

LAB-3-

THE CELL

The **cell** is the basic structural, functional, and biological unit of all known living organisms. Cells are the smallest unit of life that can replicate independently. The study of cells is called cell biology.

Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids.

Organisms can be classified as

- a- unicellular** (consisting of a single cell; including bacteria)
- b- multicellular** (including plants and animals)

* Prokaryotes are single-celled organisms, while eukaryotes can be either single-celled or multicellular.

* **Cells are of two types:**

A- Prokaryotic cells

They are simpler and smaller than eukaryotic cells, and lack membrane-bound organelles such as the nucleus. Prokaryotes include two of the domains of life, bacteria and archaea. The DNA of a prokaryotic cell consists of a single chromosome that is in direct contact with the cytoplasm. The nuclear region in the cytoplasm is called the nucleoid. Most prokaryotes are the smallest of all organisms ranging from 0.5 to 5.0 μm in diameter.

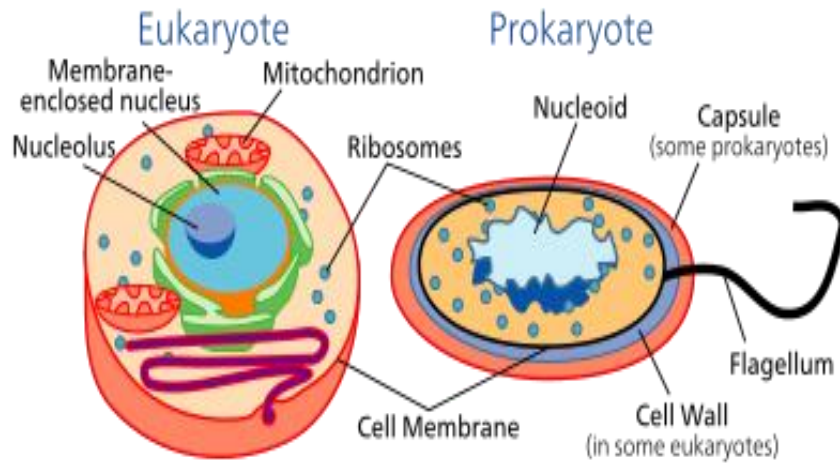
B- Eukaryotic cells

These cells are about fifteen times wider than a typical prokaryote and can be as much as a thousand times greater in volume. The main distinguishing feature of eukaryotes as compared to prokaryotes is the presence of membrane-bound organelles. Eukaryotes include fungi, animals and plants cells.

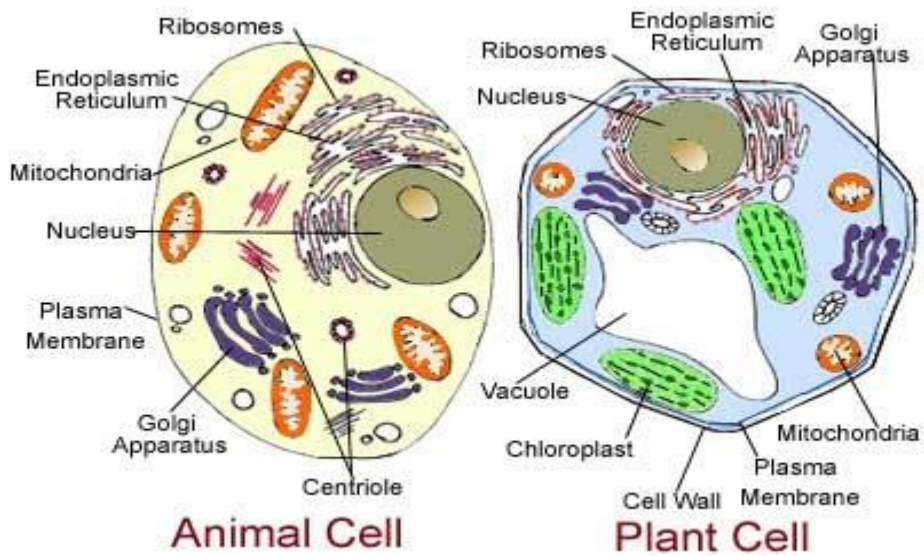
Comparison of features of prokaryotic and eukaryotic cells

	Prokaryotes	Eukaryotes
Typical organisms	bacteria	fungi, plants, animals
Typical size	~ 1–5 μm	~ 10–100 μm
Type of nucleus	nucleoid region; no true nucleus	true nucleus with double membrane
DNA	circular (usually)	linear molecules (chromosomes) with histone proteins
RNA/protein synthesis	coupled in the cytoplasm	RNA synthesis in the nucleus protein synthesis in the cytoplasm
Cell movement	flagella made of flagellin	flagella and cilia containing microtubules; lamellipodia and filopodia containing actin
Mitochondria	None	one to several thousand
Chloroplasts	None	in algae and plants
Organization	usually single cells	single cells, colonies, higher multicellular organisms with specialized cells
Cell division	binary fission (simple division)	mitosis (fission or budding) meiosis

Chromosomes	single chromosome	more than one chromosome
Membranes	cell membrane	Cell membrane and membrane-bound organelles



Structure of a typical prokaryotic and eukaryotic cell

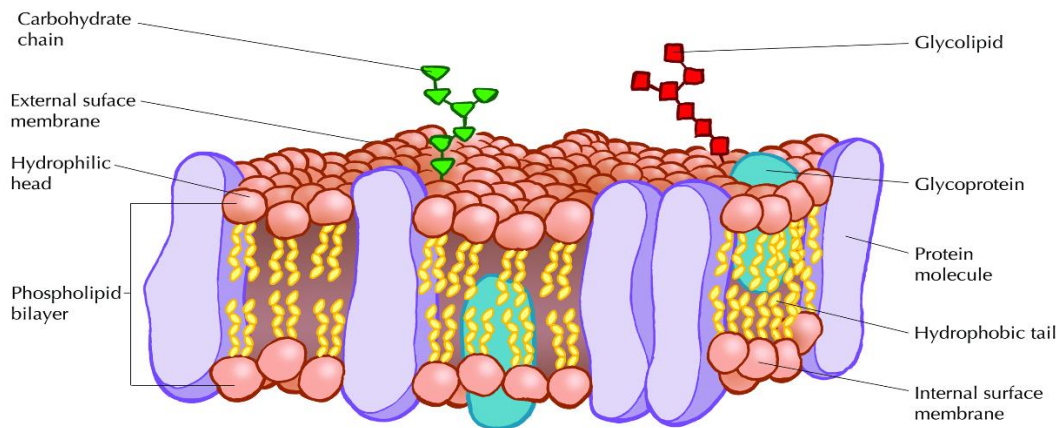


Structure of a typical animal and plant cell

Anatomy of the cell

1- Cell membrane

There are semi – permeable membrane surrounding the cell. It helps in holding the cell together and allows entry and exits of nutrients into the cell.



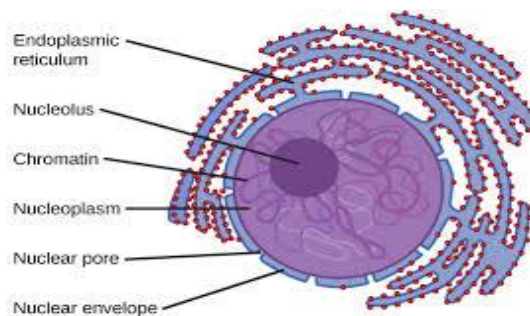
Cell membrane

2- Cytoplasm

A jelly types double membrane organelles, which are present in the inner region of the cell. It helps by keeping the cell in stable and protects the cell organelles by separating them from each other.

3- Nucleus

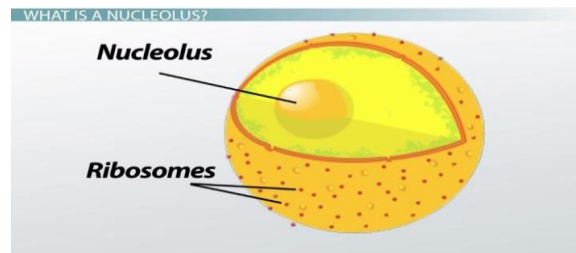
The largest organelle in the cell, which contains DNA and other cells hereditary information. The main role of nucleus in the cell is it controls all cellular activities.



Nucleus

4- Nucleolus

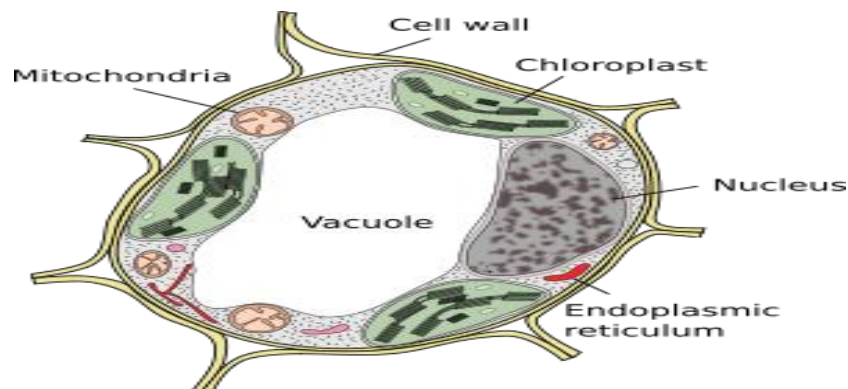
is a round body located inside the nucleus of a eukaryotic cell. It is not surrounded by a membrane but sits in the nucleus. The nucleolus makes ribosomal subunits from proteins and ribosomal RNA, also known as rRNA.



Nucleolus

5- Vacuoles

They are the fluid sacs, which are present in less numbers in animal cell compared to plant cells. The main function of this membrane is to store food and other waste materials.



Vacuoles

****Examine vacuoles in:**

A. Onion leaf

1. Cut a red onion and remove a fleshy leaf.
2. Snap the leaf backward and remove the thin piece of the inner epidermis that formed at the break point. This tissue will be as thin and flexible as plastic wrap.

3. When you obtained your piece of onion, prepare a wet-mount slide by adding a drop of water on the middle of a clean slide. Then add cover slide and examine the tissue. The preparation should be one cell thick.

4. Stain the onion tissue by placing one drop of neutral red at the edge of the cover slip for 5-15 min.

5. Carefully focus to distinguish the vacuoles surrounded by the stained cytoplasm.

B. Rose leaf

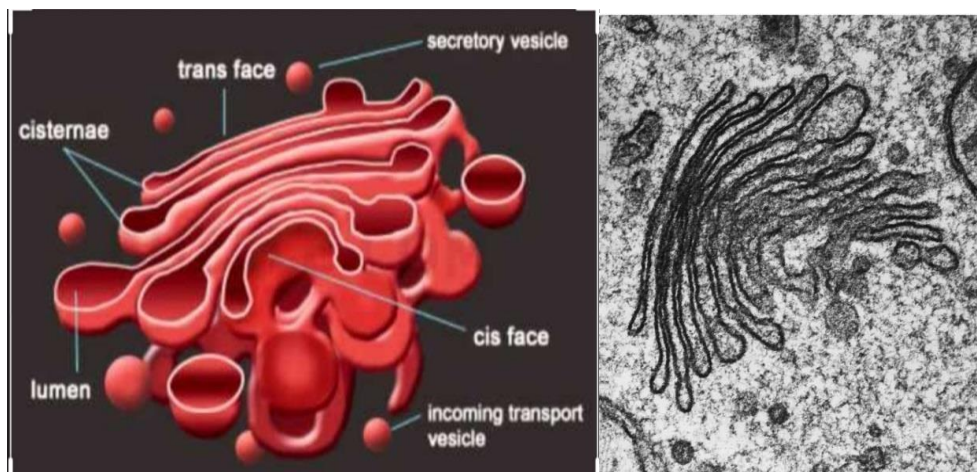
1. Snap a thin tissue from the toothed margin of a red leaf of rose plant using sharp lancet.

2. Mount it on a slide and add a cover slip.

3. Carefully focus to distinguish the colourless vacuoles near the margin. If you search far from the toothed margin, you can see red colour vacuoles because they contain anthocyanin in their cell sap.

6- Golgi Bodies or Golgi complex

The sac like structures, which are present in a cell to manufacture store, packing and shipping the selected particles throughout the cell.



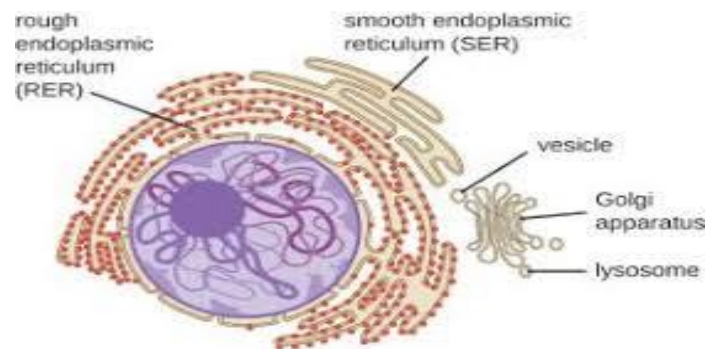
Golgi Bodies Ribosome

It is present in the cytoplasm. They are the site of protein synthesis, which are composed of ribosomal RNA and proteins.

7- Endoplasmic reticulum

The network of membrane, which helps in transporting materials around the cell and also helps in the synthesis of lipids and proteins. It forms a connection between nuclear envelope and the cell membrane of the cell. There are two types of ER:

- a- **rough endoplasmic reticulum (RER)** The outer (cytosolic) face of the rough endoplasmic reticulum is studded with ribosomes that are the sites of protein synthesis.
- b- **smooth endoplasmic reticulum (SER).** The smooth endoplasmic reticulum lacks ribosomes and functions in lipid synthesis but not metabolism, the production of steroid hormones, and detoxification.



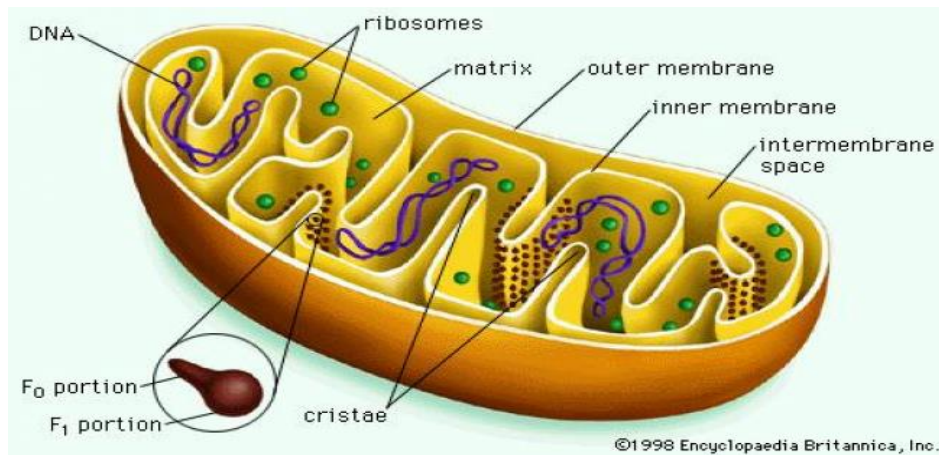
Endoplasmic reticulum

8- Ribosomes

Ribosomes are small particles which are found individually in the cytoplasm and also line the membranes of the rough endoplasmic reticulum. Ribosomes produce protein. They could be thought of as "factories" in the cell.

9- Mitochondria

They are rod shaped organelles, plays an important role in releasing energy and they are powerhouse of the cell.



Mitochondria

****Examine mitochondria in onion cells:**

Procedure

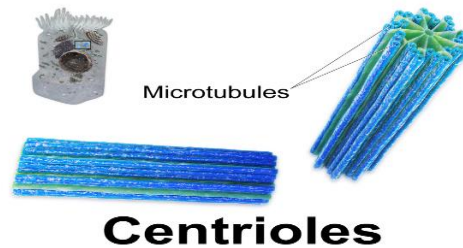
1. On a clean glass, add 2-3 drops of Iodine
2. Prepare a thin piece of onion epidermis and mount it in the staining solution:
3. Add the cover slip.
4. Search the periphery of the cells to locate stained mitochondria, they are small about 1mm in diameter.
5. Also examine slides for mitochondria in onion root tips and liver cells, the mitochondria will appear as black points around the nucleus.

10- Lysosomes

A lysosome is a membrane-bound organelle found in many animal cells. They are spherical vesicles that contain hydrolytic enzymes that can break down many kinds of biomolecules.

11- Centriole

In cell biology a centriole is a cylindrical organelle composed mainly of a protein called tubulin. The main function of centrioles is to produce cilia during interphase and the aster and the spindle during cell division.



12- Plastids (in plants only)

Its found in the cells of plants, algae, and some other eukaryotic organisms. Plastids are the site of manufacture and storage of important chemical compounds used by the cells of autotrophic eukaryotes. They often contain pigments used in photosynthesis, and the types of pigments in a plastid determine the cell's color.

*In plants, plastids may differentiate into several forms :

1- Chloroplasts

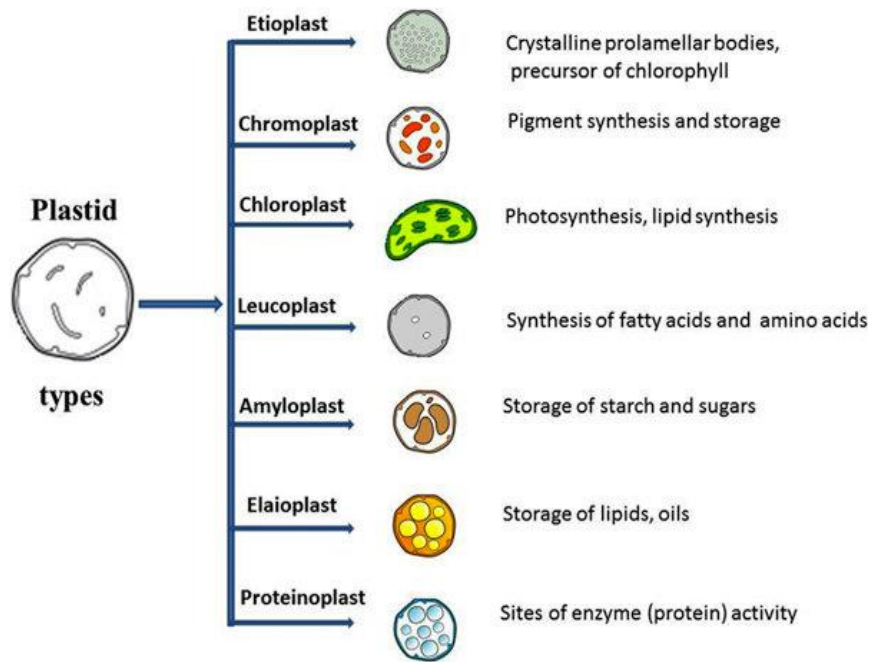
2- Chromoplasts

3- Leucoplasts

a. Amyloplasts

b. Elaioplasts

c. Proteinoplasts

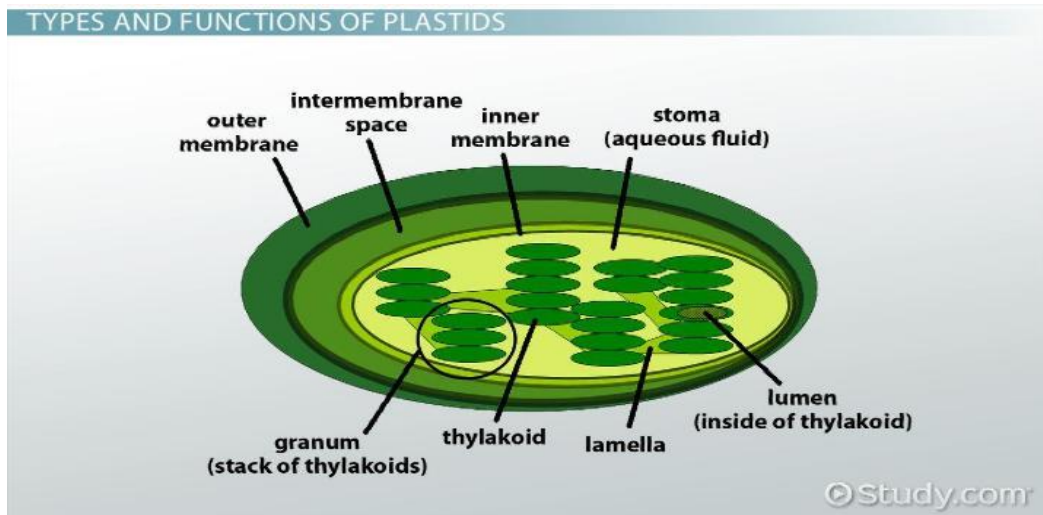


Types Of Plastids

The plastids have a double membrane envelope consisting of the outer and inner membrane (phospholipid layers). The space within the double membranes is covered with an aqueous matrix known as **stroma**. This aqueous matrix contains various enzymes and proteins that are essential for cellular processes

**Some of the other components of a chloroplast include:

- Grana - Thylakoids arranged in stacks (one on top of another)
- Peripheral reticulum - Membranous tubules arising from the inner membrane
- Chloroplast DNA
- Ribosome



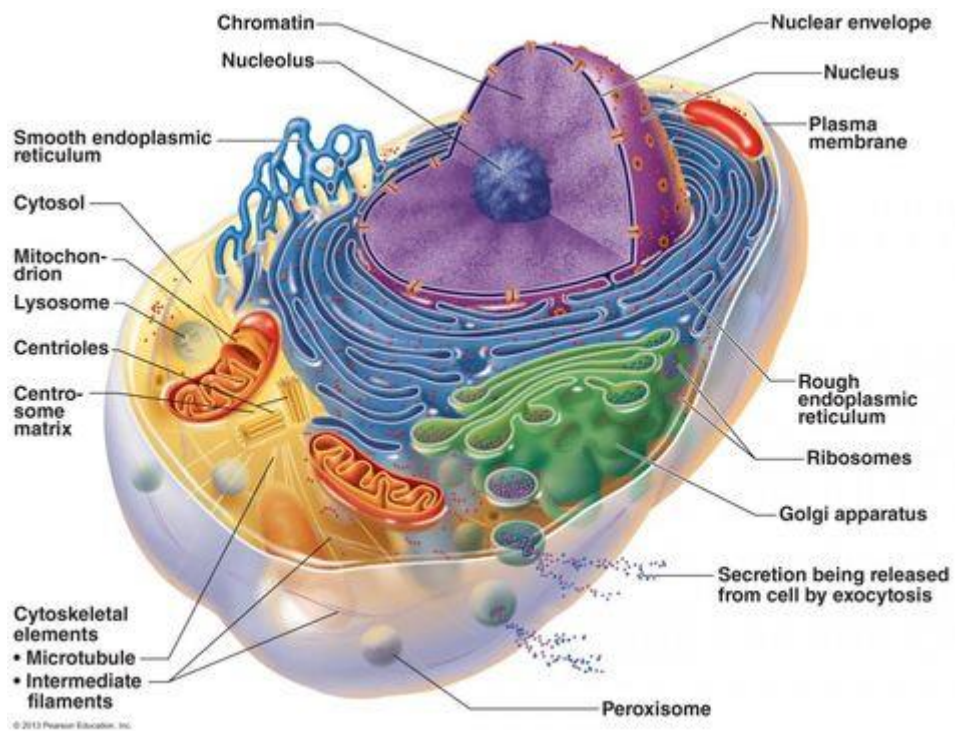
Plastids

13- Vesicle

It is a structure within or outside a cell, consisting of liquid or cytoplasm enclosed by a lipid bilayer. Vesicles form naturally during the processes of secretion (exocytosis), uptake (endocytosis) and transport of materials within the plasma membrane.

14-Cilia and Flagella

Both cilia and flagella are hair-like organelles which extend from the surface of many animal cells. The structure is identical in both, except that flagella are longer and whip like and cilia are shorter. There are usually only a few flagella on a cell, while cilia may cover the entire surface of a cell. The function of cilia and flagella include locomotion for one-celled organisms and to move substances over cell surfaces in multi-celled organisms.



Anatomy of the cell