function:

**1- Chlorenchyma:** It is specialized parenchyma tissue for **photosynthesis**; it contains numerous chloroplasts. The tissue found in the mesophyll of leaves, but chloroplasts may be abundant also in the cortex of a stem.



## 2- Storage parenchyma:

It is characterized by accumulating specific kinds of substances like starch granules and crystallized proteins, pigments and lipids are mostly found in the vacuole. Some molecules, like carbohydrates and nitrogen-containing substances, are also stored in the cytosol and plastids. Some parenchyma cells store only one type of substance, but a mix of different substances can also be found. Despite the fact that the cell wall of the parenchyma cell is typically thin, storage parenchyma cells in some seeds may show a very thick cell wall due to their capacity to store carbohydrates (as hemicellulose) within their cell wall.

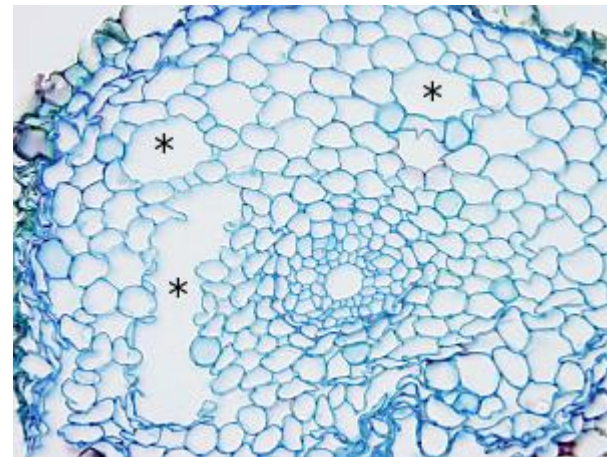


## 3- Secretory parenchyma:

In contrast, secretory types of parenchyma cells have dense protoplasts, especially rich in ribosomes and have either numerous Golgi bodies or endoplasmic reticulum, depending on the type of secretory product formed.

## 4- Aerenchyma:

It is type of parenchyma which found in the leaves, stems and roots of some plants like **aquatic**, the cells are characterized by small size, thin cell wall and air filled large cavities which provide low resistance internal pathway for the exchange of gases between plant organs above the water and submerged tissues. This tissue allows aquatic plants to float and keeps them near the surface for more efficient photosynthesis.



## 5- Water storage parenchyma:

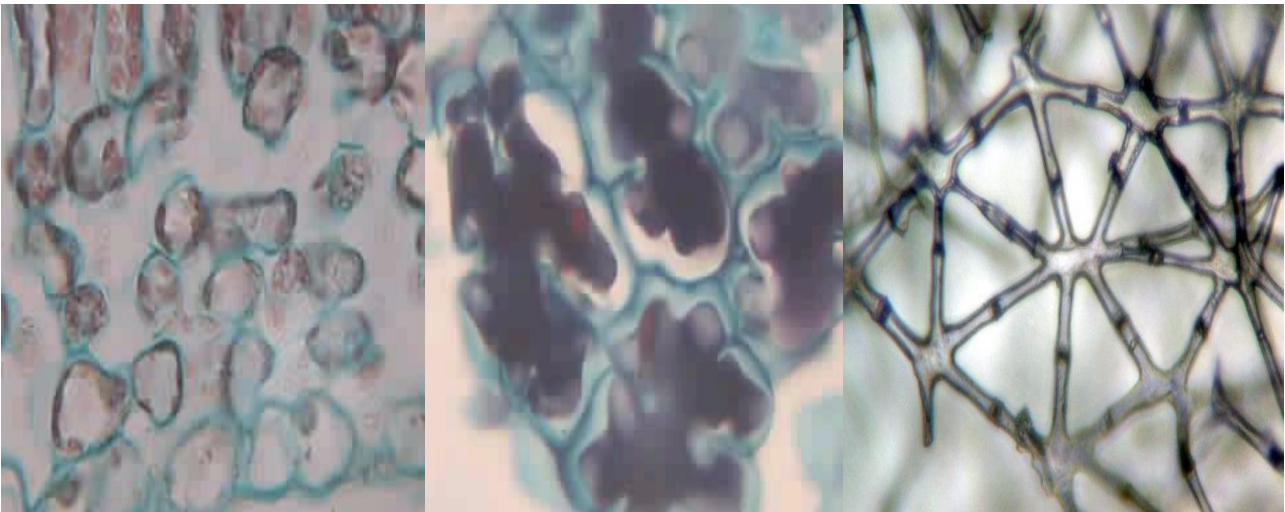
Parenchyma cells in the tissue system specialized as a water storage tissue. Many **succulent plants**, such as the Cactaceae, *Aloe*, *Agave*, contain in their photosynthetic organs chlorophyll free parenchyma cells full of water. This water

tissue consists of living cells of particularly **large size** and usually with **thin walls**.

**\*\*\*Transfer cell:** - It is a specialized form of parenchyma cell, is readily identified by ingrowths of the primary cell wall. The increase in the area of the plasma membrane beneath these walls facilitates the rapid transport of solutes to and from cells of the vascular system.

**\*\*\*Shapes of parenchyma cells:**

- 1) **Columnar:** it can be found in the palisade tissue of leaves.
- 2) **Stellate:** as in the stem of *Juncus effuses*.
- 3) **Lobbed:** as in the spongy tissues of leaves.
- 4) **Folded:** in the mesophyll of pine.



## 2- Collenchyma:

**Characters of collenchyma tissue:**

- 1- It is a living tissue composed of more or less elongated cells with thickened primary walls. The thick primary cell wall has thickenings distributed in different parts of the cell surface, providing the tissue with great resistance against mechanical stresses.
- 2- The lack of a secondary wall allows the cell to grow in both surface area and diameter.

- 3- Like parenchyma cells, collenchyma cells can restart meristematic activity.
- 4- Collenchyma and parenchyma cells are similar to one another both physiologically and structurally. Both have complete protoplasts capable of resuming meristematic activity and their cell walls are typically primary and non-lignified.
- 5- Collenchyma does not usually contain chloroplasts but is a translucent tissue that allows light to reach deeper photosynthetic tissues.
- 6- The difference between the two chiefly in the thicker walls of collenchyma cells; in addition the more highly specialized collenchyma cells are longer than most kinds of parenchyma.

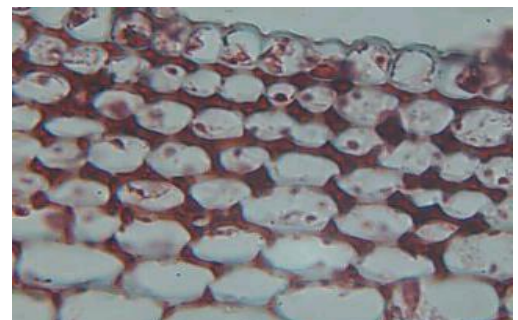
#### **Distribution of collenchyma in the plant:**

- 1- It occurs in the peripheral regions of stem and leaf, directly beneath epidermis or a few layers removed from it.
- 2- It frequently forms a continuous layer around circumference of axis (stem and leaf petiole), may occur in strands
- 3- In leaf blade occurs in ribs especially the larger one, occurs on either sides or one side of ribs.
- 4- Roots rarely have collenchyma.

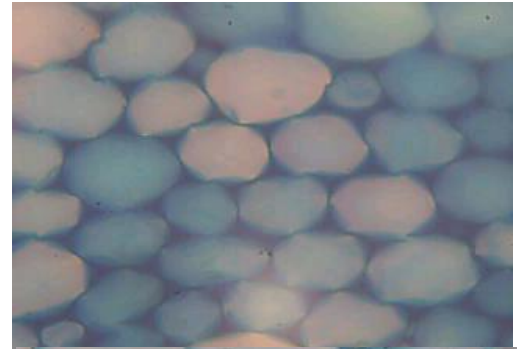
#### **Cell Walls of Collenchyma:**

It is the most distinctive characteristic of this tissue which its walls are thick and glistening in fresh sections and often the thickening is unevenly distributed. They contain, in addition to cellulose, large amounts of pectins and hemicelluloses and no lignin. The distribution of wall thickening in collenchyma shows several patterns:

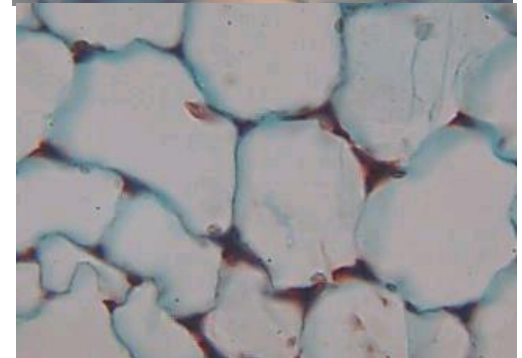
**1- Lamellar or plate:** The thickenings on two opposite sites of the tangential walls. Lamellar collenchyma is found in the stem cortex of *Sambucus nigra*.



**2-Angular:** The wall thickenings localized in the corners commonly, angular collenchyma is found in the stems of *Solanum tuberosum* and petioles of *Cucurbita*.



**3-Lacunar** or **lacunate:** When collenchyma develops **no intercellular spaces**, the corners where several cells meet show a thickened middle lamella.



### 3- Sclerenchyma

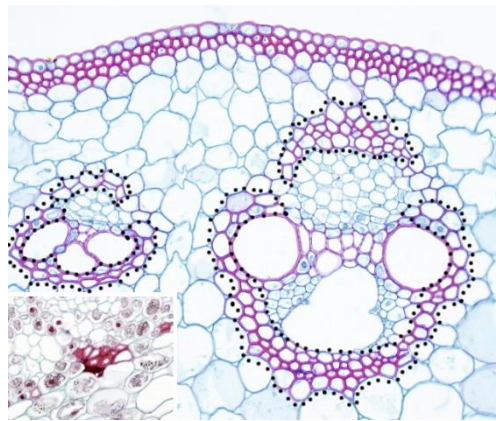
Sclerenchyma, unlike collenchyma has two types of cells (**fibers** and **sclereids**) showing a thick cell wall, with a lignified secondary cell wall in mature cells. The word sclerenchyma derives from "skleros" (Greek), meaning hard, rough. Mature sclerenchyma cells do not contain cytoplasm and are dead cells. Because of the structure of their cell walls, sclerenchyma has a relevant function in the support of organs that do not grow anymore. It protects the softer and more vulnerable parts of the plant against stretching, weights, pressures, and bending. The sclerenchyma is distributed throughout the body plant, both in organs having primary or secondary growth, it is most abundant in stems and leaves than in roots.

**1- Fibers:** They are long, spindle-shaped cells, with more or less thick secondary walls, not branched and they usually occur in strands. In the vascular tissues, these features are modulated by hormones such as auxin and gibberellins. Mature fibers may have such a thick cell wall that it can occupy the entire internal cell space. Most of the mature fibers are dead cells, although some dicotyledon plants can have living fibers in the xylem. Fibers from the leaves of some monocots are commercially important in the manufacture of clothing and other fabrics.

Because of their tensile strength, fibers are usually ordered and compressed into strands to make the commercial fibers.

Fibers found in various parts of plants, could be of two types depending on site where they are found:

**i. Extra-xylary fibers:** The fibers located outside xylem tissue like: phloem fibers (primary phloem fibers, secondary phloem fibers). The extra-xylary fibers encountered in the stems of eudicots are the cortical fibers and the peri-vascular fibers.



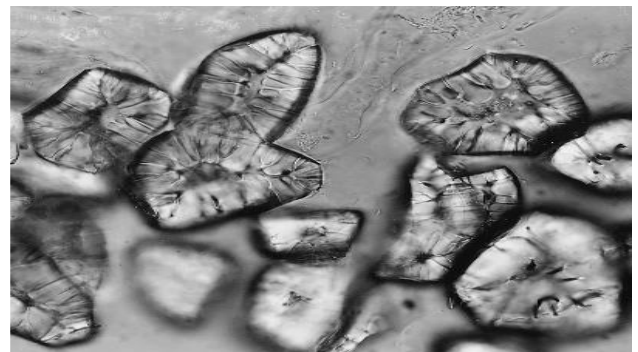
**ii. Xylary fibers:** The fibers located in xylem.

### 2- Sclereids:

They are typically short cells with thick secondary walls, strongly lignified, and provided with numerous simple pits. Some sclereids have relatively thin secondary walls. The secondary wall typically appears multilayered, reflecting its helicoidal construction.

### Classification of sclereids based on shape and size:

**1-Brachysclereids or stone cells:** - They are isodiametric or elongated cells, widely distributed in cortex, phloem and pith of stems, and in the flesh of fruit.



**2-Macrosclereids:** - They are elongated and columnar (rod-like) cells. They found in the palisade-like epidermal layer of leguminous seed coats.

**3-Osteosclereids:** - They are bone cells, also columnar but with enlarged ends as in the sub-epidermal layer of some seed coats.

**4-Trichosclereids:** - They are thin-walled sclereids resembling hairs, with branches projecting.

**5-Astrosclereids:** - They are star-cells, with lobe or arms diverging from a central body often found in the leaves of eudicots.

