Al- Mustaqbal College University

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Anatomy and Physiology

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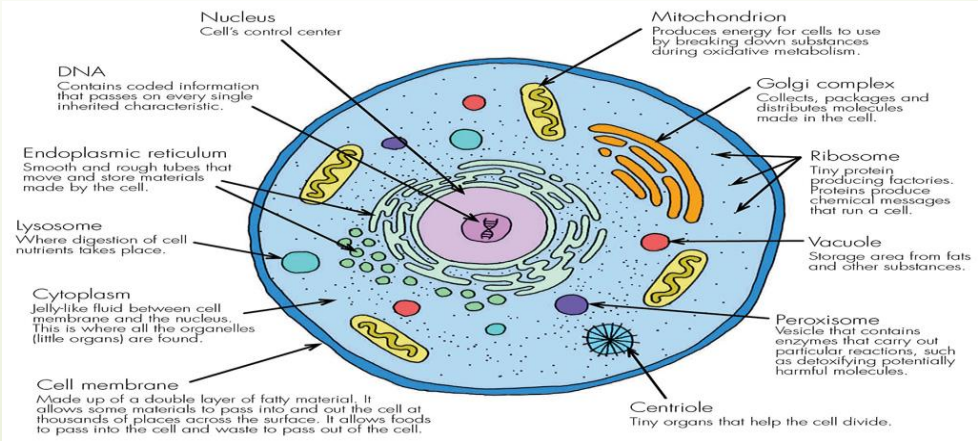
The Cellular level of organization



The cell (from Latin cella, meaning "small room") is the basic structural, functional, and biological unit of all known living organisms.

A cell is the smallest unit of life that can replicate independently, and cells are often called the "**building blocks of life**". The study of cells is called cell **biology or cytology.**

Cell biology or cytology is a branch of biology that studies the different structures and functions of the cell and focuses mainly on the idea of the cell as the basic unit of life.

Cell biology explains the structure, organization of the organelles they contain, their physiological properties, metabolic processes, life cycle, and interactions with their environment.

Cell types :-

There are two distinctive types of cells:-

1. **Prokaryotic cells**: Prokaryotes lack a nucleus (though they do have circular DNA) and other membrane-bound organelles (though they do contain ribosomes).

EX: Bacteria.

2. **Eukaryotic cells**: have nuclei bound by a nuclear membrane and membrane-bound organelles (mitochondria, chloroplasts, lysosomes, rough and smooth endoplasmic reticulum, vacuoles).

EX: fungi, animals, and plants all consist of eukaryotic cells.

Components of cell

1-Cell wall :-The cell wall is present exclusively in plant cells. It protects the plasma membrane and other cellular components. The cell wall is also the outermost layer of plant cells.

-It is a rigid and stiff structure surrounding the cell membrane.

-It provides shape and support to the cells and protects them from mechanical shocks and injuries.

2- Cell membrane: The biological structure that separates the interior of a cell from its outer environment, all living cells, prokaryotic and eukaryotic, are surrounded by a plasma membrane. As well as regulating what goes in and out of the cell

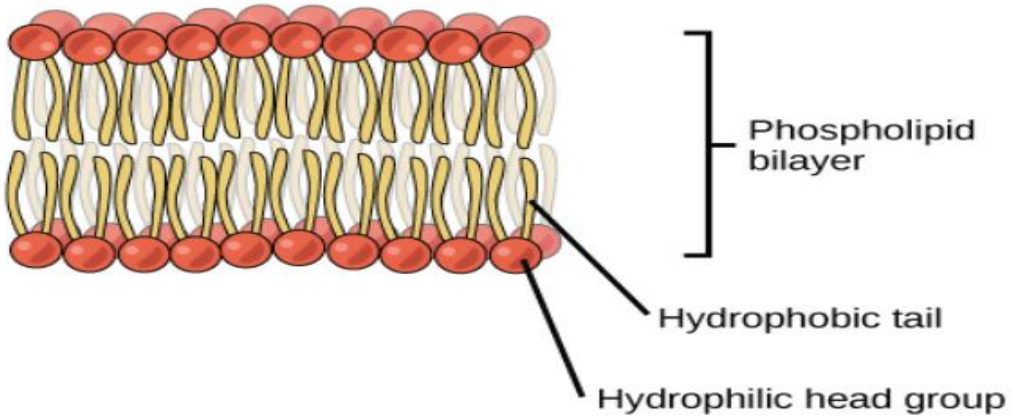
Structure of cell membrane:

Cell membrane is complex structures composed of lipid (phospholipid bilayer and cholesterol) with proteins (integral and peripheral), and carbohydrates.

A. The phospholipid bilayer contain of

A**. The hydrophilic heads** (water loving):- polar part of the phospholipid molecules attracted to water outside and inside of the cell

B**. The hydrophobic tails** (water fearing);- nonpolar part facing the interior of the cell membrane



Function of cell membrane:

1- The cell membrane is the interface between a cell and its environment.

2- The plasma membrane envelops the cell and maintains its structural and functional integrity.

3- It assists in controlling interaction between cells.

4- Regulating what goes in and out of the cell.

3- The cytoplasm :-•

*thick, clear, jelly-like substance present inside the cell membrane.•

*Most of the chemical reactions within a cell take place in this cytoplasm.

*The cell organelles such as endoplasmic reticulum, vacuoles, mitochondria, ribosomes, are suspended in this cytoplasm.

4- Nucleus:-

*The nucleus contains the hereditary material of the cell, the DNA.

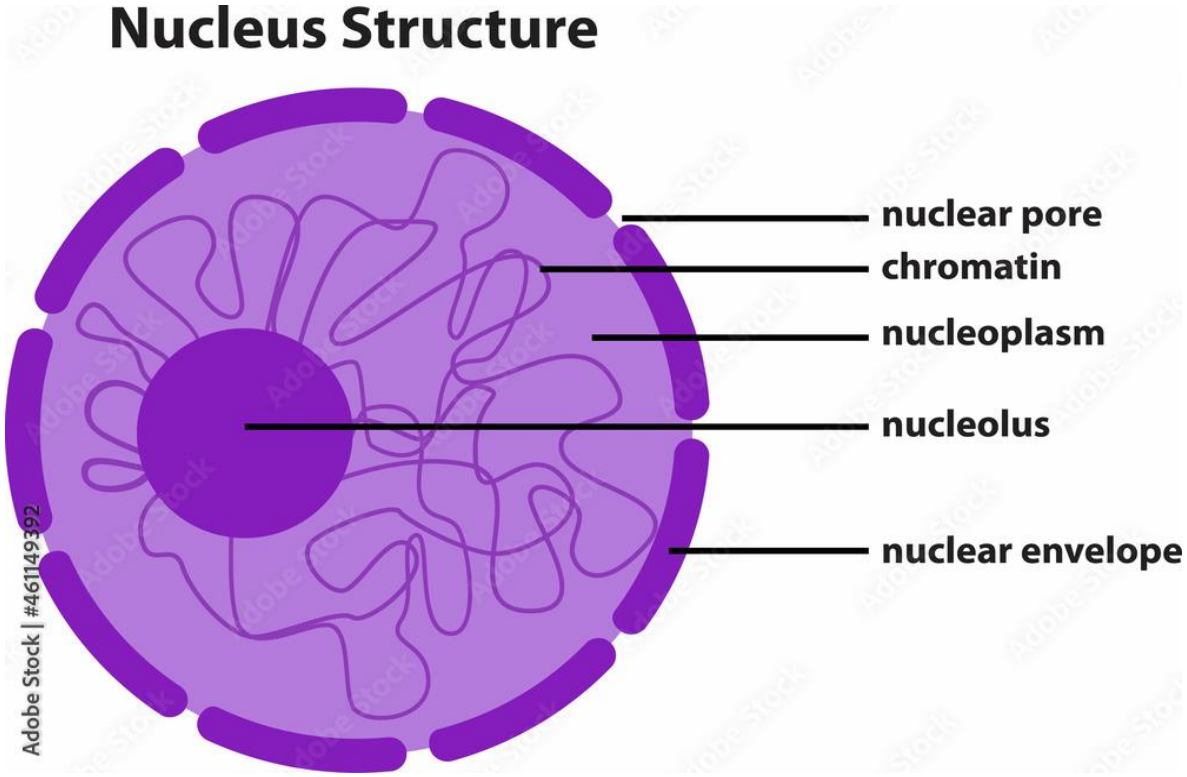
*It sends signals to the cells to grow, mature, divide and die.

*The nucleus is surrounded by the **nuclear envelope** that separates the DNA from the rest of the cell.

*The nucleus protects the DNA and is an integral component of a plant's cell structure.

5- Nucleolus :- is the largest structure in the cell nucleus. The nucleolus is responsible for the production of ribosomes, this process is referred to as the ribosome biogenesis ; it is made up of DNA, RNA and associated proteins.

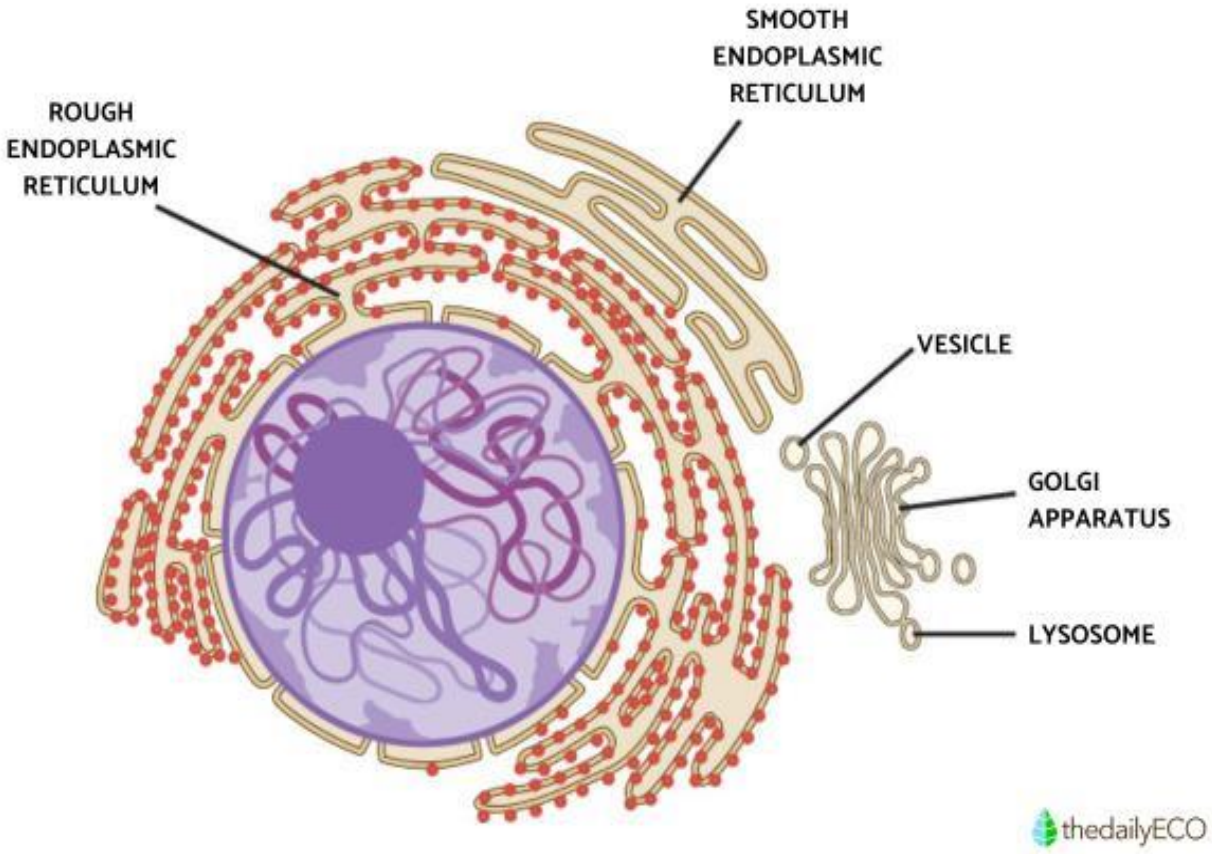
Chromatin is a genetic material or a macromolecule comprising DNA, RNA, and associated proteins, located in the nucleus of a eukaryotic cell.



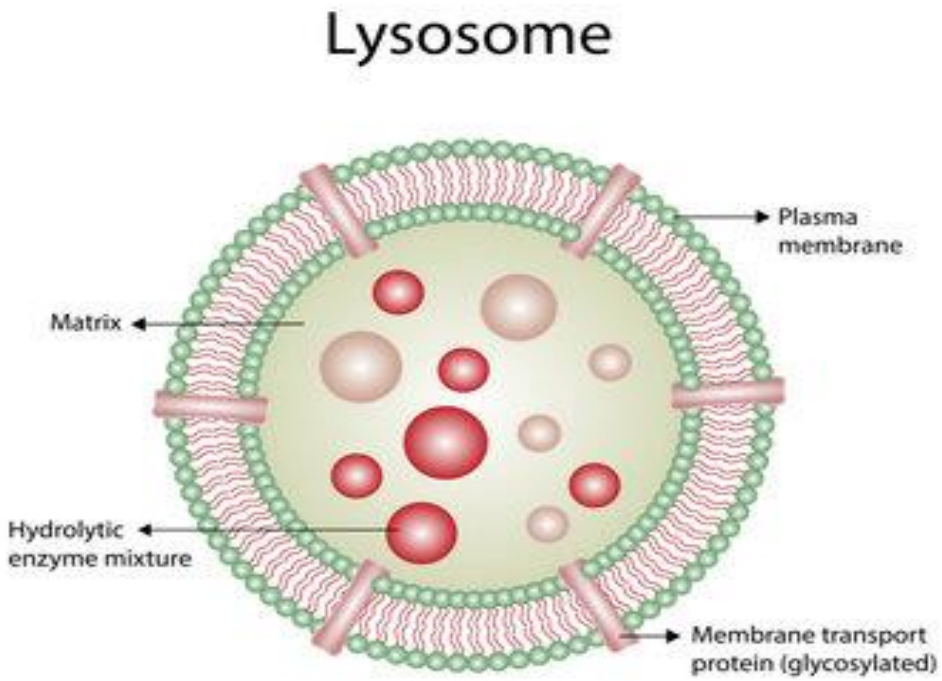
6- Endoplasmic reticulum (ER) is network of membranous canals that shares part of its membrane with that of the nucleus.

1- Endoplasmic reticulum (rough) – major site of membrane protein synthesis.

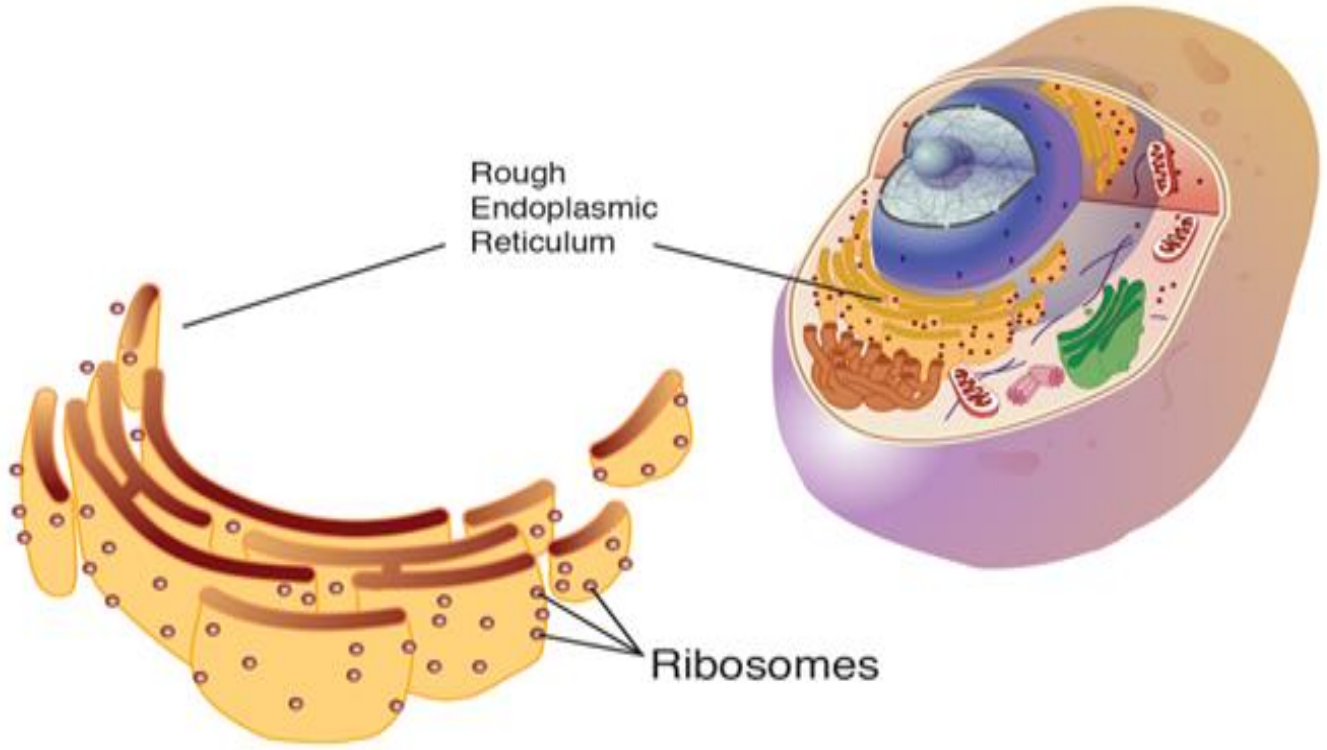
2- Endoplasmic reticulum (smooth) – major site of lipid synthesis.



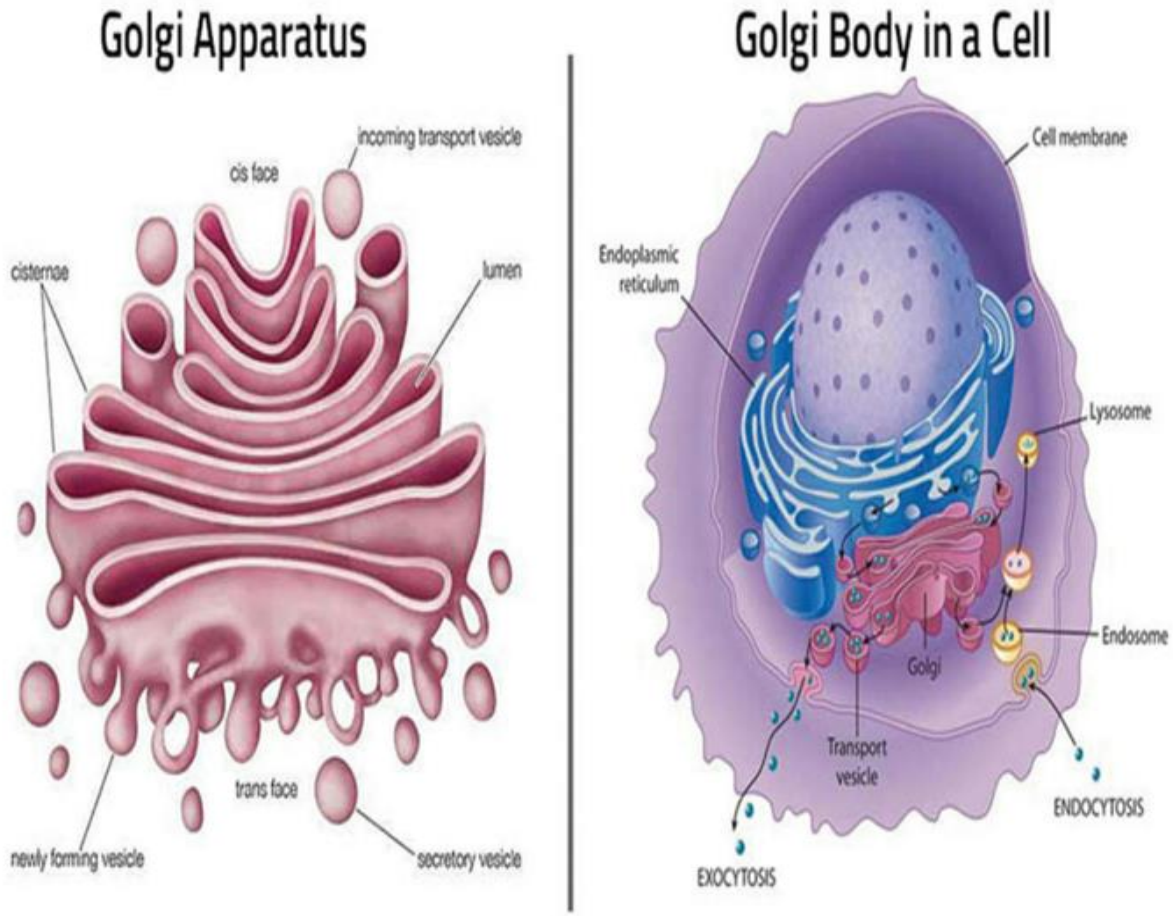
7- Lysosomes – are tiny sacs filled with fluid containing enzymes (i.e. proteins that act as a biological catalysts) which digest large molecules, also responsible for breaking down and getting rid of waste products of the cell. Lysosomes contain over 60 different enzymes that allow them to carry out these processes.



8-Ribosome – is the site of protein synthesis in both prokaryotic and eukaryotic cells.. Each ribosome consists of large subunit and a small subunit, ribosomes synthesize a variety of proteins that are essential to the survival of the cell.



9- Golgi apparatus– The Golgi apparatus is an organelle in eukaryotic organisms – functions as a factory in which proteins received from the ER are moves to their destination. The Golgi apparatus is comprised of a series of flattened sacs that extend from the endoplasmic reticulum



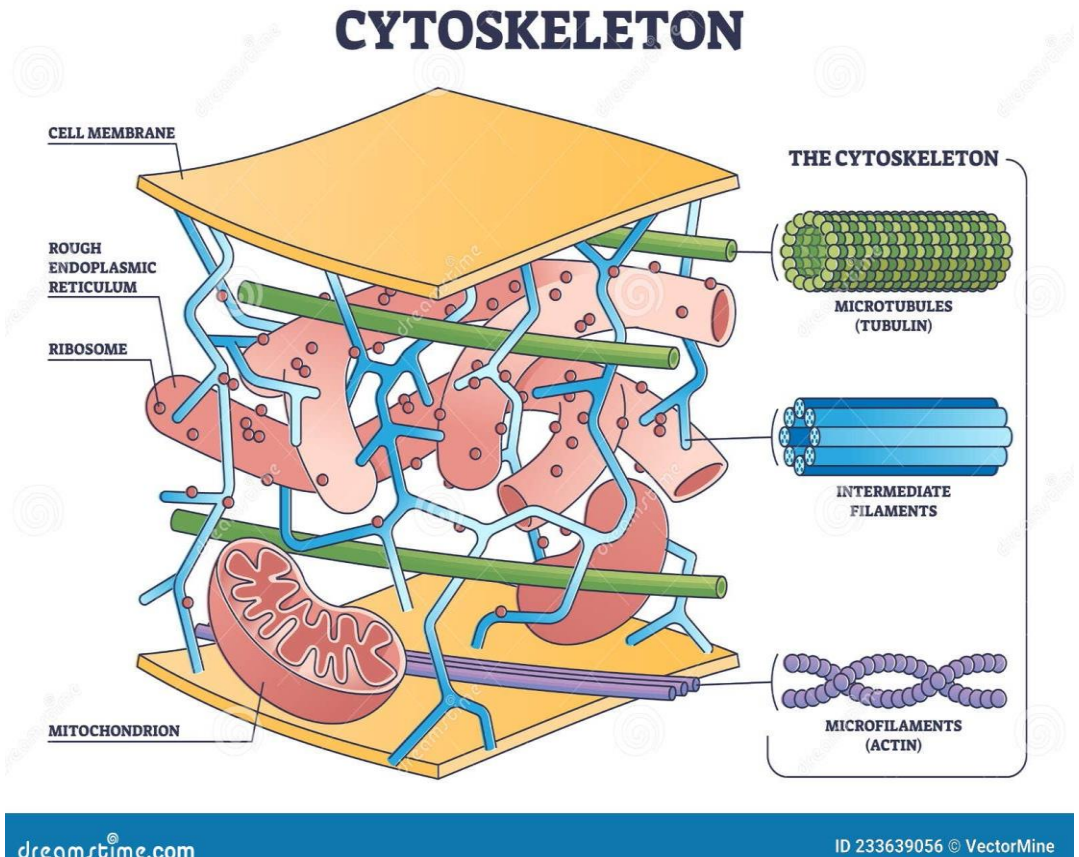
cytoskeleton is the network of fibers forming the eukaryotic cells and prokaryotic cells. These fibers in the eukaryotic cells contain a complex mesh of protein filaments and motor proteins that help in cell movement. It provides shape and support to the cell, organizes the organelles and facilitates transport of molecules, and in cell division.

A cytoskeleton structure comprises the following types of fibres:

Microfilaments

Microtubules

Intermediate Filaments



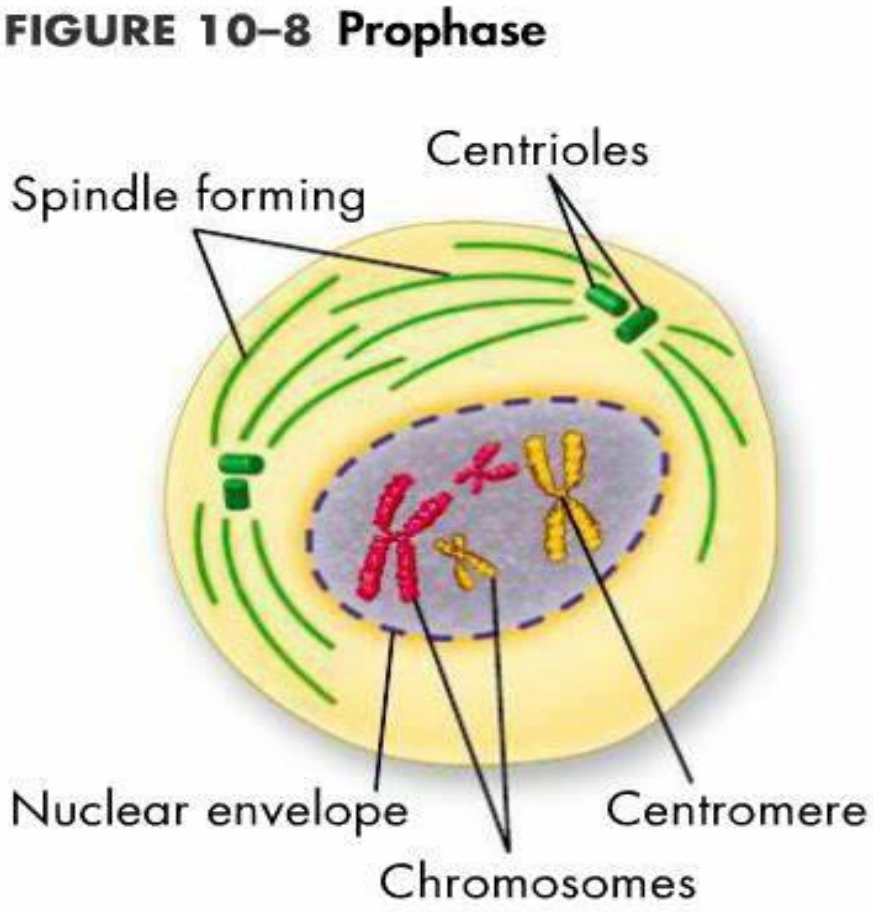
Centrosome – an associated pair of cylindrical- shaped protein structures (centrioles) aid in forming the mitotic spindle during cell division in eukaryotes.

Centrosome Function

1-The centrosomes help in cell division.

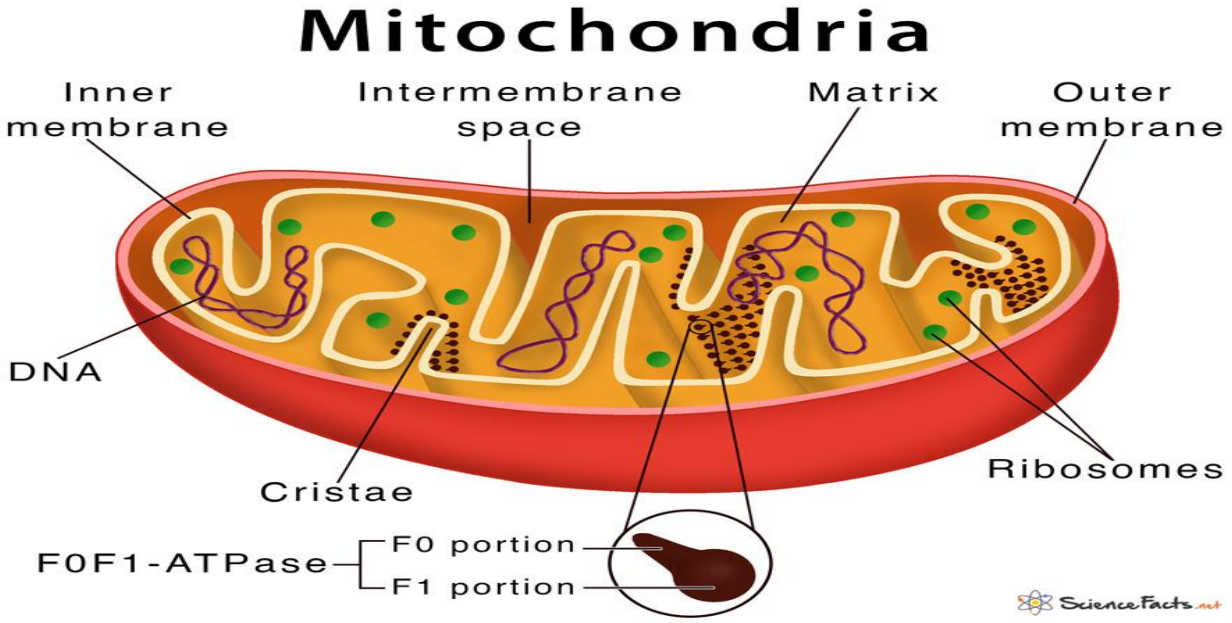
2-They also stimulate the changes in the shape of the cell membrane.

3-In mitosis, it helps in organizing the microtubules ensuring that the centrosomes are distributed to each daughter cell.



Mitochondria – major energy-producing organelle by releasing energy in the form of **ATP** by the breakdown of carbohydrates and fatty acids, which is converted to ATP by the process of oxidative phosphorylation.

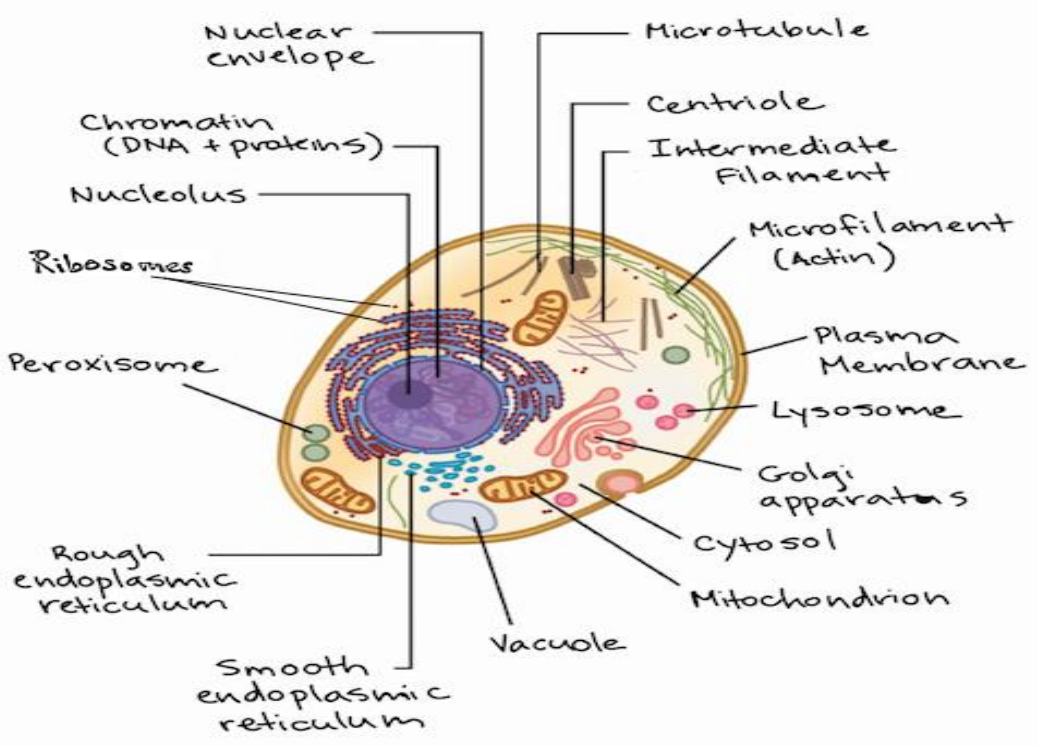
- Structure:- Mitochondria are surrounded by a double-membrane system, consisting of inner and outer mitochondrial membranes separated by an intermembrane space. The inner membrane forms numerous folds (cristae), which extend into the interior (or matrix) of the organelle



Vacuole – The term “vacuole” means “empty space”. They help in the storage and disposal of various substances. They can store food or other nutrients required by a cell to survive. They also store waste products and prevent the entire cell from contamination.

Pili – also called fimbria is used for conjugation and sometimes movement.

11-Chloroplast – key organelle for photosynthesis (only found in plant cells), are disc-shaped organelles found in the cytosol of a cell.



Transport through cells

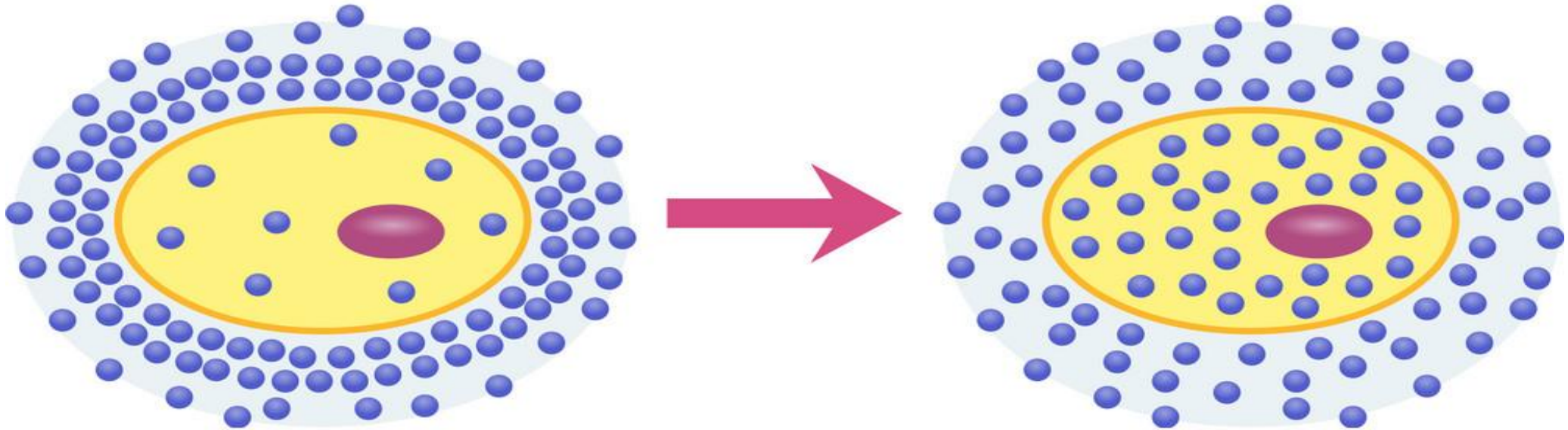
The plasma membrane only allow some substances to pass through but not others, so it can control the entrance and exit of molecules and ions.

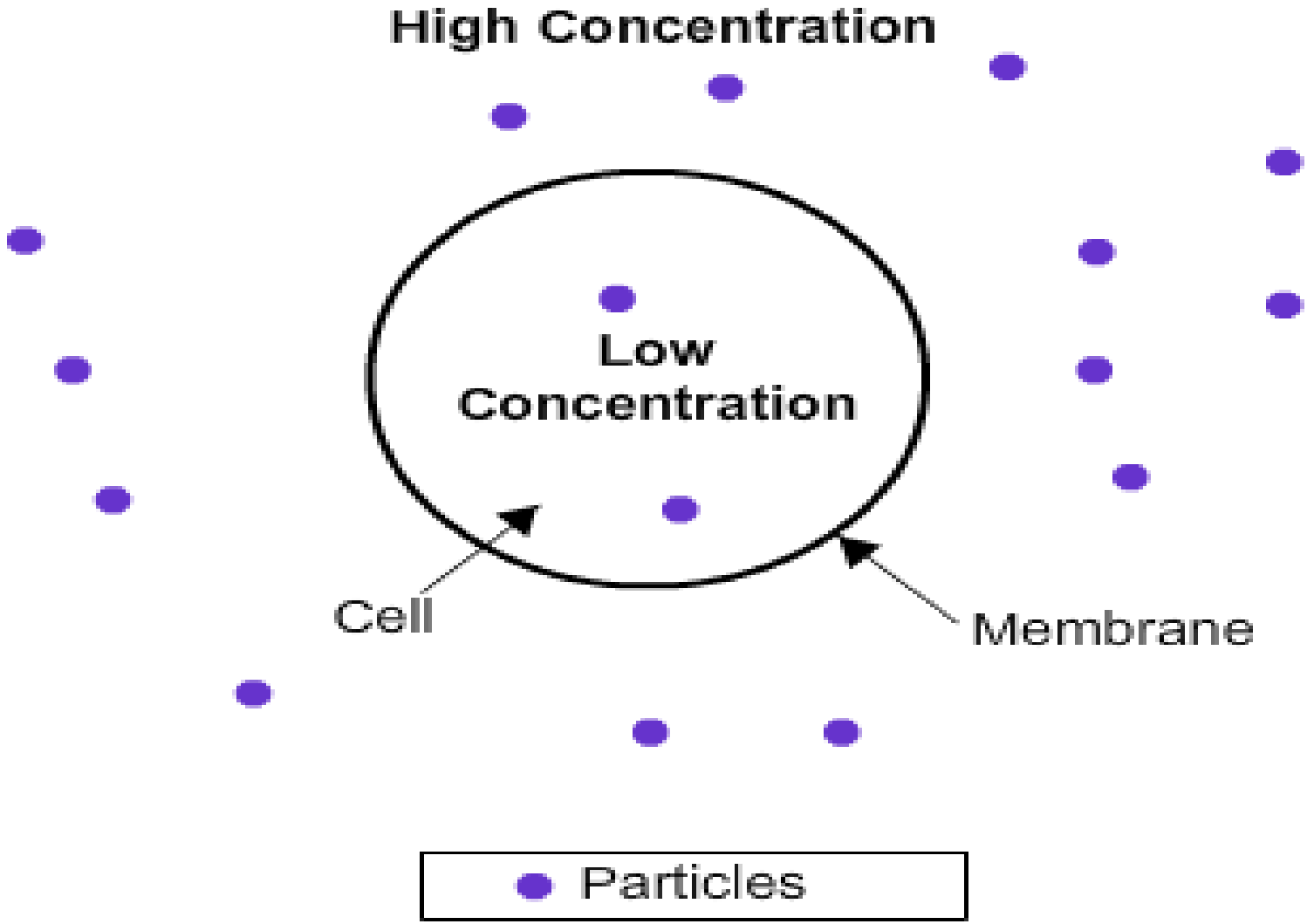
Small molecules(such as glucose, amino acids, water, mineral ions etc)can be transported across the plasma membrane by any one of the following three methods:

1- Diffusion: **molecules of substances** move from their region of higher concentration to their region of lower concentration. This does not require energy.

Example: absorption of glucose in a cell.

DIFFUSION

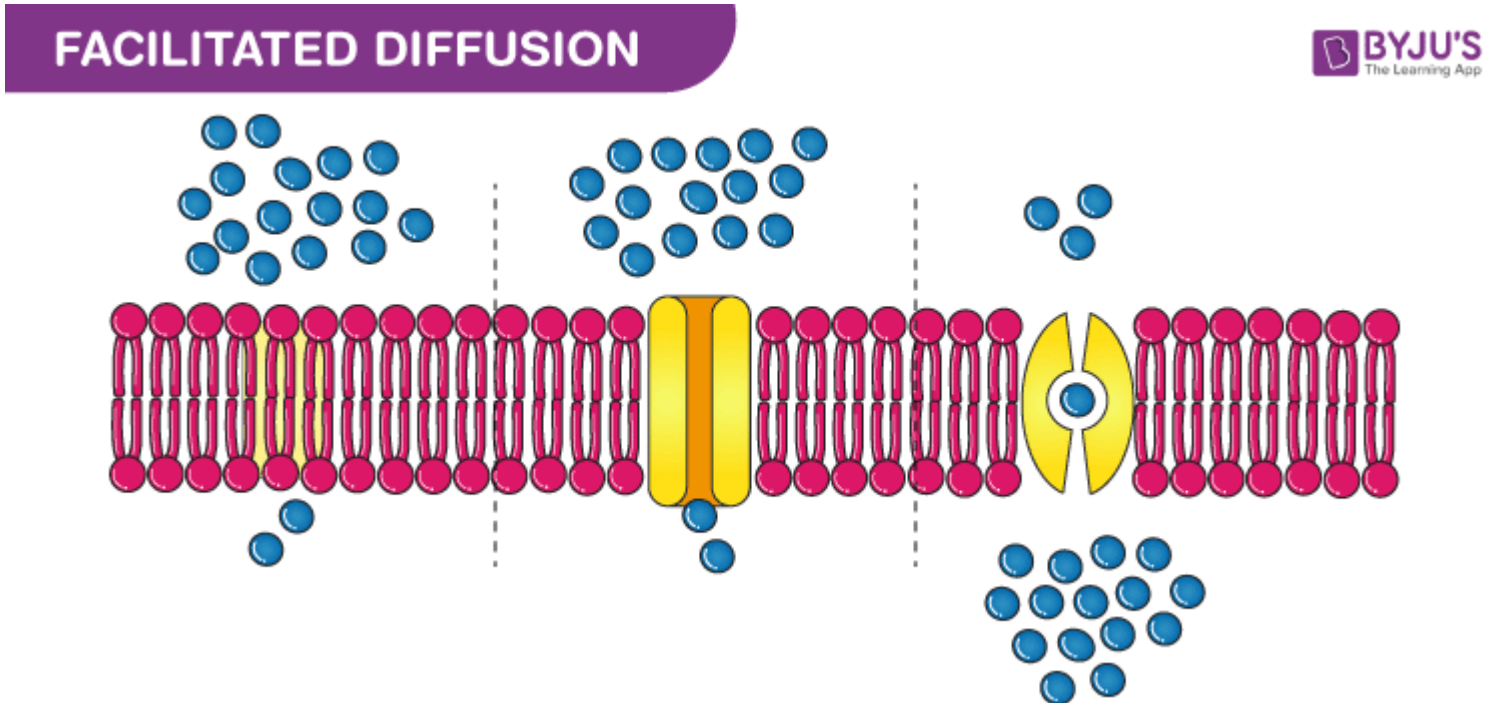



High Concentration
Low Concentration
Cell
Membrane
Particles

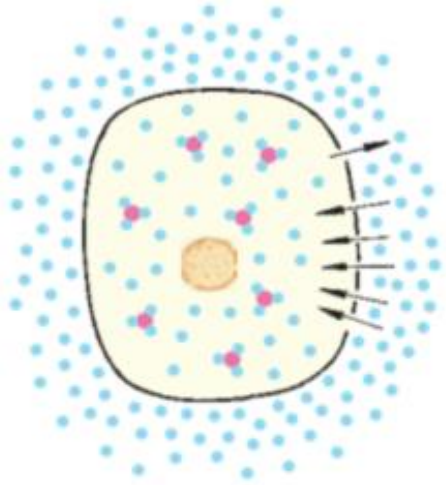
Type of diffusion

Simple diffusion:-A process in which the substance moves through a semipermeable membrane or in a solution without any help from transport proteins.

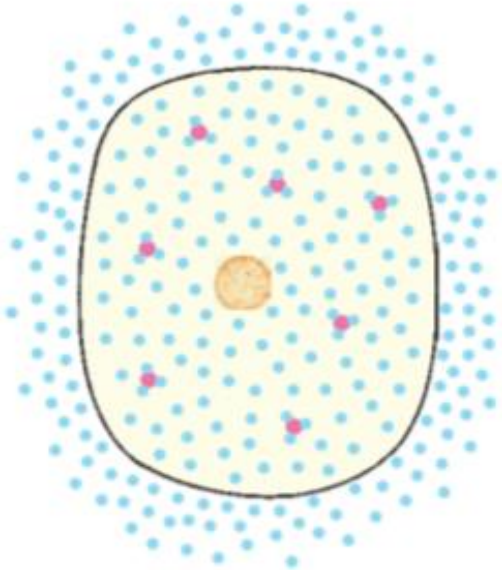
Facilitated diffusion ;- is a passive movement of molecules across the cell membrane from the region of higher concentration to the region of lower concentration by means of a carrier molecule.



2-Osmosis: Movement of water molecules from the region of their higher concentration to the region of their lower concentration through a semipermeable membrane. There is no expenditure (not require) of energy in osmosis.



(a) There is a higher concentration of free water molecules outside the cell than inside, so water diffuses into the cell.



(b) The extra water makes the cell swell up.

3-Active transport: When the direction of movement of a certain molecules is opposite that of diffusion i.e. from region of their lower concentration towards the region of their higher concentration, do require an expenditure of chemical energy.