Lec.2 **Plant anatomy**

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The eukaryotic cell is composed a **living protoplast** (the site of cellular metabolism, and an enclosing cellulosic wall of one or more layers).

Plasmodesmata: They are narrow strands of cytoplasm are interconnected the protoplasts of adjacent plant cells, which provide potential pathways for the passage of substances from cell to cell. They were first described by **Tangl** in 1879.

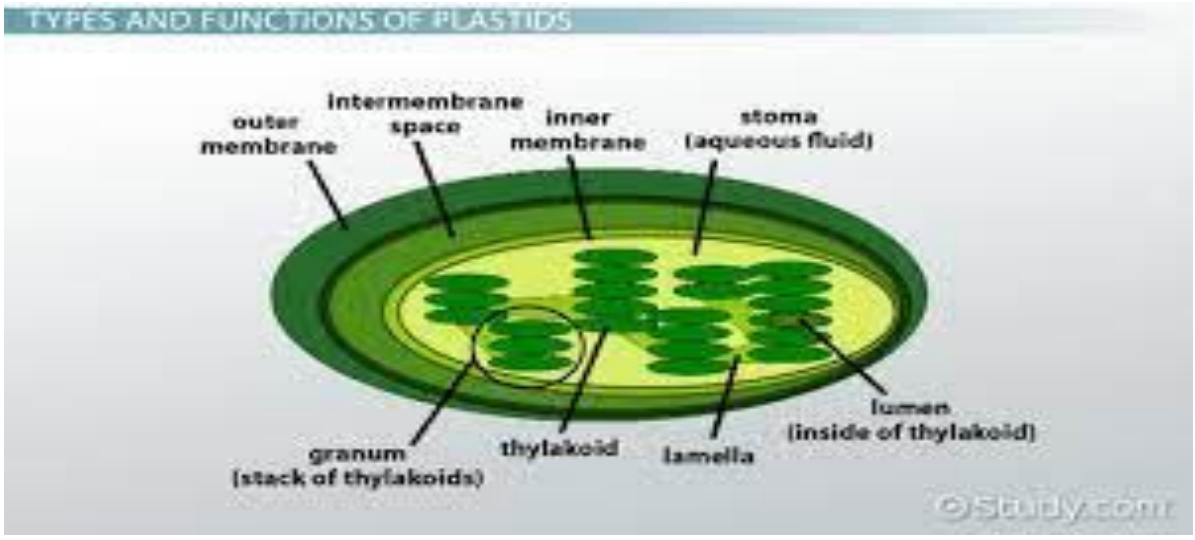
Types of plasmodesmata:

1- **Primary plasmodesmata:** Many plasmodesmata are formed during cytokinesis as strands of tubular endoplasmic reticulum become entrapped within the developing cell plate.

2- **Secondary plasmodesmata**: The formation is essential to establish communication between ontogenetically unrelated cells.

Plastids:

Plastids are characteristic components of plant cells. Each plastid is surrounded by an envelope consisting of two membranes. Internally the plastid is differentiated into a more or less homogeneous matrix (**stroma)** and a system of membranes called **thylakoids**. Plastids are semiautonomous organelles have evolved from free-living cyanobacteria through the process of endo-symbiosis. Mature plastids are commonly classified on the basis of the kinds of pigments they contain.



1- Chloroplasts:

It is the sites of photosynthesis, contain chlorophyll and carotenoid pigments. The chlorophyll pigments are responsible for the green color of these plastids, which occur in green plant parts. In seed plants, chloroplasts are usually disk-shaped and measure between 4 and 6 micrometers in diameter. The number of chloroplasts found in a single mesophyll (middle of the leaf) cell varies widely, depending on the species and the size of the cell. Chloroplasts often contain starch, phytoferritin (an iron compound) and lipid in the form of globules called **plastoglobuli** (singular: **plastoglobule**).

2- Chromoplasts:

They are also pigmented plastids of variable shape; they lack chlorophyll but synthesize and retain carotenoid pigments, which are often responsible for the yellow, orange, or red colors of many flowers, old leaves, some fruits, and some roots. Chromoplasts are the most heterogeneous type of plastids.

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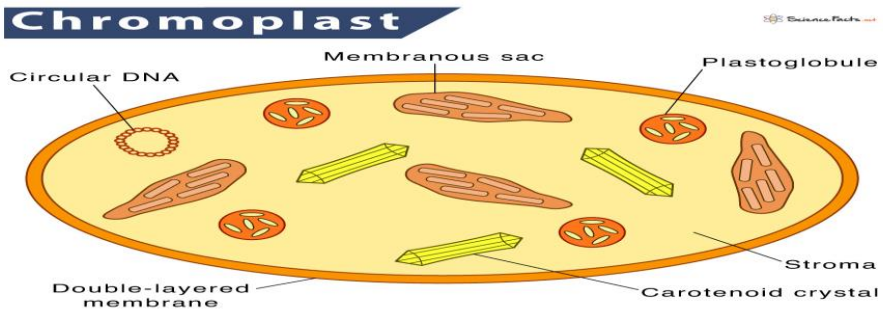
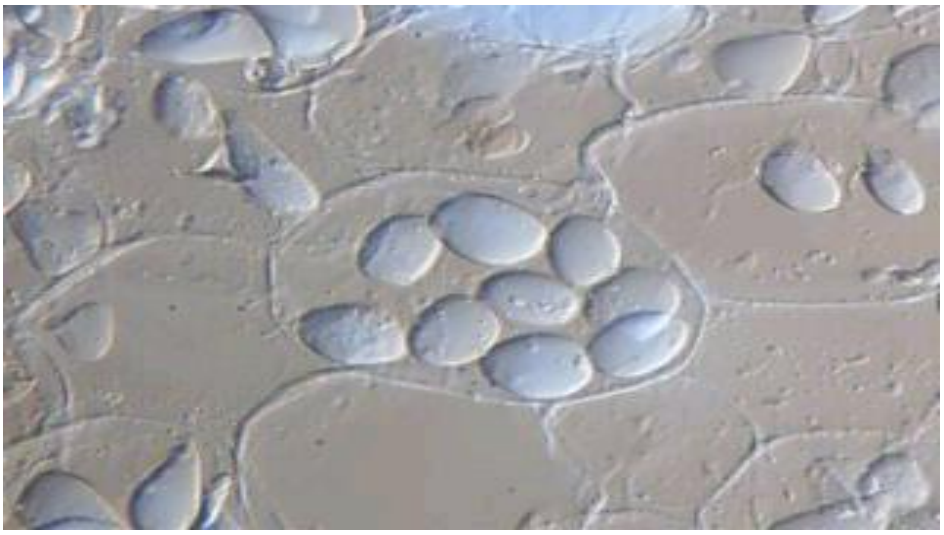


Leucoplasts (Non-pigmented Plastids):

Leucoplasts generally have a uniform granular stroma, several nucleoids, and typical 70S ribosomes. They lack an elaborate system of inner membranes. Some store starch (**amyloplasts**), others store proteins (**proteinoplasts**), fats (**elaioplasts**), or combinations of these products. Amyloplasts are classified as simple or compound. Simple amyloplasts, such as those of the potato tuber, contain a single starch grain, whereas compound amyloplasts contain several often tightly packed starch grains as in the endosperm of oats and rice.



Non-living components of plant cell

1-Vacuoles:

Vacuoles are organelles bounded by a single membrane, the **tonoplast**, or vacuolar membrane. They are multifunctional organelles and are widely diverse in form, size and content.

***Functions of vacuoles:**

1- Some vacuoles function primarily as storage organelles.
2- Some vacuoles are lytic compartments, breakdown of macromolecules
3- the recycling of components within the cell. such as senescent plastids and mitochondria engulfed and degraded by vacuoles

Components of vacuoles:

The principal component of the non–protein-storing vacuoles is water, with other components varying according to the type of plant, organ and cell and their

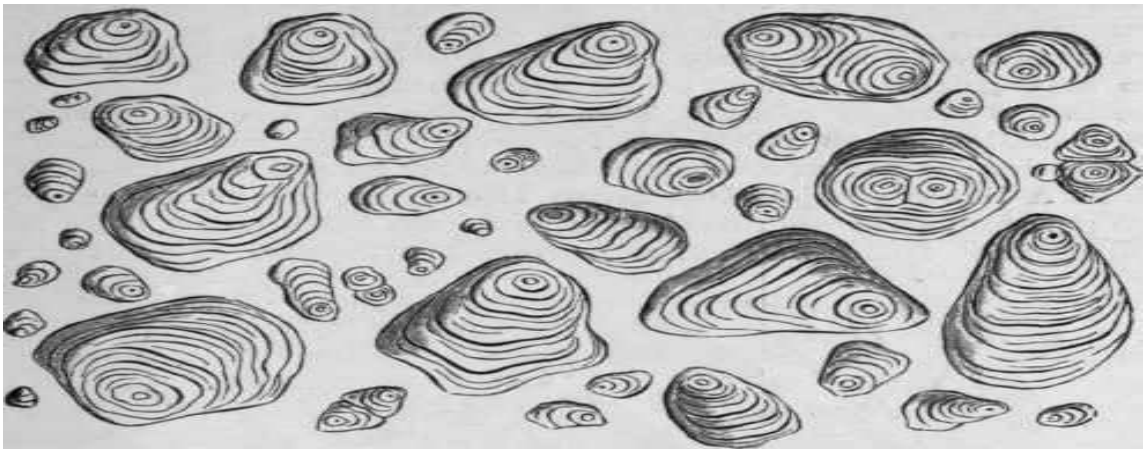
developmental and physiological state. In addition to inorganic ions (Ca^{2+}, Cl^{-}, K^{+}, Na^{+}, NO_3^{-}), also, contain sugars, organic acids and amino acids, and the aqueous solution commonly is called **cell sap**.

Ergastic or stored compounds

All compounds stored by plants are products of metabolism. These compounds may appear, disappear and reappear at different times in the life of a cell.

1- Starch grains: A starch is the most abundant carbohydrates in the plant world. During photosynthesis starch is formed in chloroplasts. Later it is broken down into sugars, transported to storage cells, a re-synthesized as storage starch in amyloplasts. an amyloplast may contain one **(simple)** or more **(compound)** starch grains.

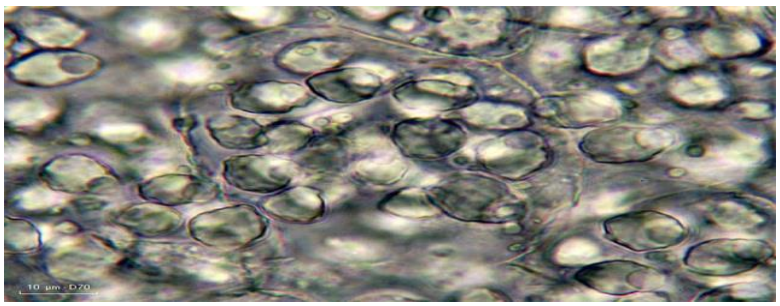
If several starch grains develop together, they may become enclosed in common outer layers, forming a complex starch grain. Starch grains or granules, are varied in shape and size and commonly show layering around a point, the **Hilum**, which may be the center of the grain or to one side. The layering of starch grains is attributed to an alternation of these two polysaccharide molecules.



2- Storage proteins: may be formed in different ways, depending in part upon whether they are composed of salt-soluble globulins or alcohol-soluble prolamins, globulins are the major storage proteins in legumes and prolamins in

most cereals. Typically globulins aggregate in protein storage vacuoles after having been transported there from the rough ER via the Golgi apparatus. Protein bodies also contain a large number of enzymes and fair amounts of phytic acid, a cation salt of myo-inositol hexaphosphoric acid, which usually is stored in the globoids. Phytic acid is an important source of phosphorous during seedling development.

3- Aleurone grains: They are storage proteins that found in wheat, which considerable part of the prolamins aggregate directly within the rough ER and then are transported in distinct vesicles to the vacuoles without Golgi involvement. Structurally consist of an amorphous proteinaceous matrix surrounded by a bounding membrane.



4- Oil bodies: They are more or less spherical structures that have a granular appearance to the cytoplasm of a plant cell when viewed with the light microscope. Oil bodies are widely distributed throughout the plant body but are most abundant in fruits and seeds. Approximately 45% of the weight of sun flower, peanut, and sesame seed is composed of oil. The oil provides energy and a source of carbon to the developing seedling

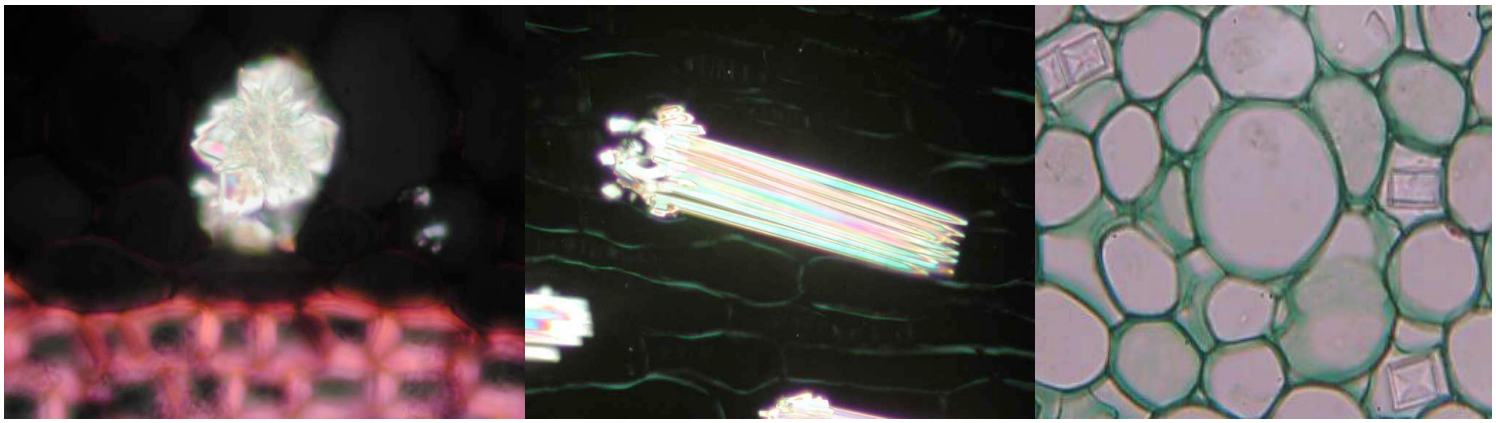
5- Crystals: They are inorganic deposits in plants consist mostly of calcium salts and anhydrides of silica. Among the calcium salts, the most common is calcium oxalate**.**

1) **Calcium oxalate:** It occurs in the majority of plant families. Calcium oxalate occurs as mono- and dihydrate salts in many crystalline forms. The most common forms of calcium oxalate crystals are:

a) Prismatic crystals: They are various shaped prisms, usually one per cell.

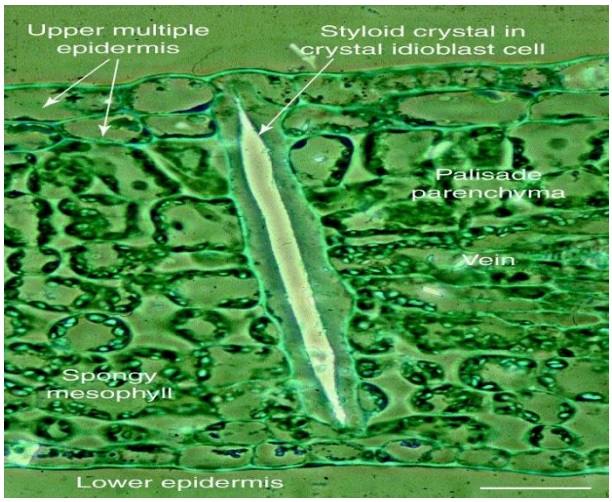
b) Raphides:- They are long needle-shaped crystals that occur in bundles.

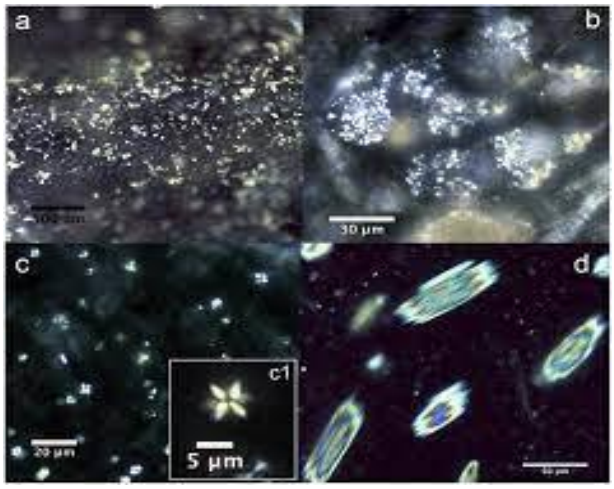
c) Druses: They are spherical aggregates of prismatic crystals.



d) Styloids: They are elongated crystals with pointed or ridged ends.

e) Crystal sand: They are very small crystals, usually in masses.





2) Calcium carbonate crystals: They are not common in seed plants. The best known calcium carbonate formations are **cystoliths** (which are formed in specialized enlarged cells called **lithocytes** of the ground parenchyma and epidermis) . The cystolith develops outside the plasma membrane in association with the cell wall of the lithocyte. Callose, cellulose, silica, and pectic substances also enter into the composition of cystoliths, which are found in (14) of plant families.

Cystoliths