

Class 9th

# The Fundamental Unit of Life

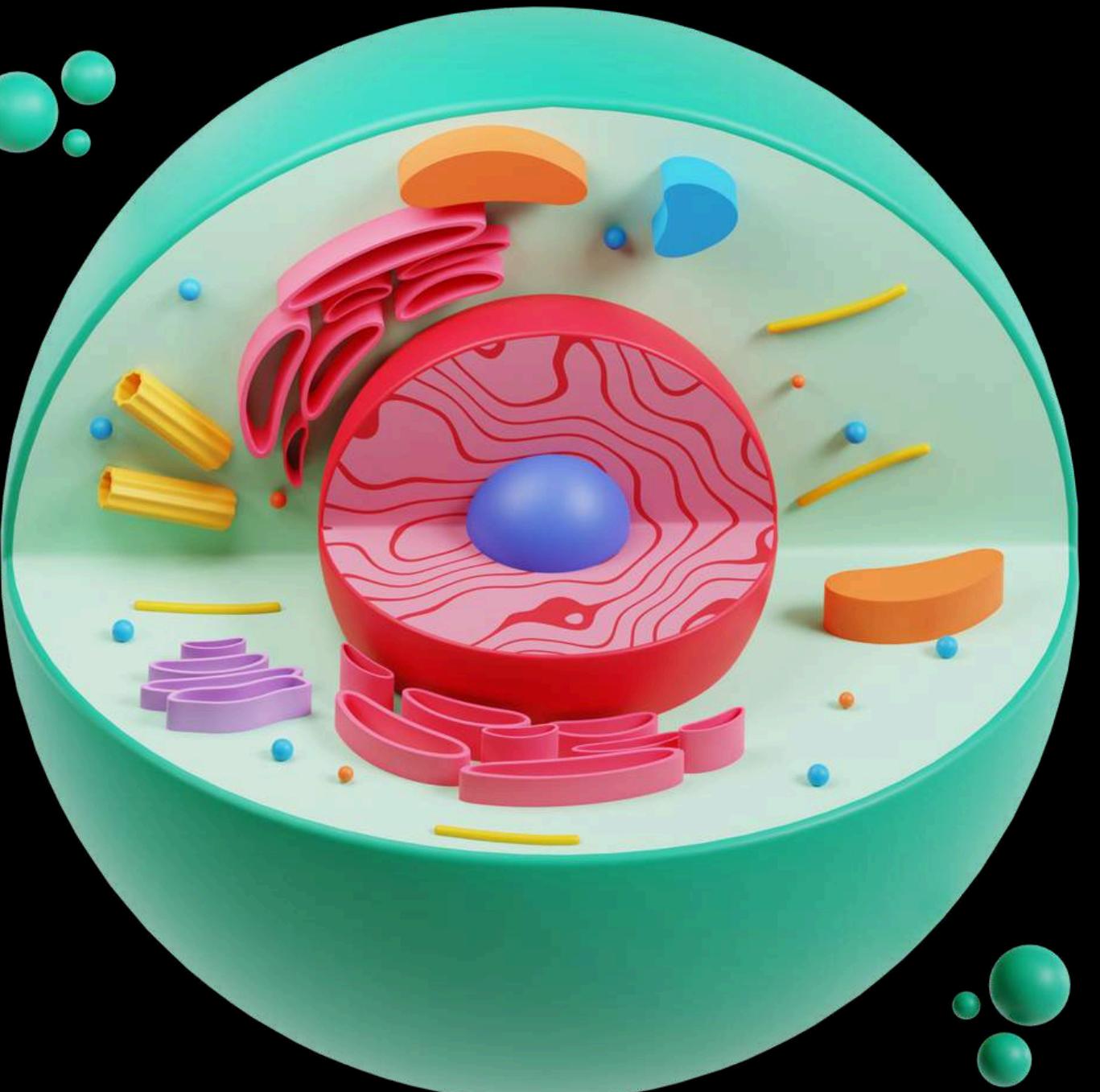
“ Prashant Bhaiya ”



# Topics to be Covered

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- Introduction to Cell
- Cell theory
- Cell - different shape, size and number
- Cell Structure
- Cell Division



# Introduction to Cell



- Cells are the structural, functional, and biological units of all living beings.
- The entire functioning of living organisms begins from basic unit called cell, that's why it's called fundamental unit of life.
- A cell can replicate itself independently. Hence, they are known as the **building blocks of life**.



# Discoveries related to Cell



- The cell was first discovered and named by ROBERT HOOKE in 1665.

<b>Anton Van Leuwenhoek (1674)</b>	Discovered protozoa and bacteria, living cell
<b>Robert Brown (1831)</b>	Discovered cell nucleus
<b>Schleiden and Schwann (1838, 1839)</b>	Proposed cell theory
<b>Purkinje (1839)</b>	Protoplasm



# Cell Theory



- All the living organisms are composed of cells
- The living organisms could be made up of one or more cells
- The new cells arise from pre-existing cells through the process of cell division





# Cell

Size

Number

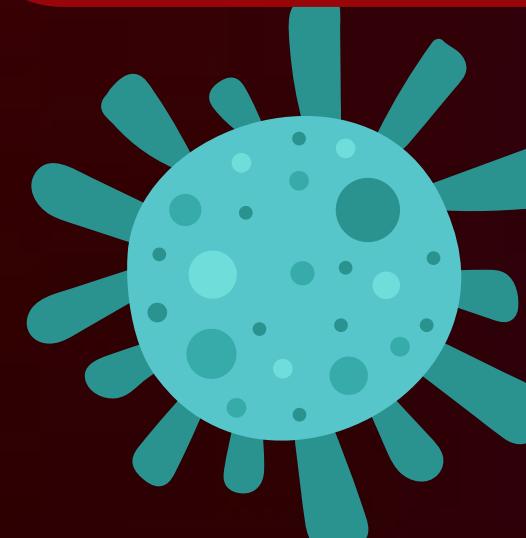
Shape



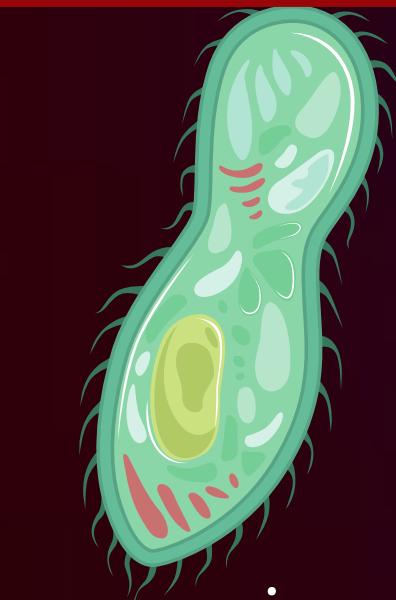
# Cell - different cell number

- If an organism is made up of a single cell, it is called a **unicellular organism** (uni: one; cellular: cell). e.g. bacteria, protozoa, etc.
- The organisms which are made up of more than one cell are called **multicellular organisms** (multi: many; cellular: cell). e.g. humans, animals, etc.

## Unicellular



Bacteria



Paramecium

## Multicellular



Human

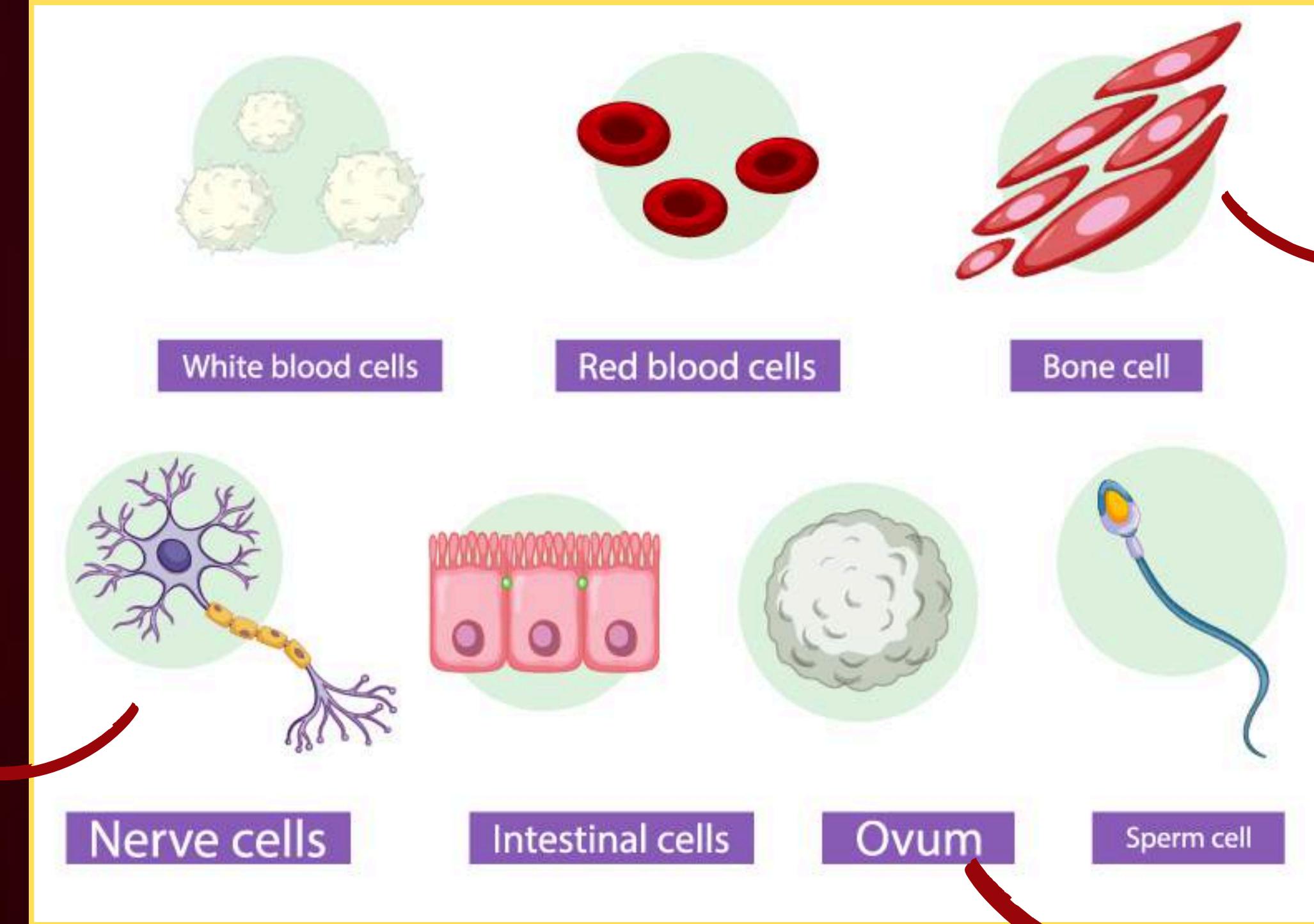


Animal



# Cell - different shape

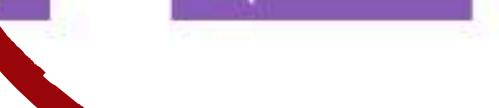
BRANCHED &  
ELONGATED



SPINDLE



SPHERICAL





# Cell - different size



**Smallest cell- Mycoplasma (Bacteria)**

PPLD (Pleuro- Pneumonia like Organisms)

**Largest cell- Ostrich egg**

# CELL



(Basic structural and functional unit of living organisms)

## Components

### Plasma Membrane/ cell Membrane

- Outermost covering of cell
- Permits the entry and exit of some materials (selectively permeable)

### Cell Wall

- Rigid outer covering lying outside the plasma membrane
- Present in plants only.

### Nucleus

- Has double layered nuclear membrane having nuclear pores for transfer of material and chromosomes.

### Cytoplasm

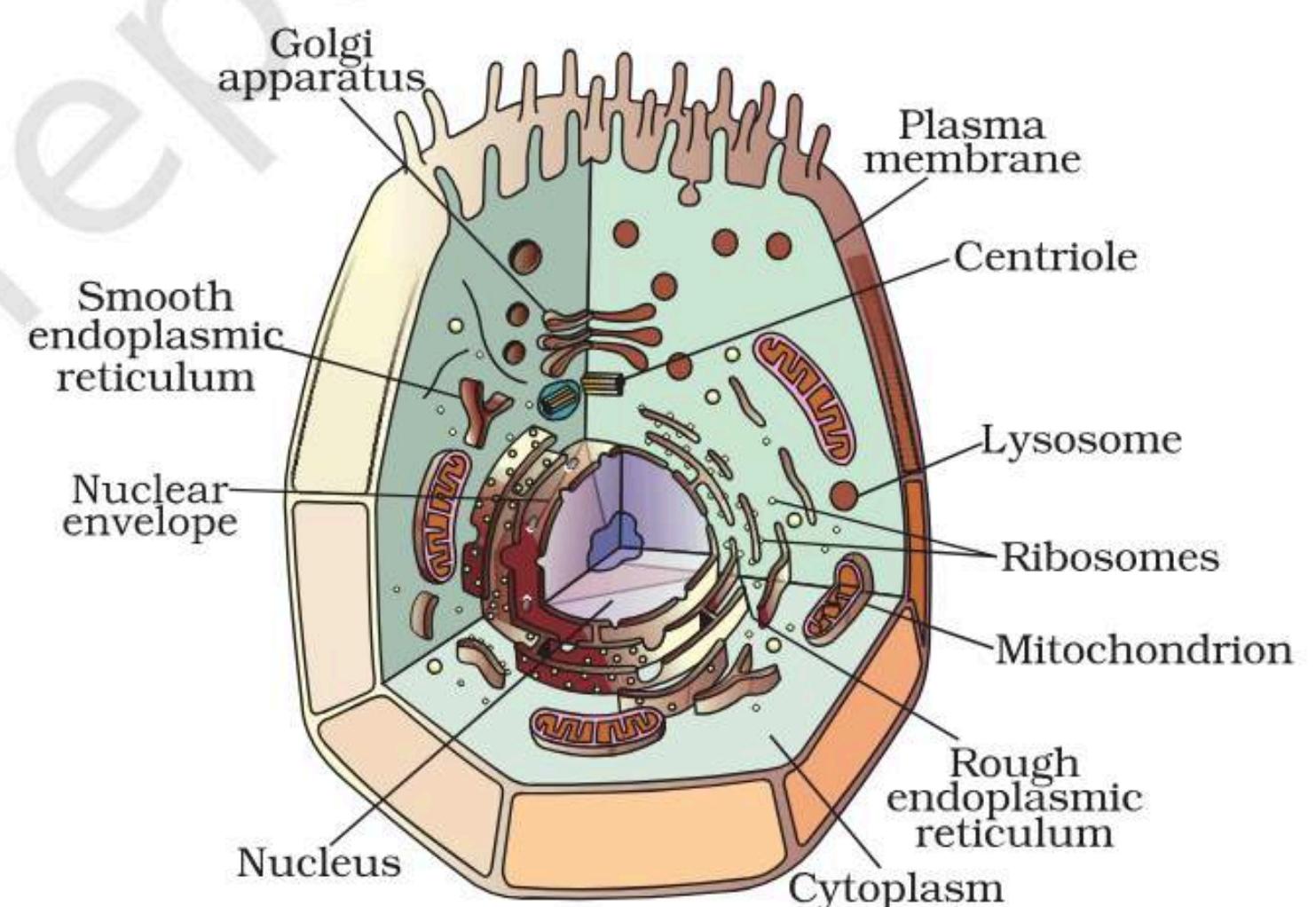
- Fluid content inside the plasma membrane and outside the nucleus

### Cell Organelles

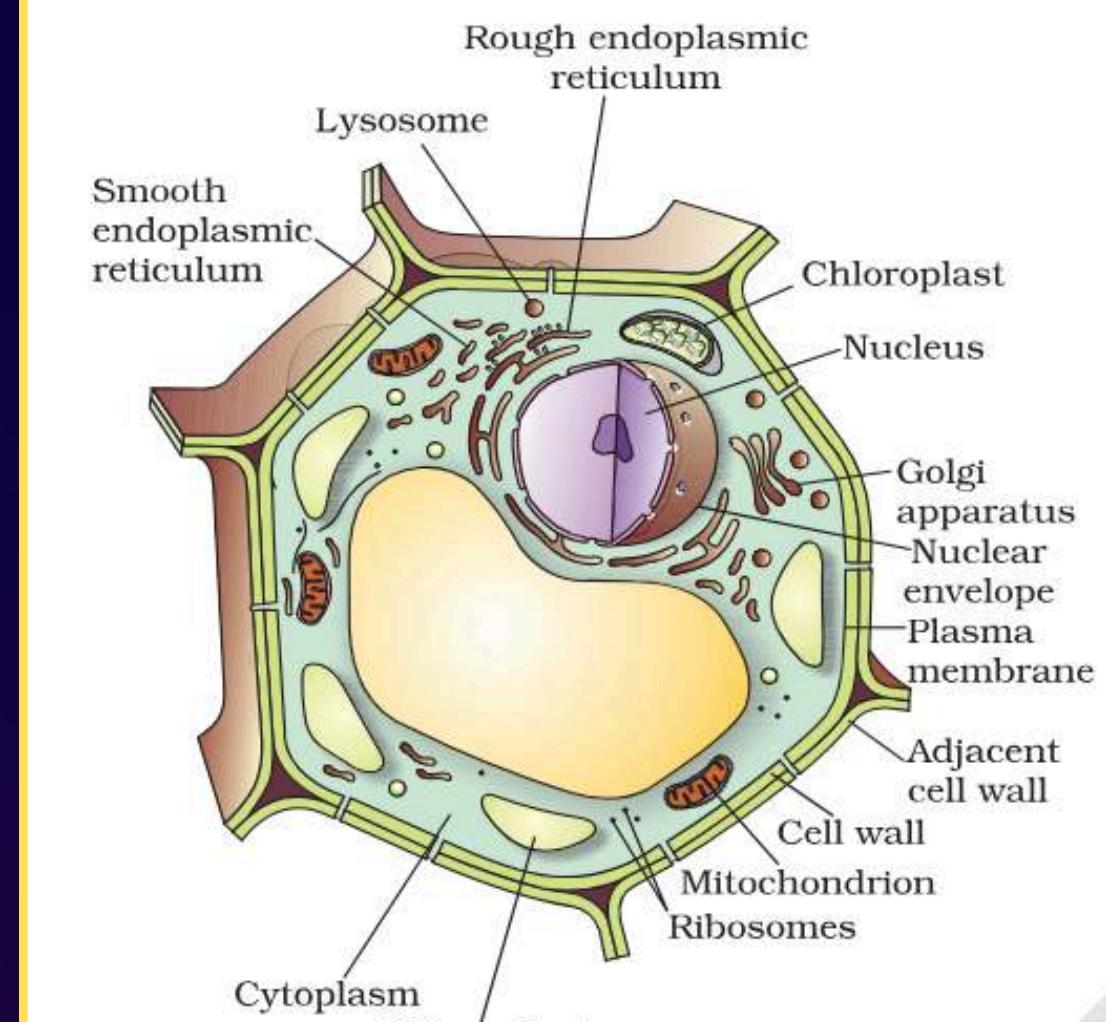
- These are specialised membrane-bound parts of cell present in cytoplasm



# Cell Structure



*Fig. 5.5: Animal cell*

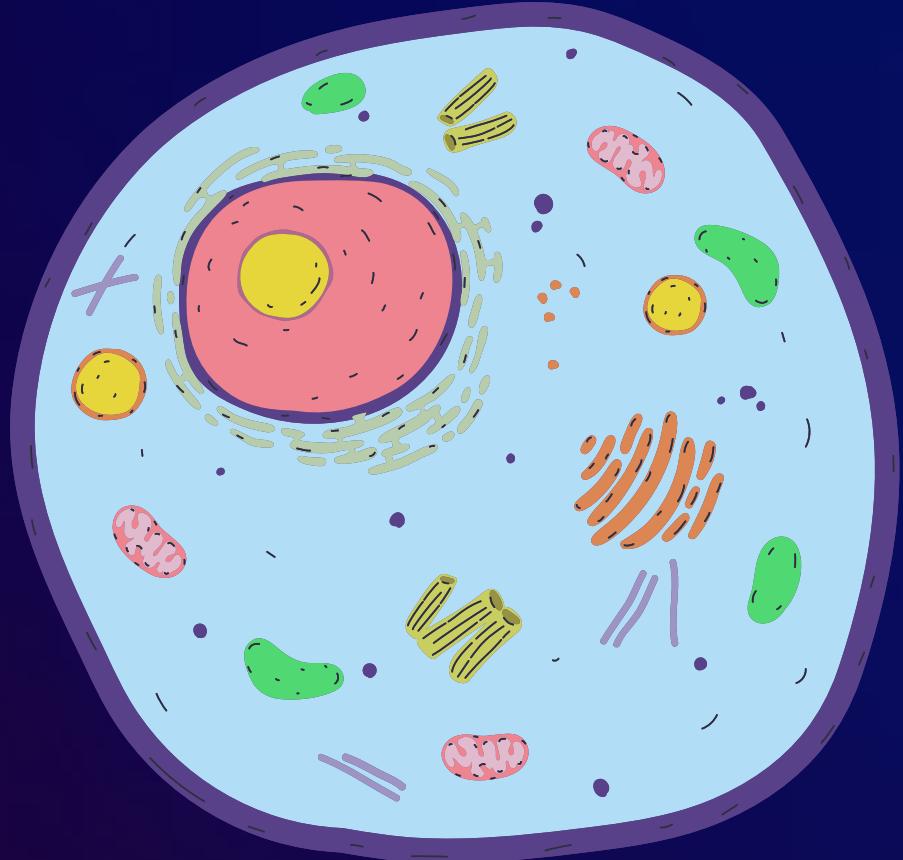
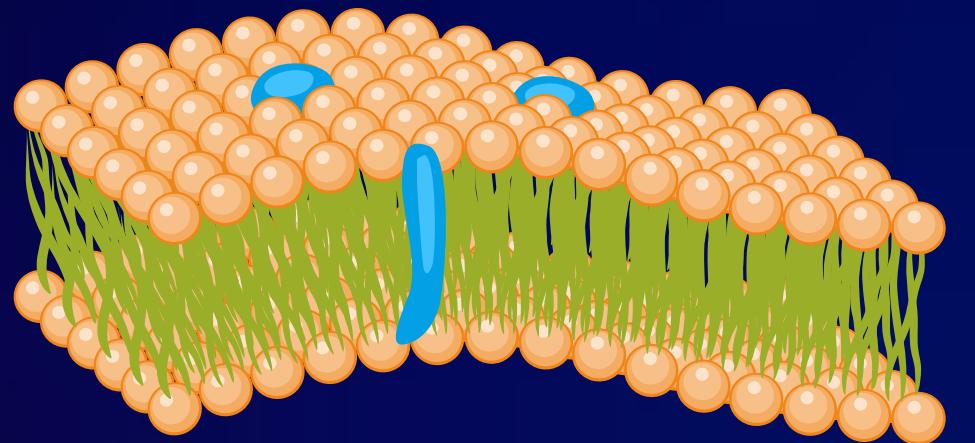


*Fig. 5.6: Plant cell*



# Plasma Membrane or Cell Membrane

- Outermost covering of the cell and it separates cell contents from external environment.
- Selectively **permeable membrane**:
  - Allows entry and exit of some materials.
  - Prevents movement of some materials.
- Allows diffusion of substances like carbon dioxide and oxygen.
- Regulates movement of substances in and out of the cell.
- It is made up of **lipids and proteins**.





# Active and Passive Transport

## Passive Transport

Substances move from their higher to lower concentration.

No energy is required.

It is a slow movement

Only small molecules or water molecules are transported passively

## Active Transport

Substances move from their lower to higher concentration.

It requires energy in the form de ATP molecules

It is a rapid movement.

Movement of large molecules occur by active transport.



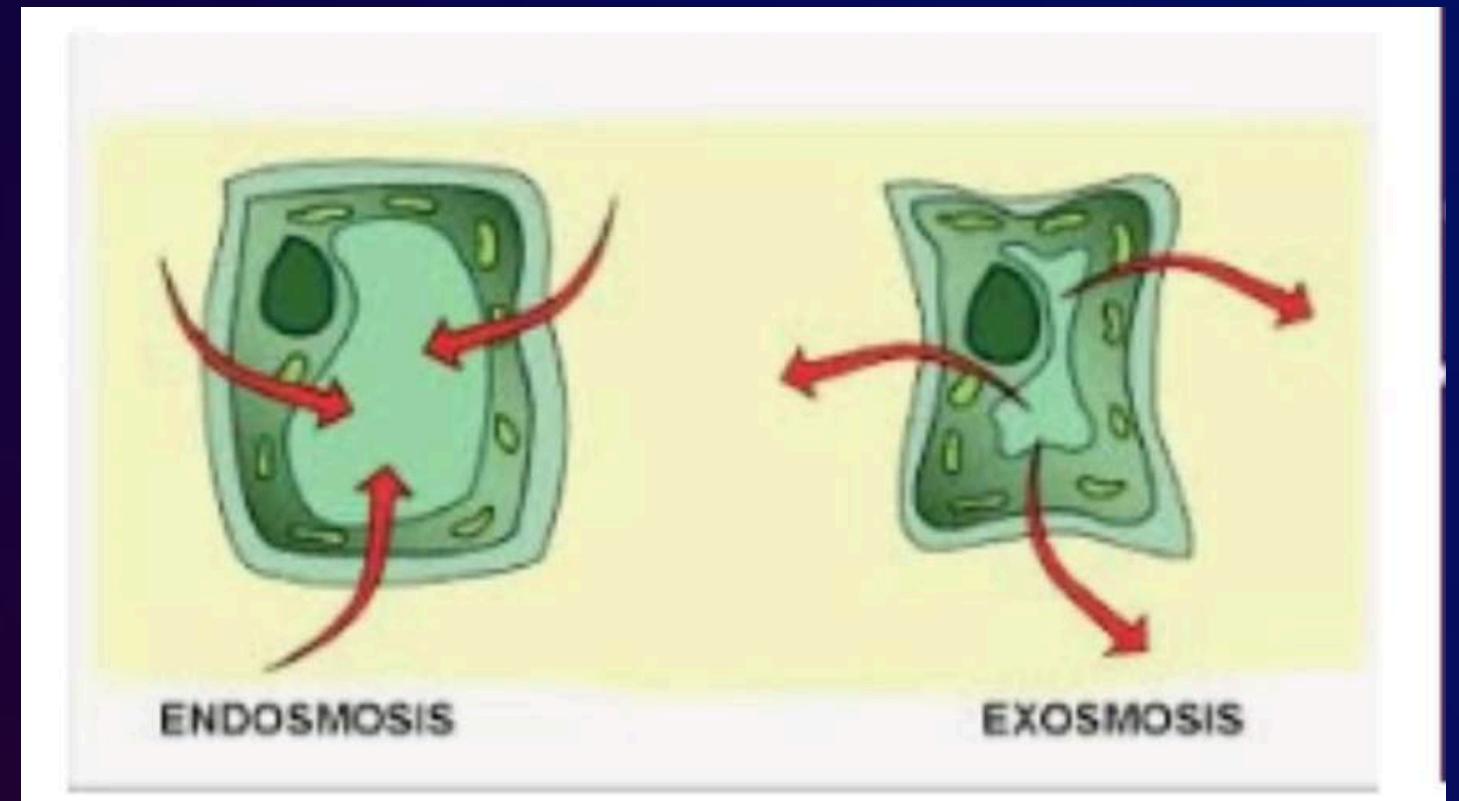


# Osmosis

- Osmosis is the passage of water molecules across a semi-permeable membrane from a solution with a high concentration to a solution with a lower concentration

*Types of Osmosis:*

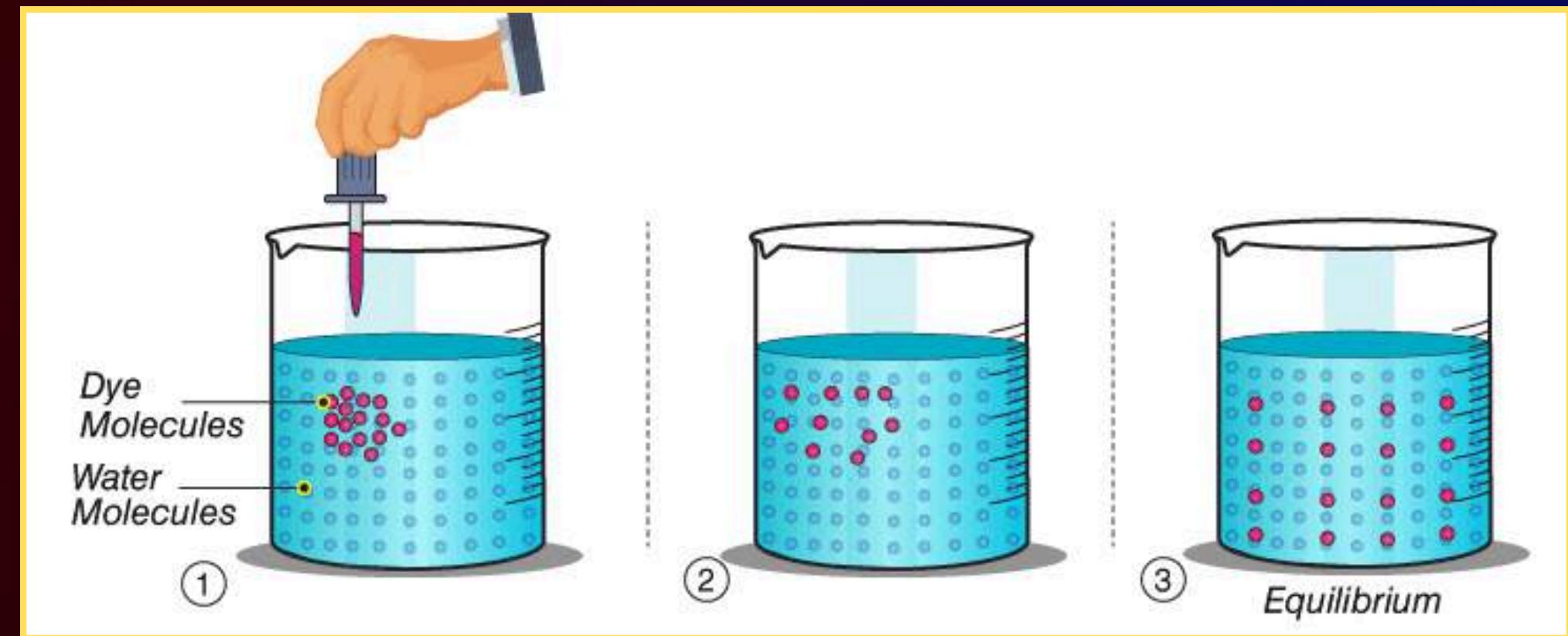
- **Endosmosis** : The process in which the water molecules / solvent enter into the cell. (Cell Swell)
- **Exosmosis** : The process in which the water molecules / solvent move out of the cell. (Cell Shrink)





# Diffusion

- The process of movement of a substance (solid, liquid, or gas) from the region of higher concentration to the region of lower concentration so as to spread uniformly.
- In the process of diffusion the molecules of the one substance mix with the molecule of the other substance.





## DIFFUSION

It is the phenomenon of moving particles from a region of higher concentration to a region of lower concentration.

It occurs in liquids and gases.

No membrane separation is required here.

Water is not necessary for movement.

The flow of constituents is in all directions.

Diffusion is a natural phenomenon that can not be stopped.

All the types of substances present in the solution can move from the region of its high concentration to the region of low concentration.

Example – Addition of ink in water leads to the colouring of the water.

## OSMOSIS

It is the phenomenon of moving solvent particles across a semipermeable from a region of low solute concentration to more solute concentration.

It occurs in liquids only.

It requires a semi-permeable membrane.

Water is the main solvent that moves from one region to another.

The flow of constituents occurs in one direction only.

The process can be stopped or we can reverse it by applying an external force.

There is a movement of only water or any other substance from a region of higher concentration of solvent to the region of low concentration.

Example – Red blood cells swell up when exposed to water.



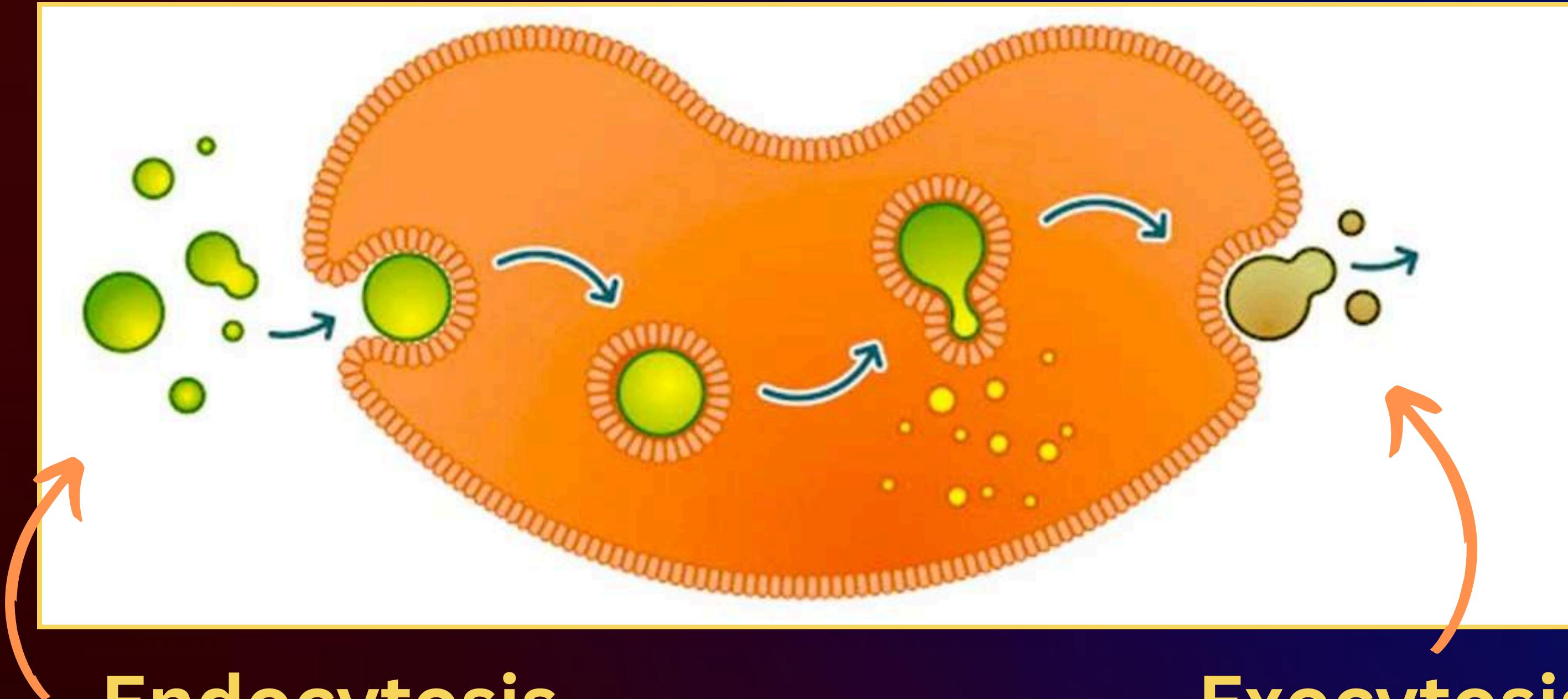
# Types of Solutions

Hypertonic	Isotonic	Hypotonic
Higher solute OUTSIDE	Equal solute	Higher solute INSIDE
Higher water INSIDE	Equal water	Higher water OUTSIDE
Water moves OUT	No net movement	Water moves IN
Cell SHRINKS	Normal	Cell SWELLS

Hypotonic  
↓  
swell



# Endocytosis & Exocytosis



Endocytosis

Exocytosis

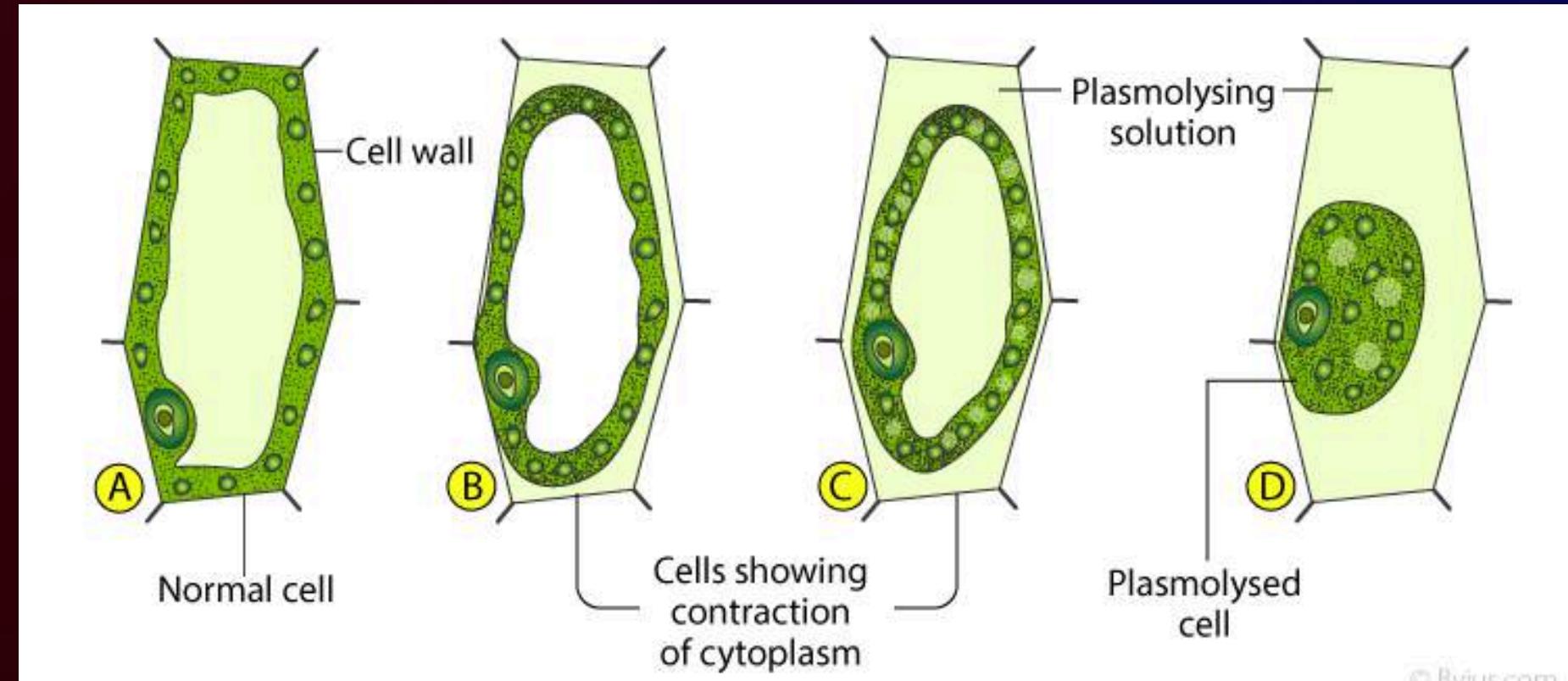


# Cell Wall

- **Non-living**, rigid outer covering of plant cells composed mainly of **cellulose**.
- Provides **structural strength**, lies outside the plasma membrane.

## Plasmolysis:

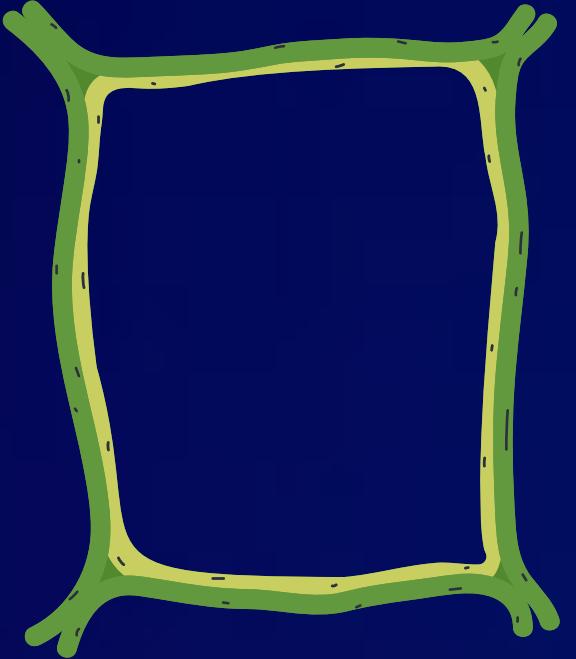
- Occurs in living plant cells when they lose water through osmosis.
- Results in shrinkage of cell contents away from the cell wall.





# Functions of Cell Wall :

- Permits plant, fungi, and bacterial cells to resist bursting in hypotonic environments.
- Cells absorb water by osmosis, leading to swelling and pressure against cell wall.
- Cell wall exerts equal pressure against swollen cell.
- Cells with walls can endure greater changes in surrounding medium than animal cells.



Plants	Present	Cellulose
Bacteria	Present	Peptidoglycan
Fungi	Present	Chitin
Animals	Absent	X
Virus	Absent	X



# Why cell walls are only present in plants and not animals? (PYQ)

Cell wall is present in plants while animals have cell membrane.

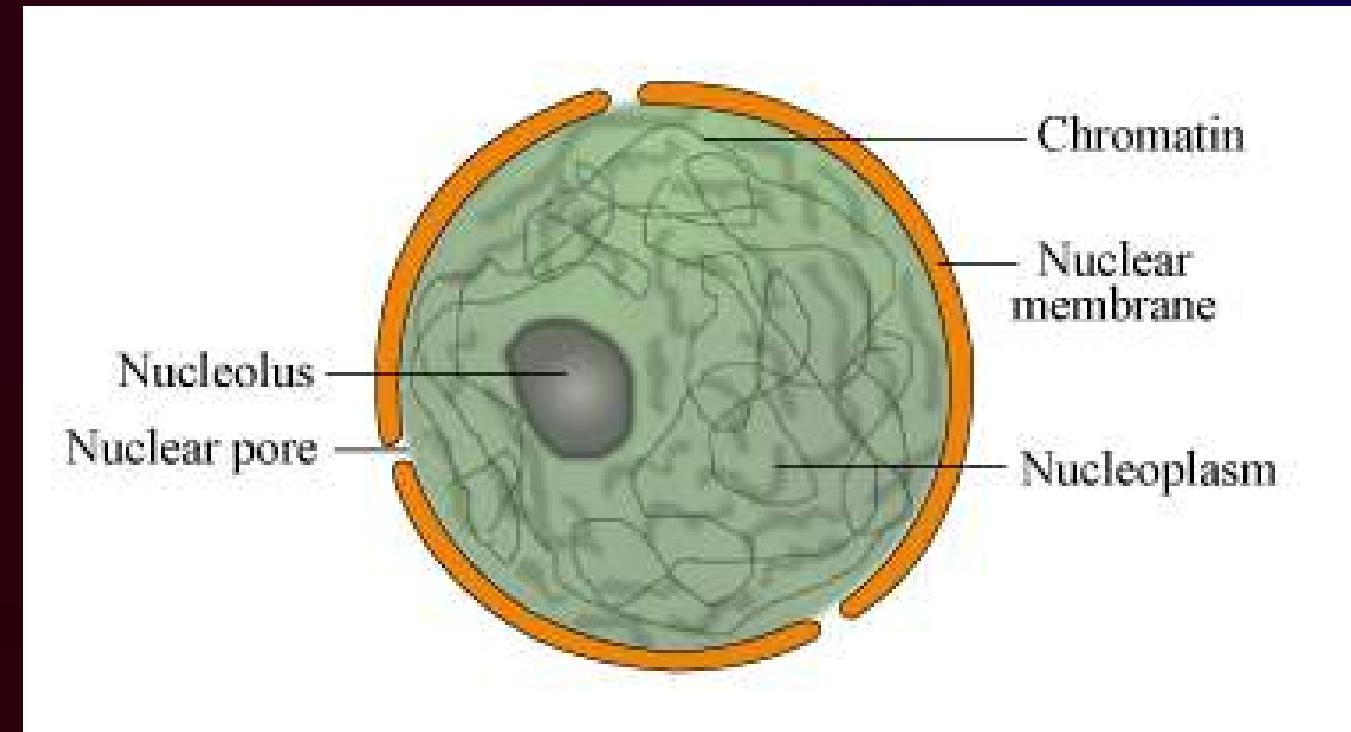
Cell wall mainly helps the plant to remain rigid and fixed. this helps the plants because they are immobile. the cell wall mainly contains cellulose and other substances, which are the main reasons why the trunks and branches of the trees are strong.





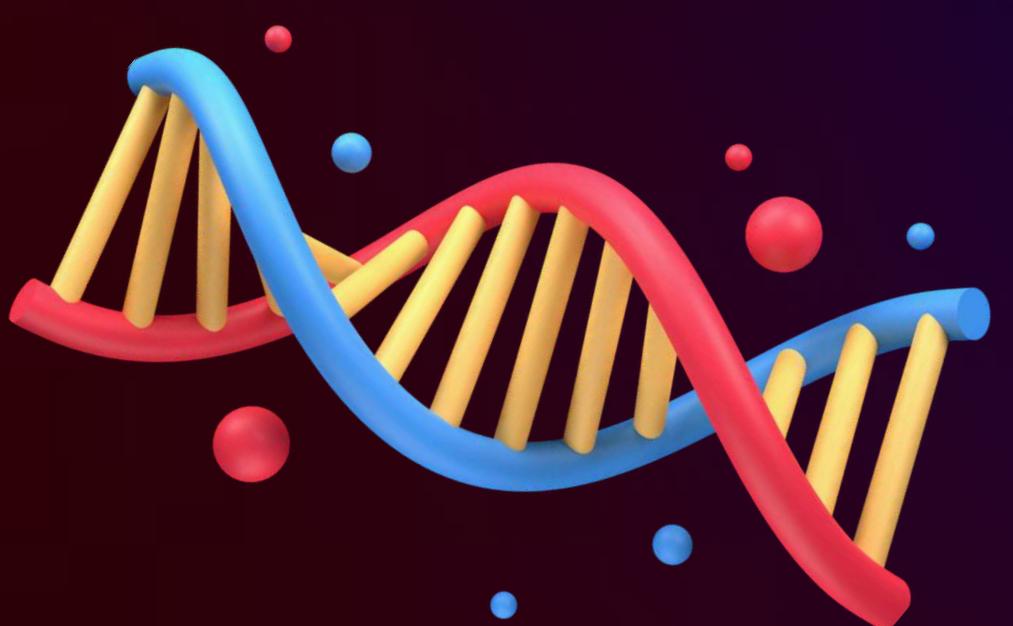
# Nucleus

- The nuclear membrane is double-layered and contains pores for material exchange between the nucleus and cytoplasm.
- Nucleus contains **chromosomes** (DNA and Protein) , visible during cell division, which carry genetic information in the form of DNA molecules.
- **DNA (Deoxyribose Nucleic Acid)** molecules contain the information essential for constructing & organizing cells. These molecules consist of **genes**, which regulate cell functions and inheritance, and are visible as **chromatin material** in non-dividing cells.





- **Chromatin material**, visible as an entangled mass of thread-like structures, undergoes organization into chromosomes during cell division.
- The nucleus plays a central role in cellular reproduction and development by directing chemical activities and determining cell maturity.





# Cell - origin and cellular structure

## Prokaryotic Cell

Size is generally small which ranges from  $1 - 10\mu m$  where,  $1\mu m = 10^{-6}m$

Nuclear region is not well - defined and it is known as Nucleoid.

Single chromosome.

Cell is membrane bounded and organelles are absent.



## Eukaryotic Cell

Size is generally large which ranges from  $5 - 10\mu m$ .

Nuclear region is well defined as well as it's surrounded by a nuclear membrane.

More than one chromosomes.

Cell is well-defined membrane bound and organelles are present.





Q. The undefined nuclear region of prokaryotes are also known as

- (a) nucleus
- (b) nucleolus
- (c) nucleic acid
- (d) nucleoid

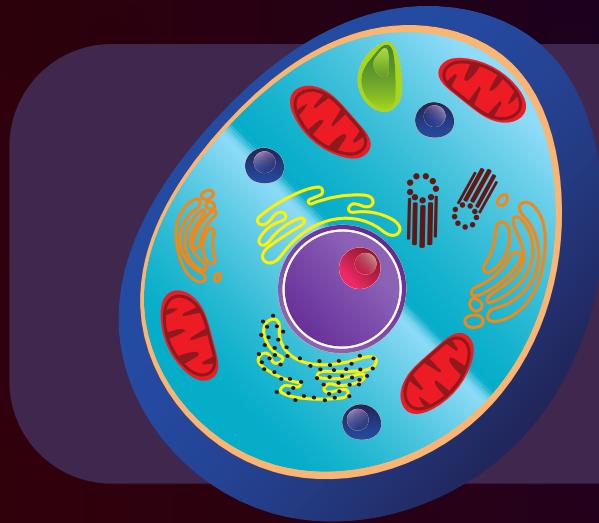
**(PYQ)**



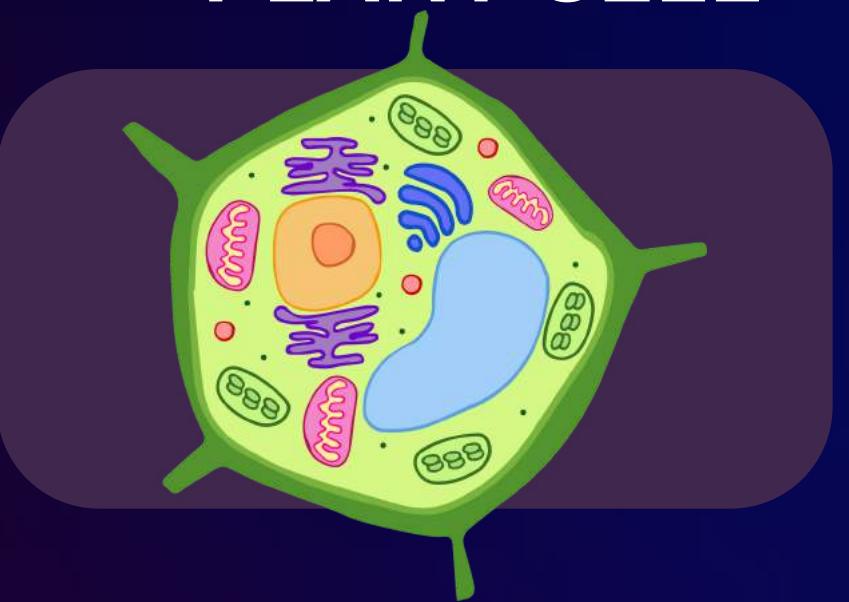


# Eukaryotes

ANIMAL CELL



PLANT CELL



**Cytoplasm-** the fluid content enclosed by the cell membrane, contains specialized organelles. Organelles perform specific functions and are enclosed by membranes.

**Cell Organelles-** Eukaryotic cells contain various membrane-bound organelles that carry out various functions in the cell, e.g. Nucleus, Endoplasmic reticulum, Golgi apparatus, Lysosomes, etc.



Q. The only cell organelle seen in prokaryotic cell

- (a) Mitochondria
- (b) Ribosomes
- (c) Plastids
- (d) Lysosomes

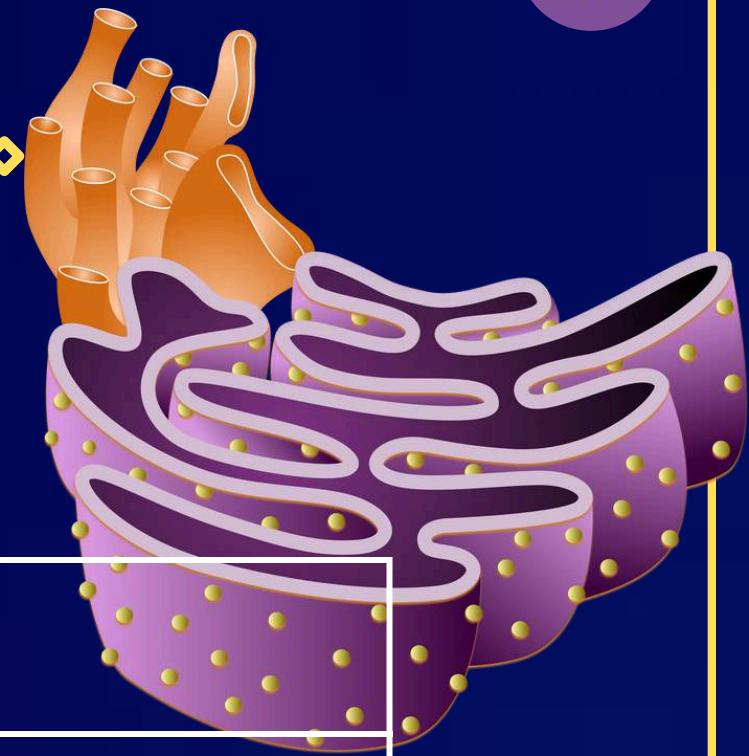
**(PYQ)**



# Endoplasmic Reticulum



- The endoplasmic reticulum (ER) forms a network of membrane-bound tubes and sheets within the cell.



Rough Endoplasmic Reticulum (RER)	Smooth Endoplasmic Reticulum (SER)
Appears rough due to ribosomes; sites of protein synthesis.	Smooth appearance; facilitates lipid, enzyme, and hormone production.
Ribosomes synthesize proteins.	No protein synthesis; functions in lipid production.
Not involved in lipid production.	Facilitates lipid synthesis.
No role in enzyme or hormone synthesis.	Functions in enzyme and hormone production.
No detoxification capability.	Crucial in detoxification, especially in liver cells.



- Q. Lipid molecules in the cell are synthesised by
- a. Smooth endoplasmic reticulum
  - b. Rough endoplasmic reticulum
  - c. Golgi apparatus
  - d. Plastids

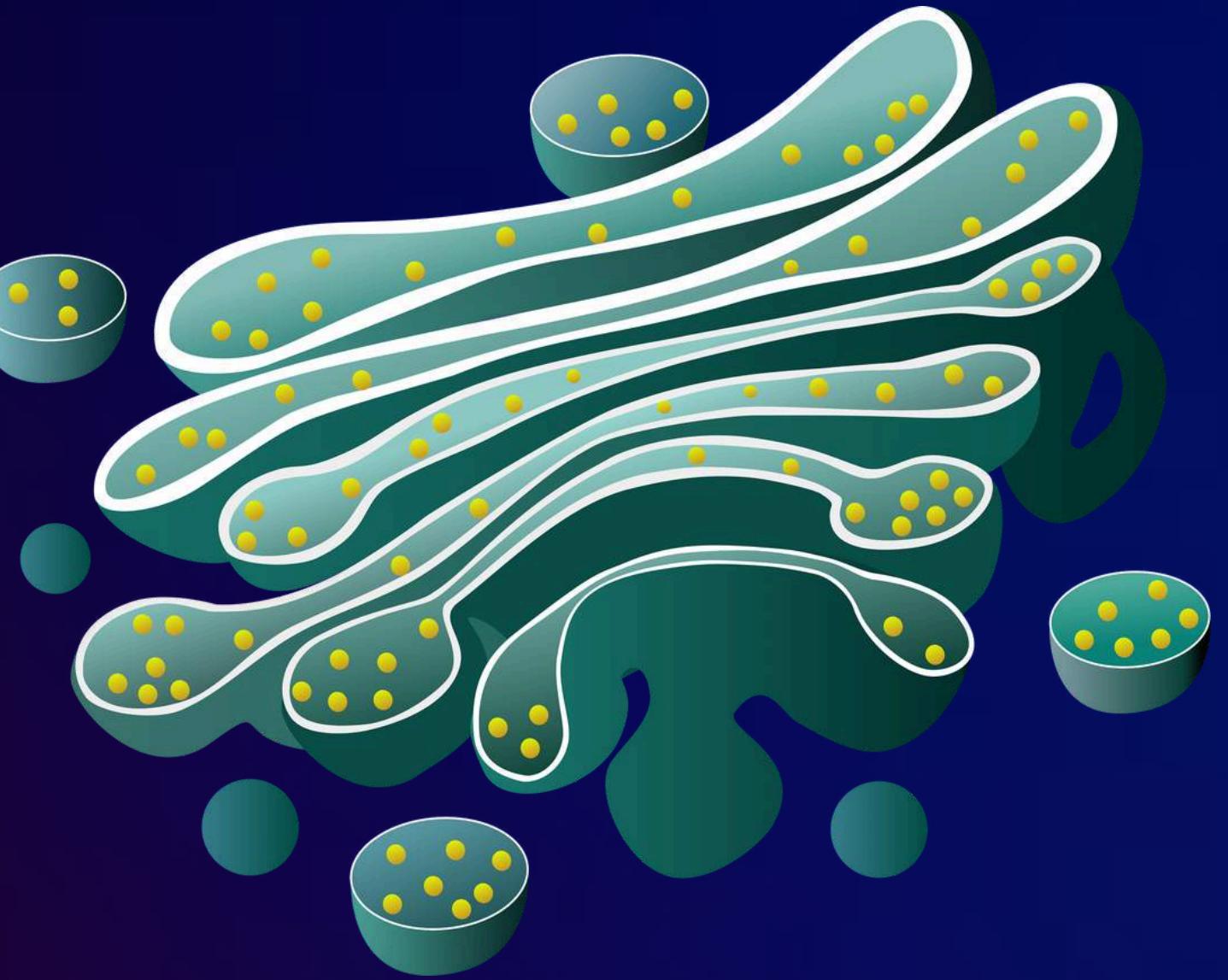
(PYQ)





# Golgi Apparatus

- Named after its discoverer, Camillo Golgi.
- Comprises a system of membrane-bound vesicles arranged roughly parallel to each other in stacks known as cisterns.
- Facilitates the packaging and transportation of proteins across the cytoplasm.
- Performs functions such as storage, modification, and packaging of products in vesicles.
- Plays a role in the formation of lysosomes.

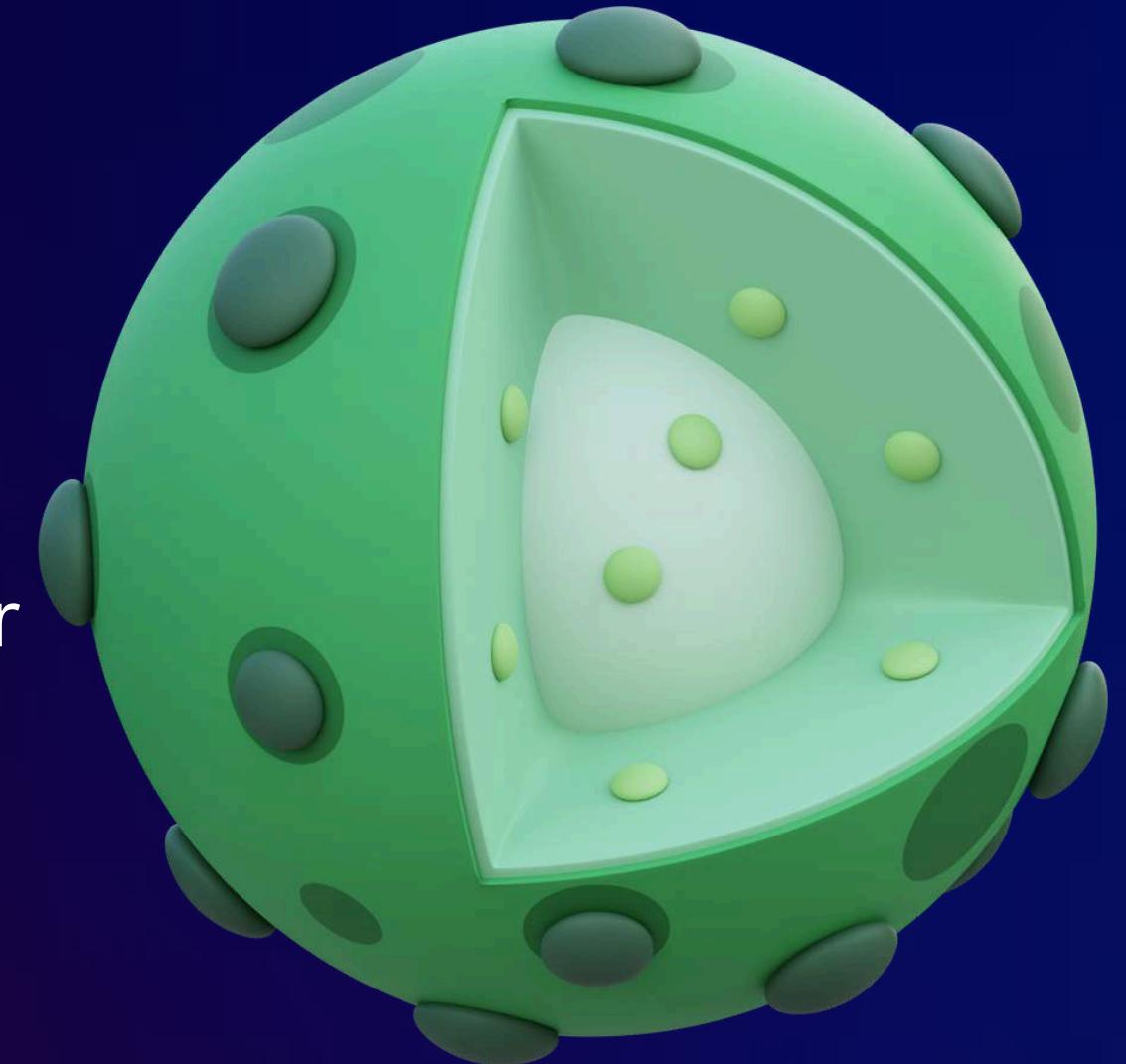


**Traffic police' of the cell**



# Lysosomes

- Lysosomes, filled with digestive enzymes from the RER, act as the cell's **waste disposal system**.
- They digest foreign material and worn-out organelles to maintain cell cleanliness.
- Lysosomes break down complex substances into simpler ones using **powerful enzymes**.
- Termed "**suicide bags**" as they may burst during cellular disturbance, leading to self-digestion.
- Involved in breaking down all organic material, including bacteria and old organelles.

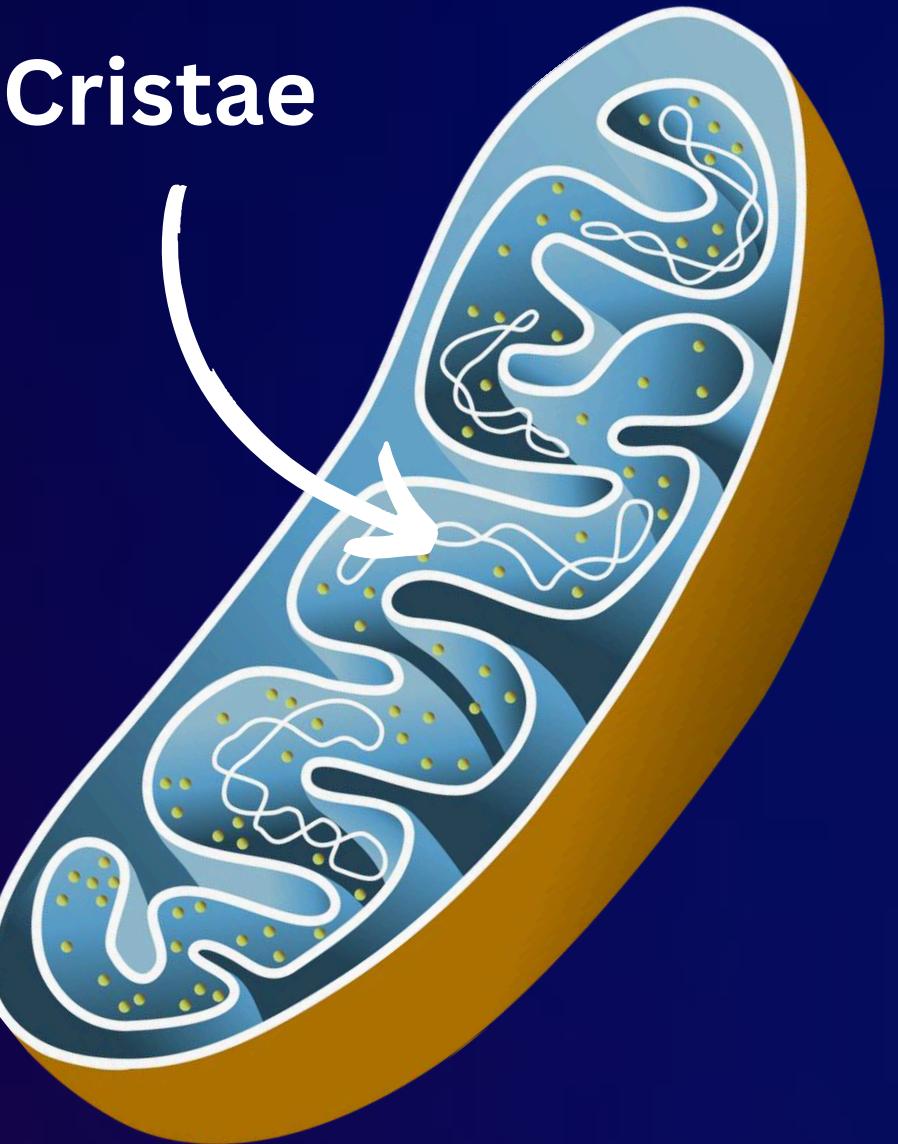


**'Suicide bags' of the cell**



# Mitochondria

- Mitochondria, the cell's powerhouses, have two membranes: porous outer and folded inner.
- Inner folds increase surface area for **ATP** generation, the **cell's energy currency**.
- Mitochondria produce ATP, used for cellular activities and mechanical work.
- They possess their own DNA and ribosomes, enabling protein synthesis.

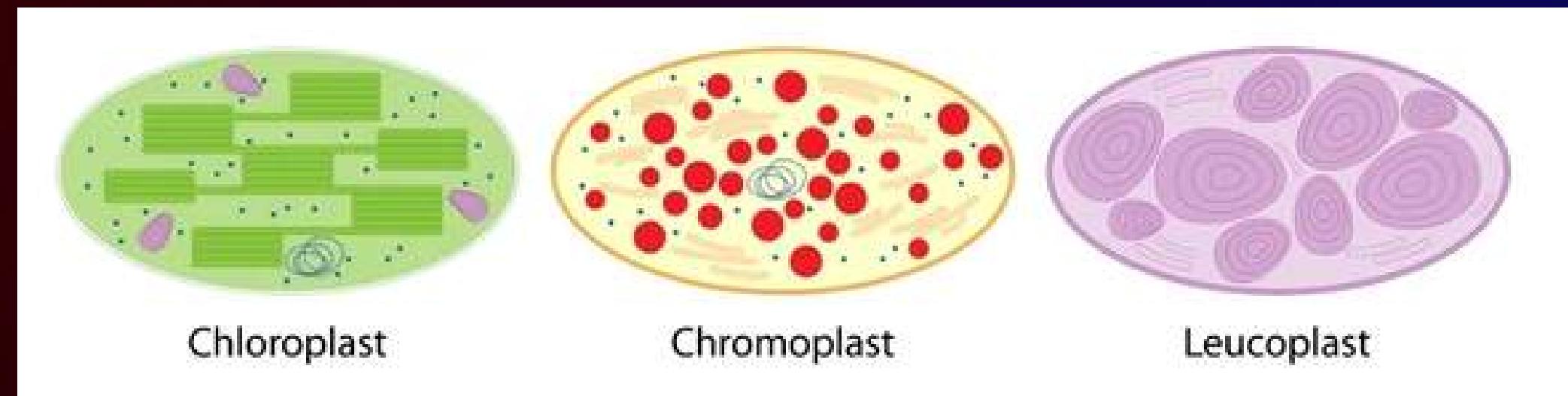


**'Powerhouse' of the cell**



# Plastids

- Plastids, exclusive to plant cells, exist in two varieties: chromoplasts and leucoplasts.
- **Chromoplasts** are colored plastids (flowers).
- **Chloroplasts**, are chromoplasts, containing chlorophyll, enabling photosynthesis, which regulates atmospheric oxygen levels.
- **Leucoplasts** lack coloration and primarily function as storage sites for starch, oils, and protein granules.



# Ribosomes

- Membrane less cell organelle.
- Involved in synthesis of protein
- Present in both Prokaryotic and Eukaryotic cell.





Q. Which of these options are not the functions of ribosomes?

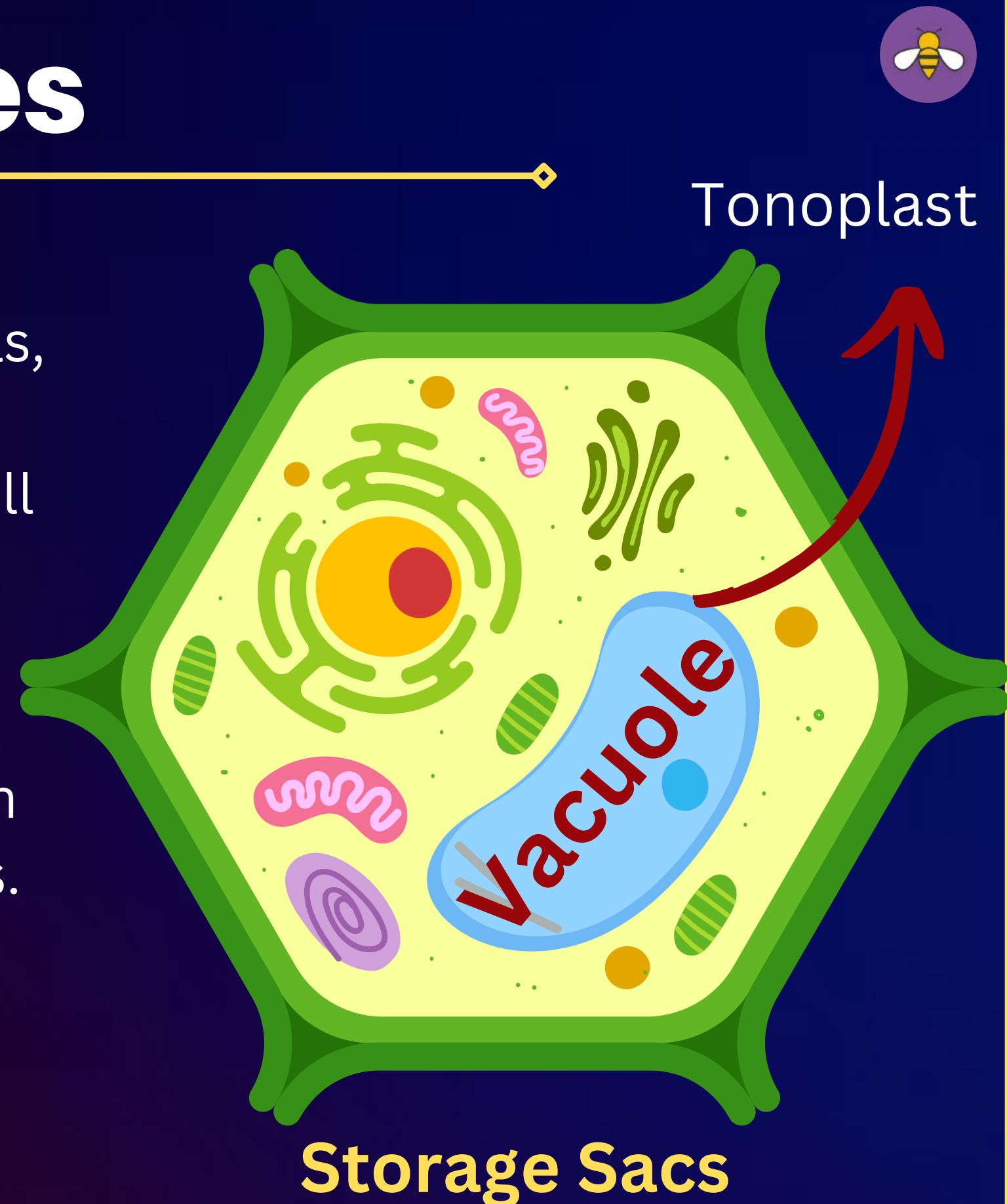
- I. It helps in manufacture of protein molecules.
  - II. It helps in manufacture of enzymes.
  - III. It helps in manufacture of hormones.
  - IV. It helps in manufacture of starch molecules.
- (a) I and II
  - (b) I and III
  - (c) III and IV
  - (d) IV and I

**(PYQ)**



# Vacuoles

- Vacuoles: Storage sacs in cells, small in animals, large in plants.
- Plant Central Vacuole: Occupies 50-90% of cell volume, filled with cell sap.
- Functions: Provide turgidity and rigidity to plant cells, store essential substances.
- Contents: Amino acids, sugars, proteins, and in single-celled organisms, consumed food items.
- Specialized Roles: Expelling excess water and wastes from unicellular organisms.





# To Remember



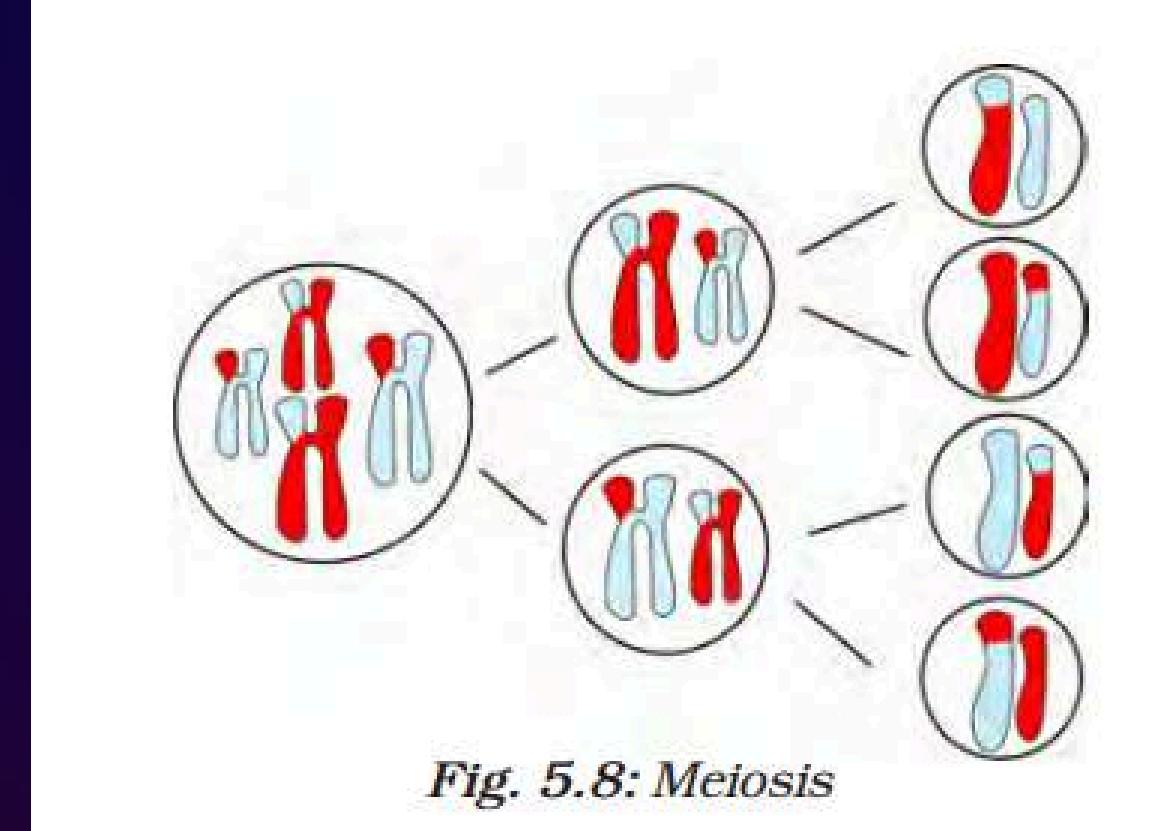
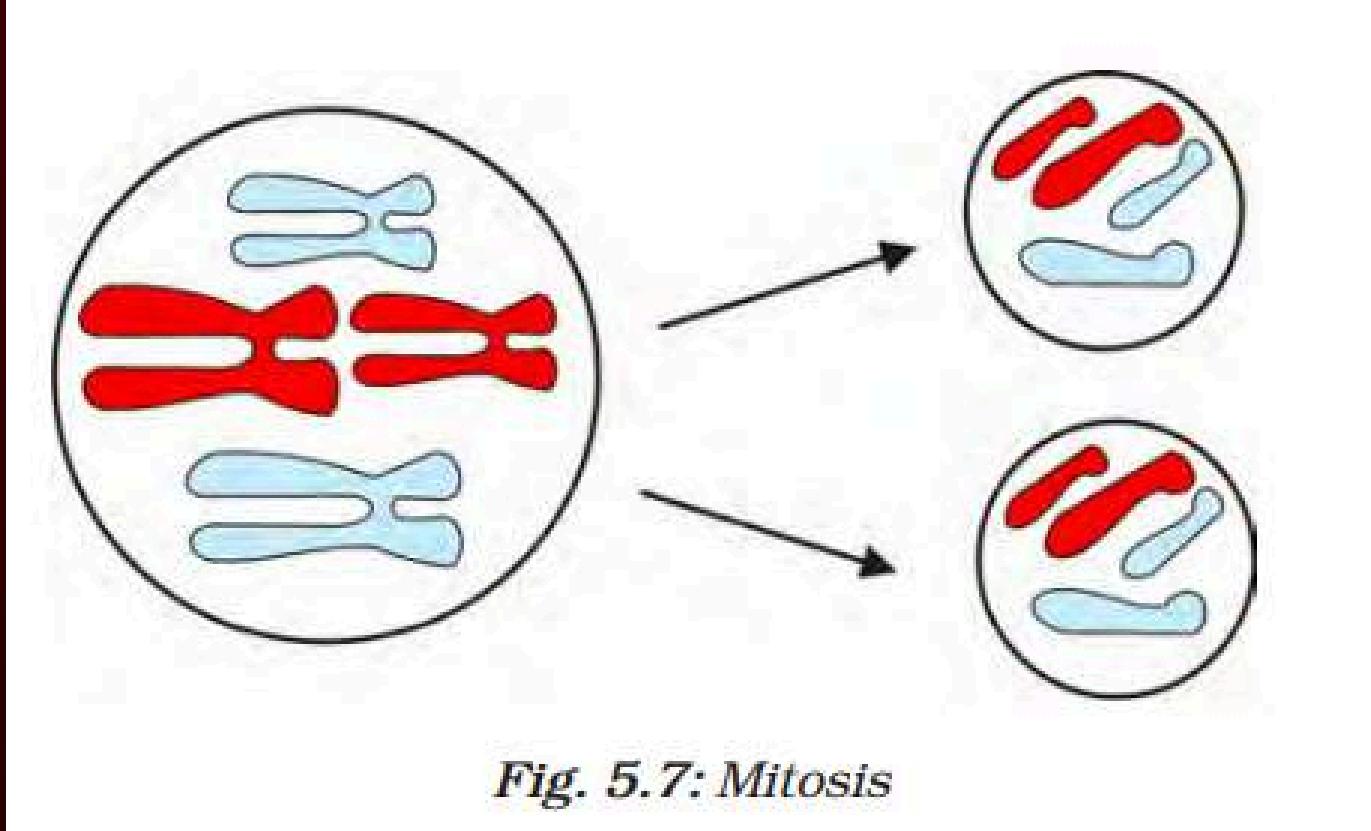
- **Double membrane-bound:** Nucleus, Mitochondria, Plastids
- **Single membrane-bound:** vacuole, lysosome, Golgi apparatus, endoplasmic reticulum
- **Membrane-less:** Ribosome, Centrosome (Centriole)

Feature	Plant Cell	Animal Cell
Cell Shape	Square or rectangular in shape	Irregular or round in shape
Cell Wall	Present	Absent
Plasma/Cell Membrane	Present	Present
Endoplasmic Reticulum	Present	Present
Nucleus	Present and lies on one side of the cell	Present and lies in the center of the cell
Lysosomes	Present but are very rare	Present
Golgi Apparatus	Present	Present
Cytoplasm	Present	Present
Ribosomes	Present	Present
Plastids	Present	Absent
Vacuoles	Few large or a single, centrally positioned	Usually small and numerous
Cilia	Absent	Present in most of the animal cells
Mitochondria	Present but fewer in number	Present and are numerous
Mode of Nutrition	Primarily autotrophic	Heterotrophic



# Cell Division

- Cell division is the process through which **new cells** are formed in organisms.
- New cells formed for growth, cell replacement, and reproduction.
- Two main types: mitosis and meiosis.





## Mitosis

It is an equational division.

Two daughter cells are formed.

Daughter cells have same number of chromosomes as the parent cell.

It helps in growth and repair of injured tissues.

## Meiosis

It is reductional division.

Four daughter cells are formed.

Daughter cells have half the number of chromosomes as the parent cell.

It is responsible for production of gamete.

(PYQ)

Q. In brief state what happens when

- (a) Dry apricots are left for sometime in pure water and later transferred to sugar solution?
- (b) A red blood cell is kept in concentrated saline solution?
- (c) The plasma membrane of a cell breaks down?
- (d) Rhoeo leaves are boiled in water first and then a drop of sugar syrup is put on it?
- (e) Golgi apparatus is removed from the cell?





**Answer-**

- (a) Dry apricots in pure water: Swell due to osmosis, then shrink in sugar solution due to exosmosis.**
- (b) Red blood cell in concentrated saline solution: Shrinks due to exosmosis caused by water loss.**
- (c) Plasma membrane breakage: Disruption of cell integrity, scattering of cell organelles.**
- (d) Boiled Rhoeo leaves with sugar syrup: No osmosis due to cell death, demonstrating selective permeability.**
- (e) Removal of Golgi apparatus: Impaired protein processing, storage, and secretion.**



*“be powerhouse of your life”*

- Mitochondria

