
Cell
The unit of Life
sharma

The fundamental unit of life

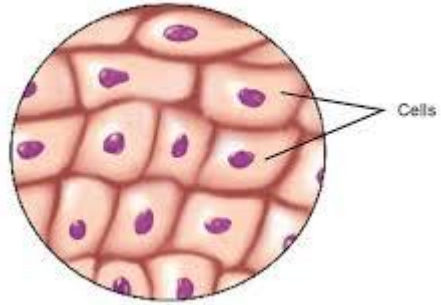
Cell :- Every organism in this universe are made up of tiny basic structural unit called cell

Or

The structural and functional unit of living organism is known as cell.

Why cell is known as structural and functional unit of living organism ?

It is known as the structural and fundamental unit of life because it is the basic building unit of an organism and is capable to perform basic functions of all living organisms.



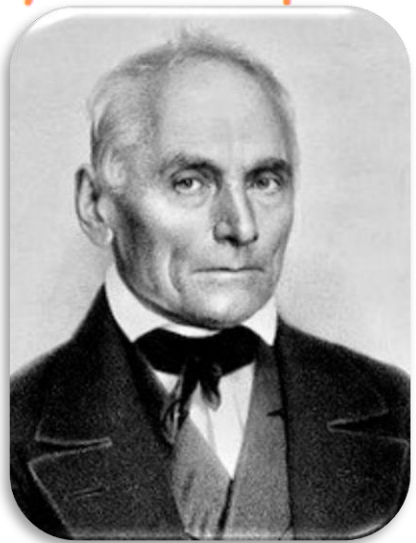
Discovery of cell :-

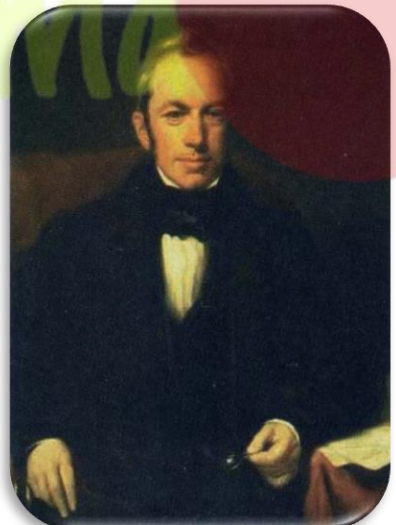
- Cell is a latin words means “little room”.
- **Robert Hooke** discovered cell in 1665 by observing cell in a thin slice of cork through self designed microscope.
- A.V. Leeuwenhoek, in 1674, groundbreaking discovery of the first free-living cell.
- Discovery of Protoplasm (living component of the cell) led to the understanding that cells fundamental unit of life and that protoplasm is the basis of for all life process.

Discovery of Living Cell ⟶ Anton Van Leeuwenhock (1674)

Discovery of Nucleus ⟶ Robert Brown (1831)

Discovery of Protoplasm ⟶ J. E. Purkinje (1839)



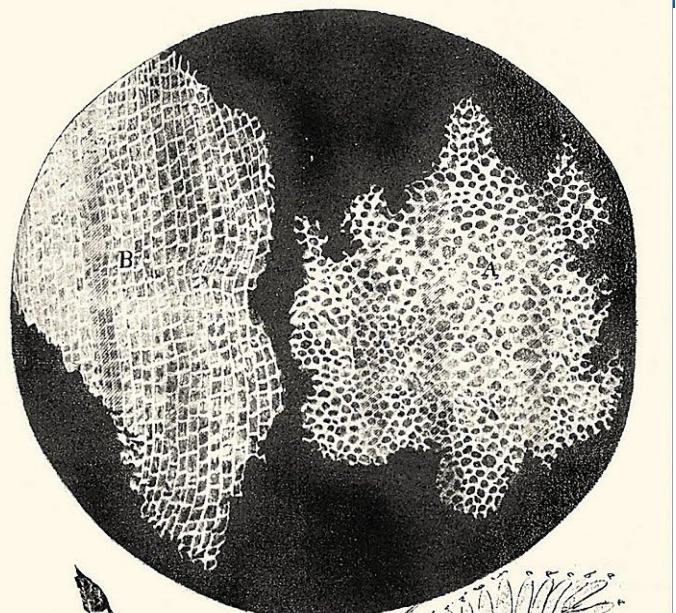


CELL THEORY

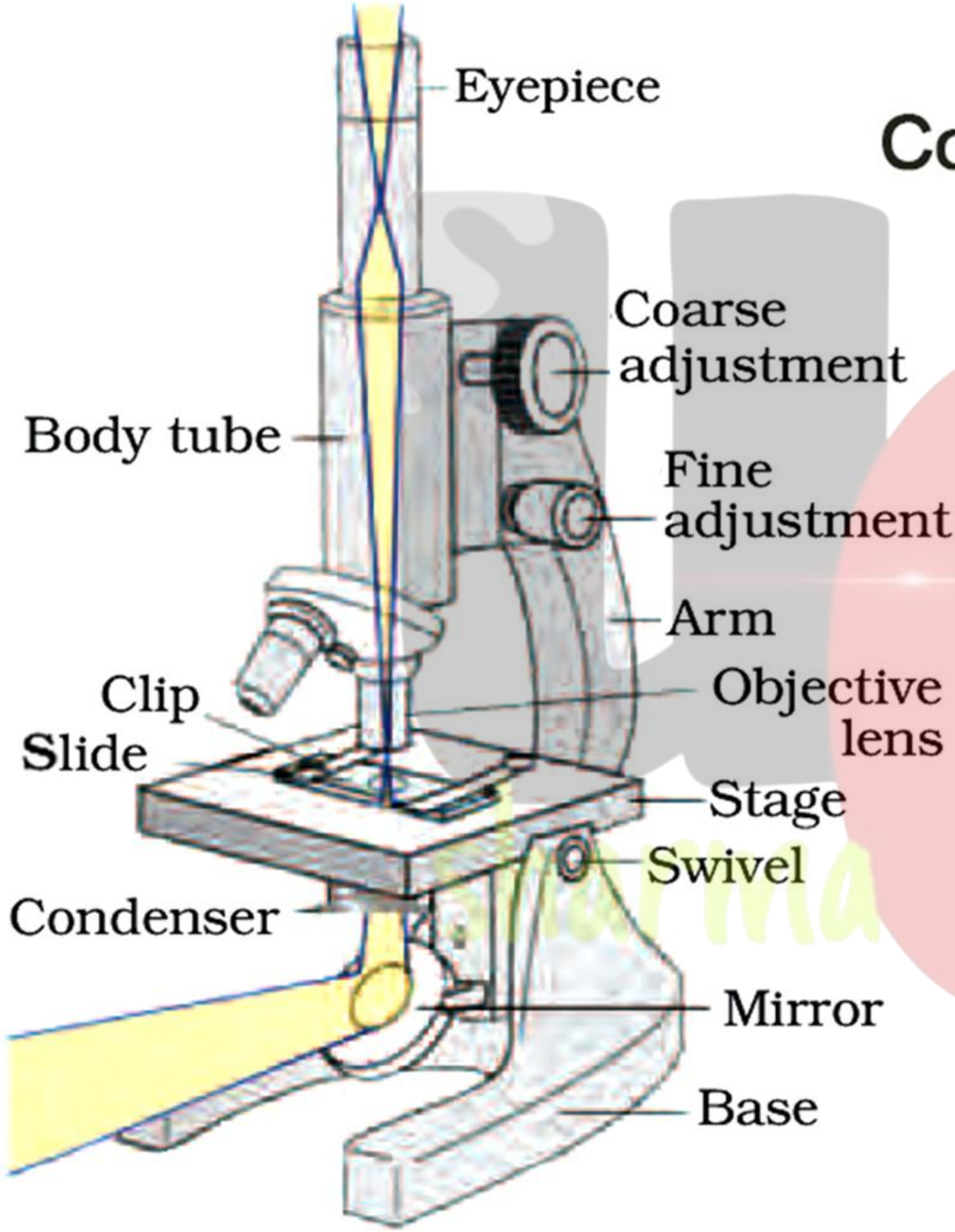
1. All living things are made of cells
2. Cells are the basic unit of structure and function in living things
3. All cells are produced from existing cells.

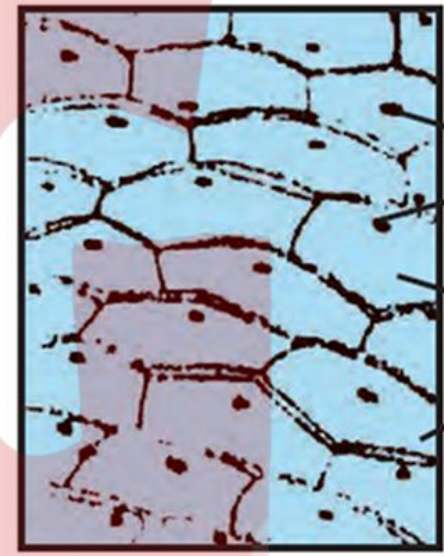
Cell Theory

- The cell theory was first proposed by a German botanist, Matthias Schleiden (1838) and a British zoologist, Theodore Schwann (1839).
- Rudolf Virchow (1855) later added the concept of formation of cells; to this theory-*omnis cellula-e cellula*.



Compound microscope

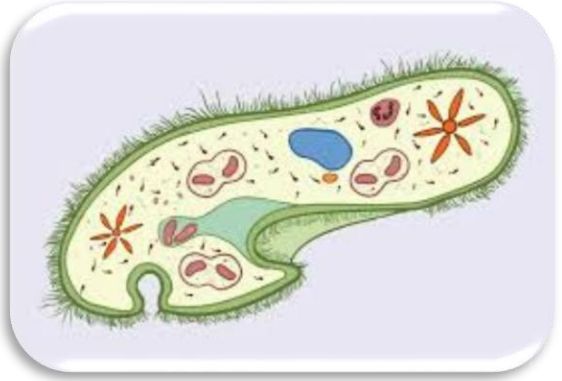




Cells of an onion peel

Classification of organism on the basis of number of cell present :-

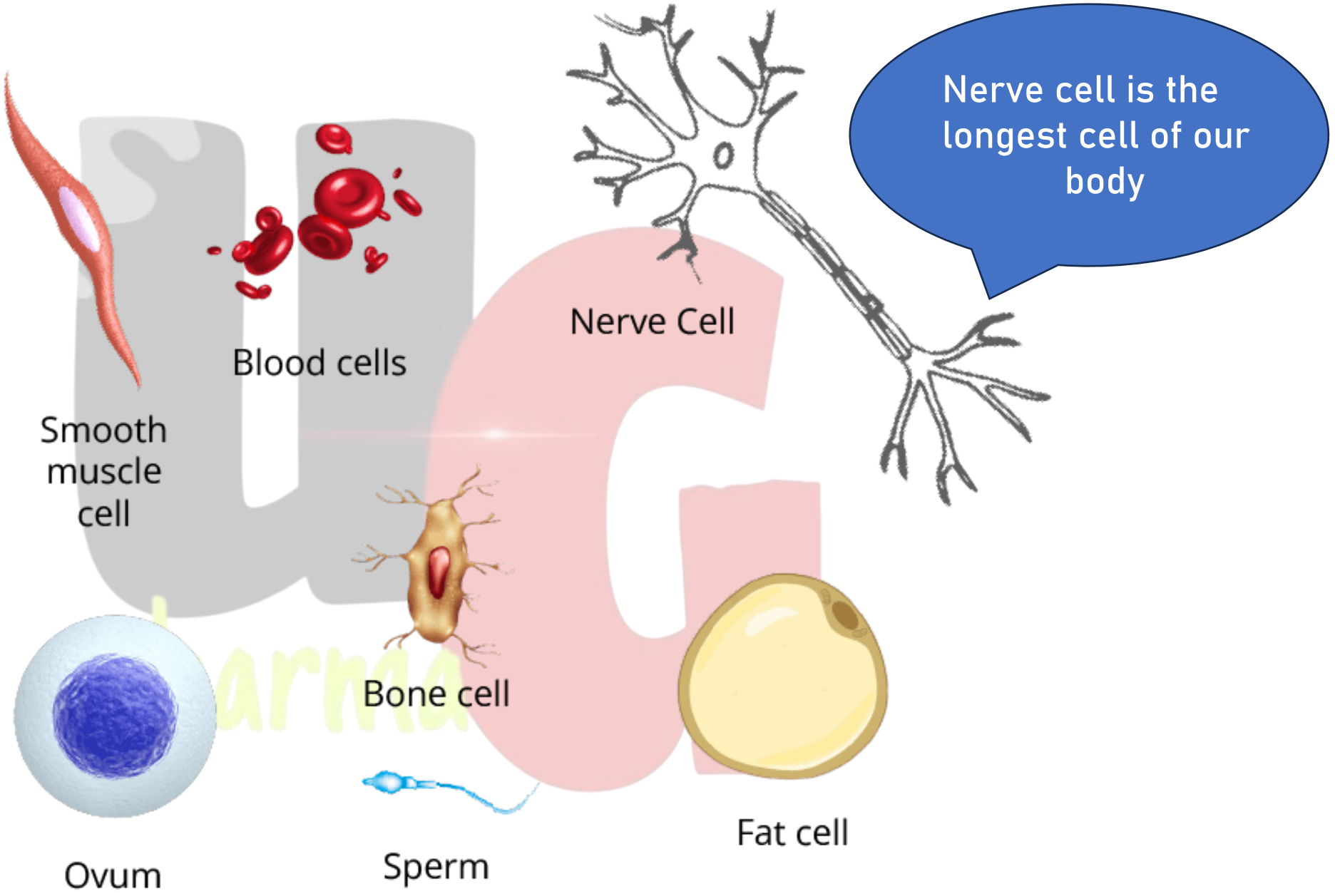
Unicellular Organism	Multicellular Organism
→Made up of only one cell	→Made up of many cell
→Whole function of body is performed by one cell	→Different function performed different cell
→Unicellular have short life span	→Multicellular have long life span
→Eg :- Amoeba , chlamydomonas (marine) , paramecium etc	→Eg :- Plants and animals



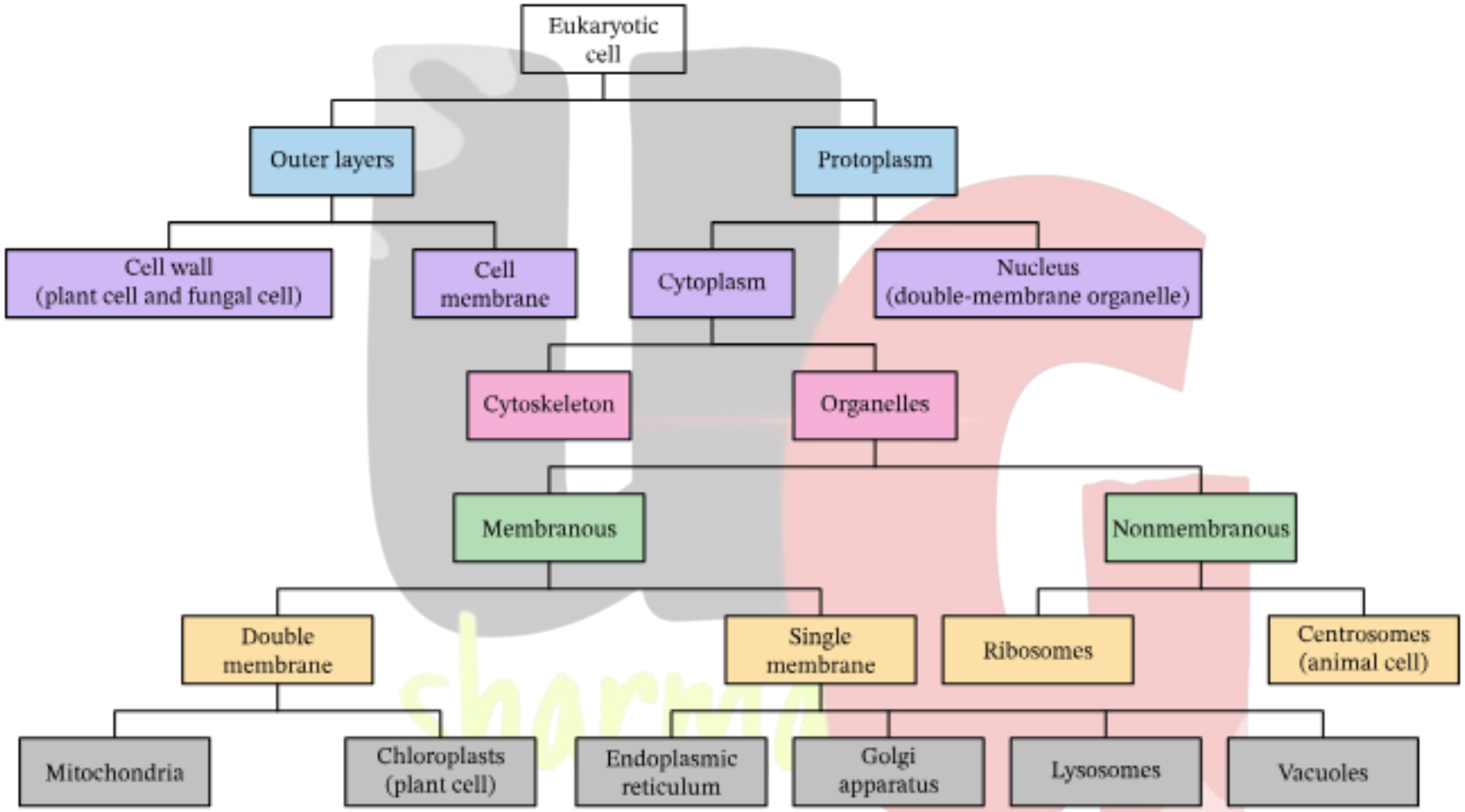
NOTE :- All Multicellular Organisms comes from a single cell due to cell division of pre existing cell occurs which form multicellular organism.

- The shape and size of cell are different according to the kind of function they perform. There is division of labour in cells.
- Each cell has certain (same) kind of cell organelles to perform different type of function like mitochondria for respiration.

Almost each cell have same cell organelles even they have different shape.



STRUCTURE OF CELL

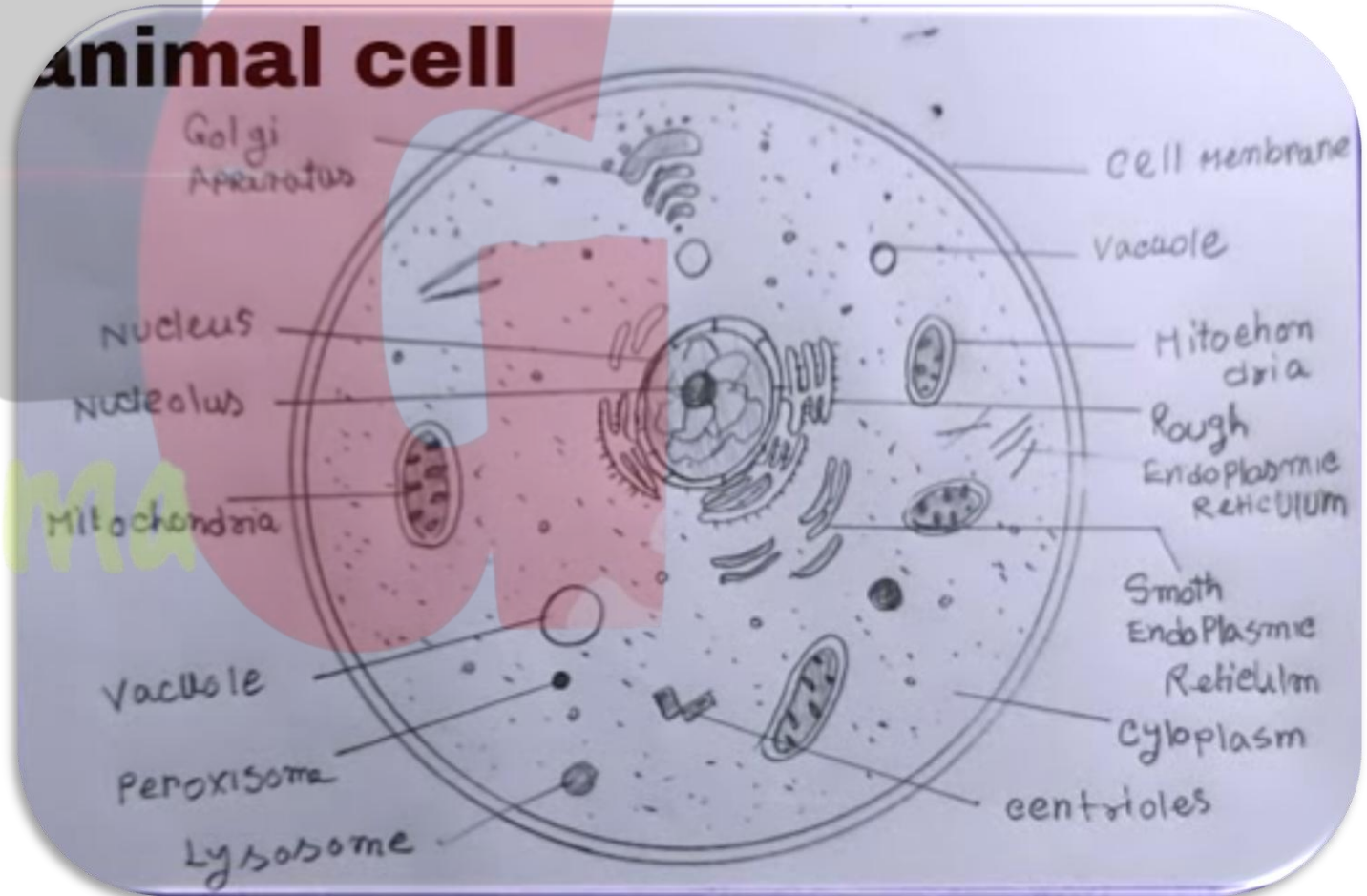


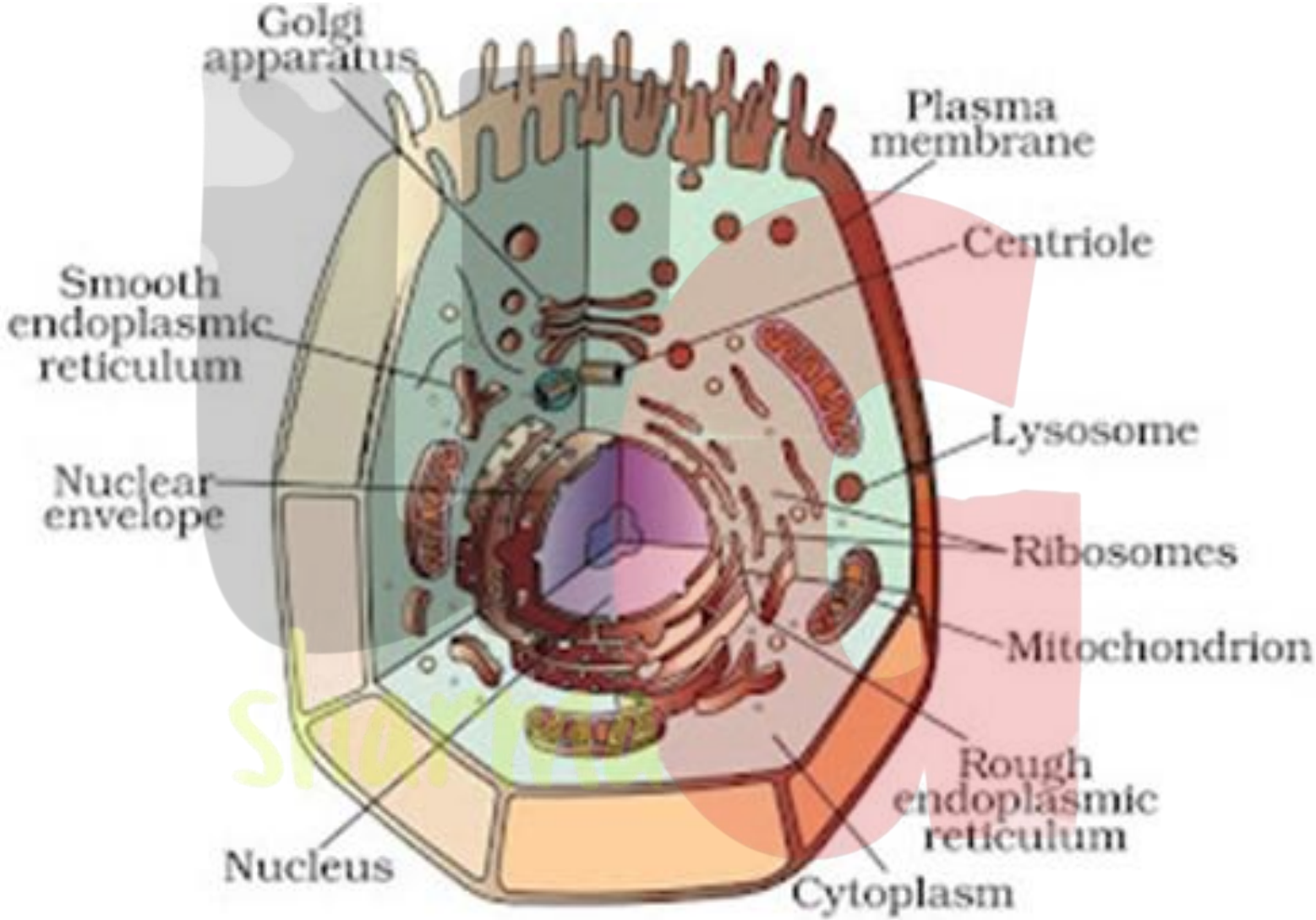
Organelles :- Cell are made up of specific components called cell organelles.

STRUCTURE OF CELL

- A cell is live and capable to perform their function due to the presence of these cell organelles. As making new material, clearing the material from cell, etc.
- All cells have the same organelles irrespective of their function and organism they are found in i.e let it be a bone cell or a nerve cell or any other cell, all will have same components.
- These components of cells are :-

- Cell wall
- Cell / Plasma membrane
- Nucleus
- Cytoplasm
- Endoplasmic reticulum
- Golgi apparatus
- Lysosomes
- Mitochondria
- Plastids
- Vacuoles




Golgi apparatus
Plasma membrane
Centriole
Smooth endoplasmic reticulum
Lysosome
Nuclear envelope
Ribosomes
Mitochondrion
Rough endoplasmic reticulum
Nucleus
Cytoplasm

CELL / PLASMA MEMBRANE

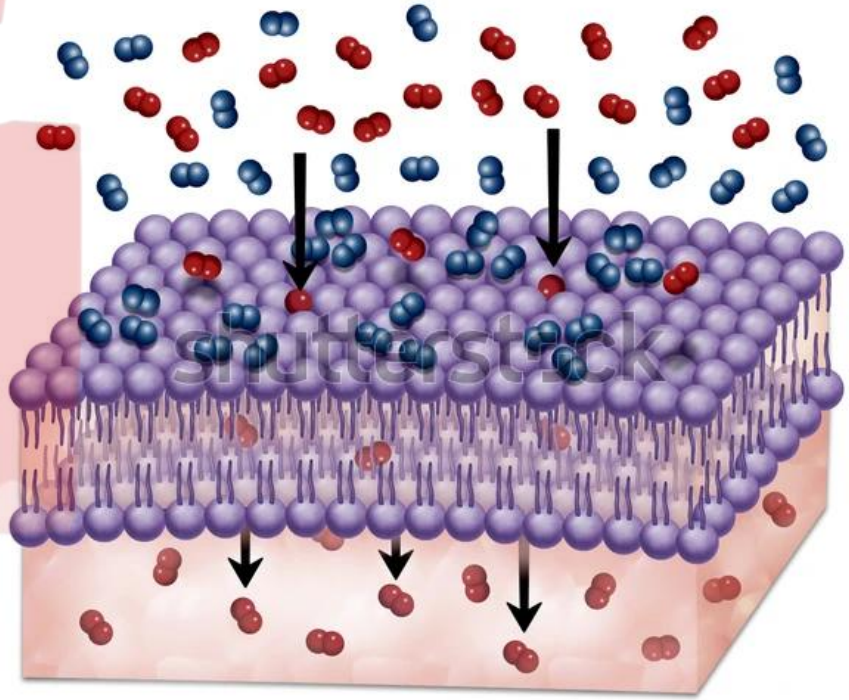
- Outermost layer in cells.
- Separates content of cell (organelles) from outermost environment.
- Allow exchange of material from surrounding and inside the cells.
- It controls the entry and exit of materials in and out and hence called **selectively permeable membrane.**

Diffusion :- Gases like CO_2 or O_2 can move in or out from higher concentration to lower concentration through cell membrane is called diffusion.

Osmosis :- The movement of water molecule through semi permeable membrane (or cell membrane) from region of higher concern to lower concentration is called osmosis.

OR,

Movement of water molecule through cell membrane.



- The following one phenomena will occur when plant or animal cell put into solution of salt or sugar.

1. **Hypotonic solution :-** If the concentration of water inside the cell is lower than surrounding (outside) then this cell will gain water through osmosis. This type of solution is known as hypotonic solution. Hence, cell will swell up.

2. **Isotonic solution :-** Concentration of water inside and outside the cell is same and hence no movement of water occurs such type of solution is called isotonic solution.

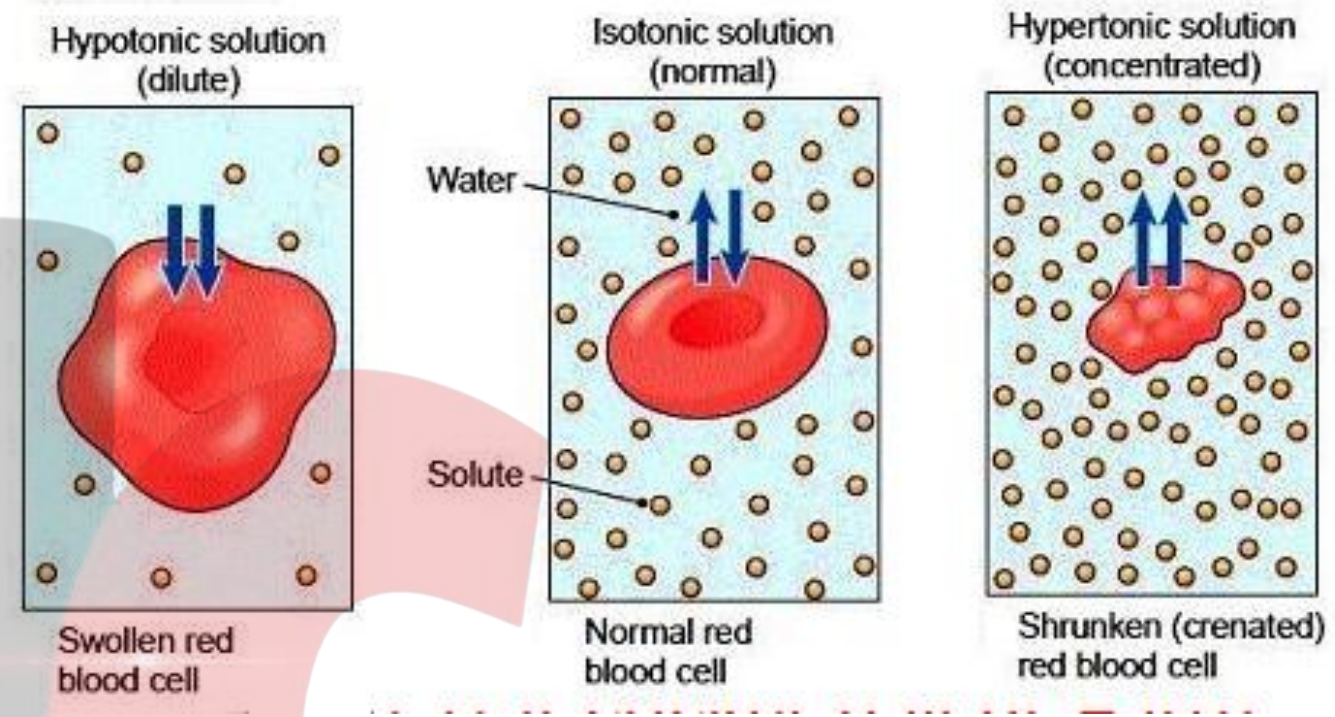
   Movement of water occurs in both directions in equal amount. Hence, no change in size of cell.

3. **Hypertonic solution :-** Medium has lower concentration than the cell causes loss of water by cell through cell / plasma membrane or cell wall by the process of osmosis.

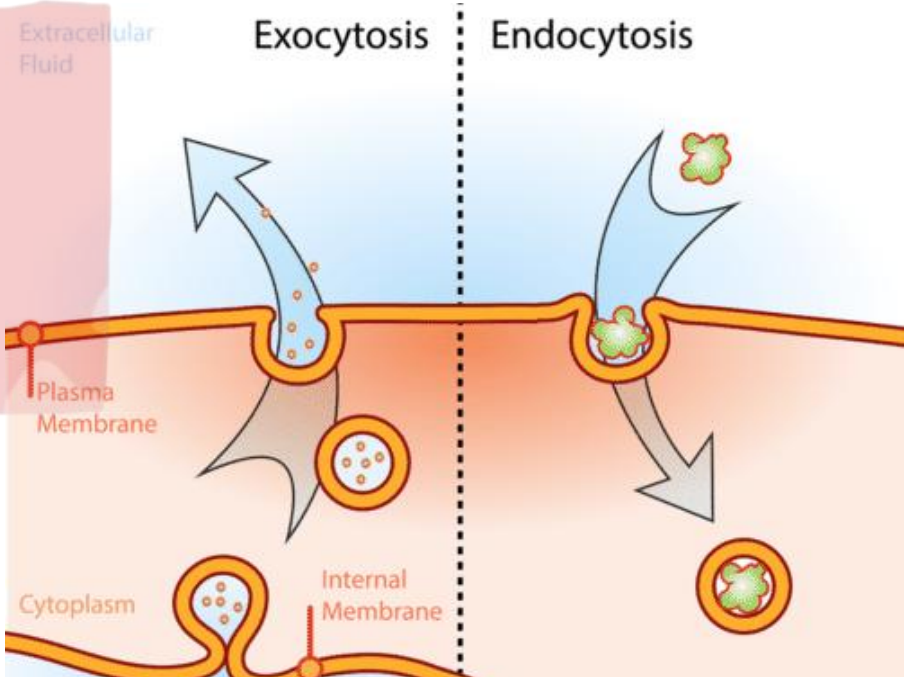
   Water crosses the cell membrane in both directions but in this case the amount of water leaves is higher than enters.

- Absorption of water by plant roots is also an example of osmosis process.
- Diffusion play importance role in gaseous exchange.

Note :- Plasma membrane is flexible membrane and is made up of organic molecule called lipids and protein



Endocytosis :- Due to flexibility of cell membrane helps to engulf (intake/eat) food and other material from its outer environment this process is called endocytosis.



Difference b/w osmosis and diffusion

Osmosis

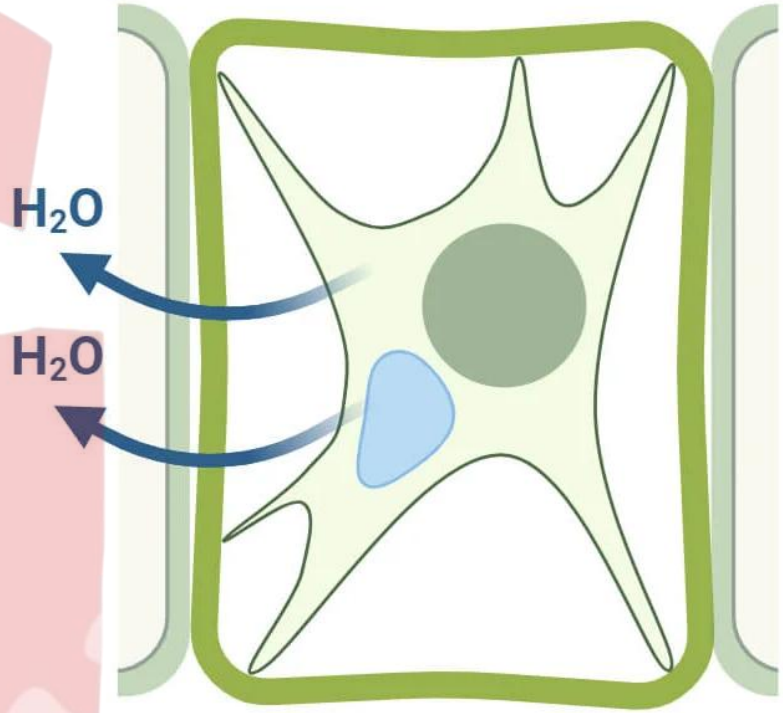
- It occurs only in a liquid medium.
- It requires a semi-permeable membrane.

Diffusion

- It can occur in any medium.
- It does not require a semi-permeable membrane.

Cell wall

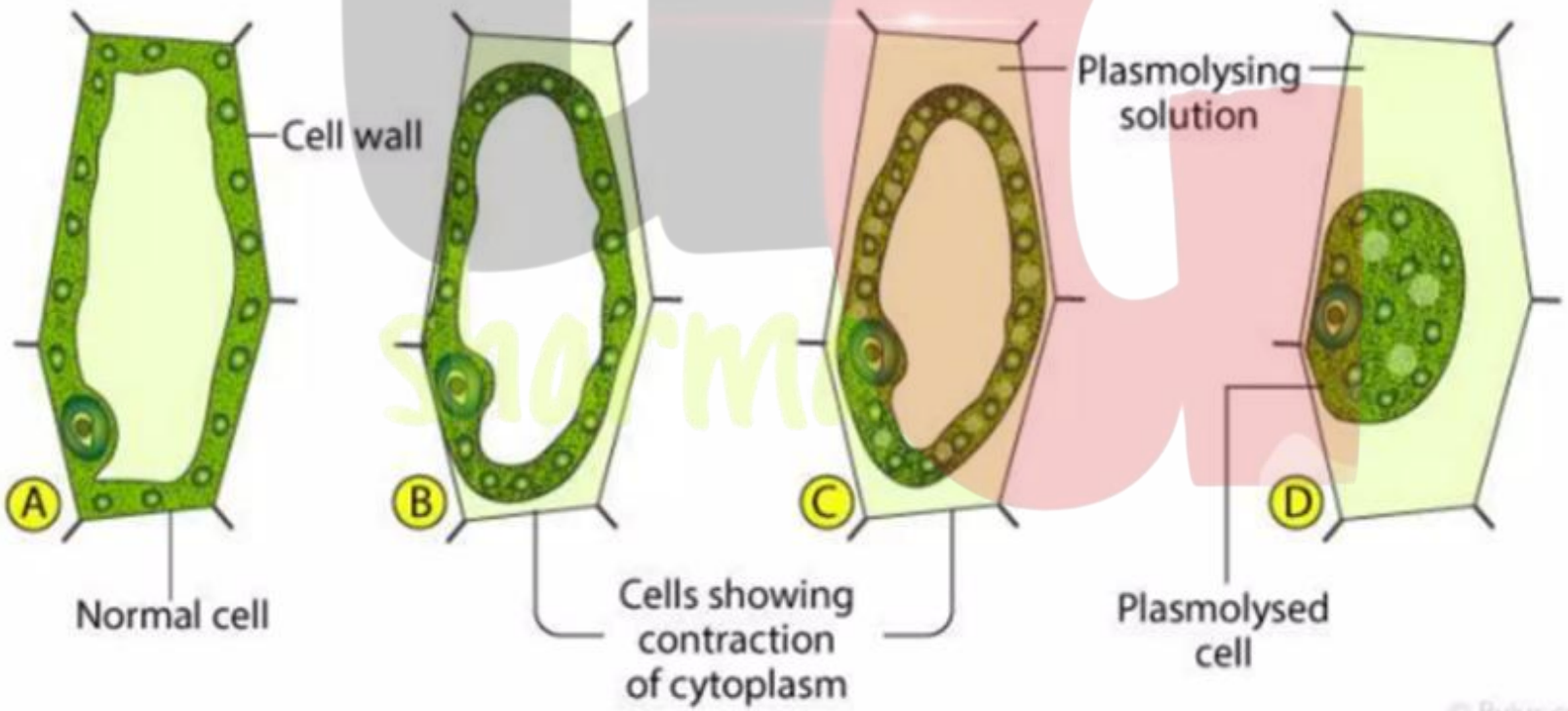
- Cell wall is found in plant cells outside the plasma membrane.
- Rigid and made up of cellulose (Complex substance provides a structural support to plant).
- Due to the presence of cell wall plant cell can withstand greater changes in the surrounding media than animal cell due to exertion of equal pressure to the cell when it swell up by taking up water through osmosis in a hypnotic media.
- Cell wall of fungus is made up of chitin.



Plasmolysis

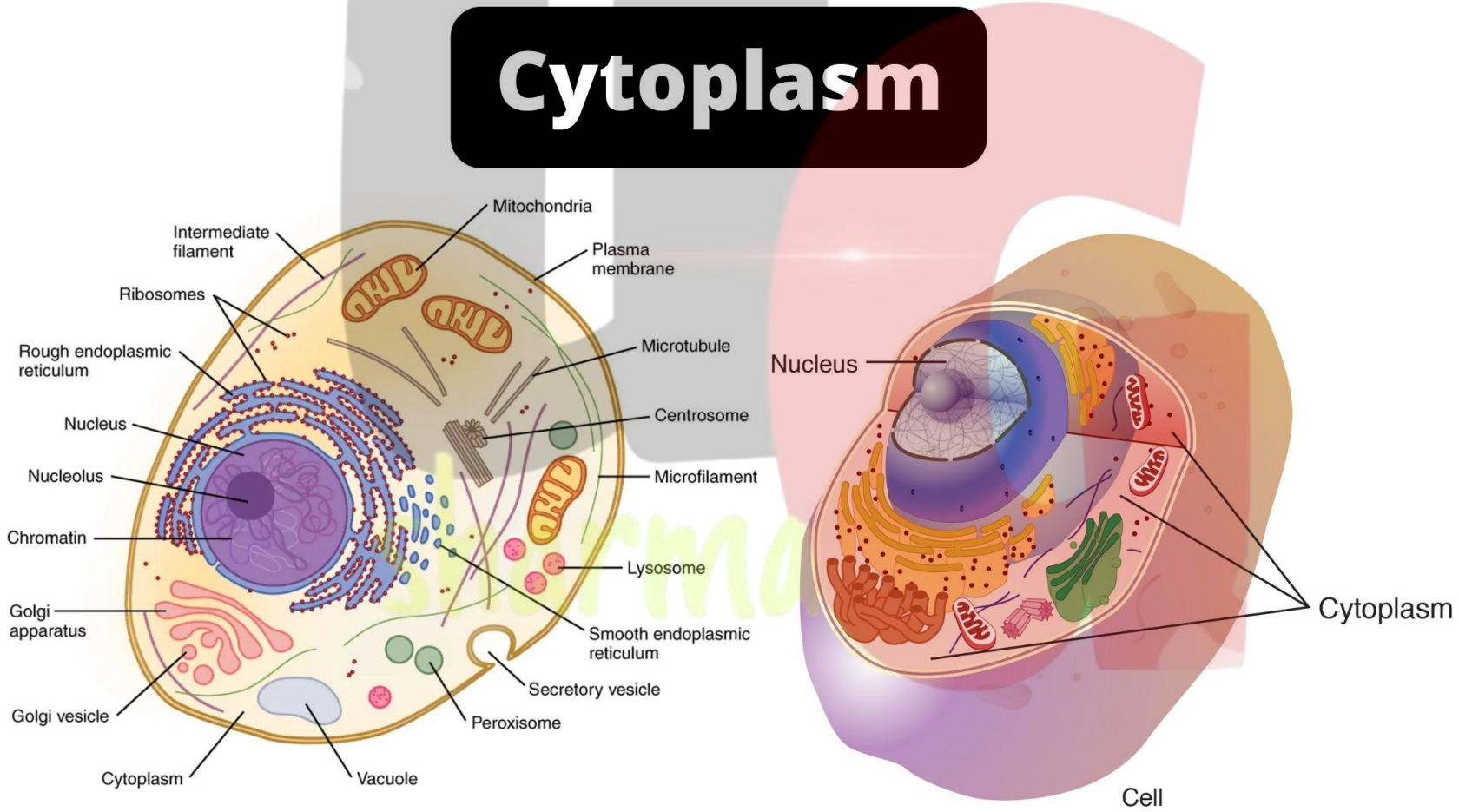
- Plasmolysis is the phenomenon by which a plant cell shrinks away from the cell wall when it loses water by osmosis.

OR, The phenomena of contraction of all the contents of the cell from cell wall during loss of water through osmosis is called plasmolysis.



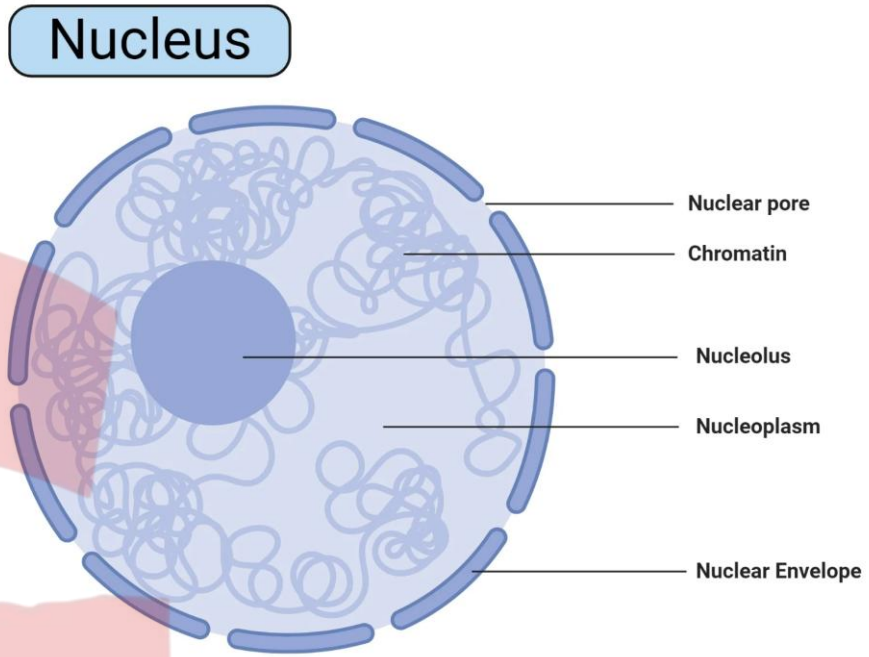
Cytoplasm

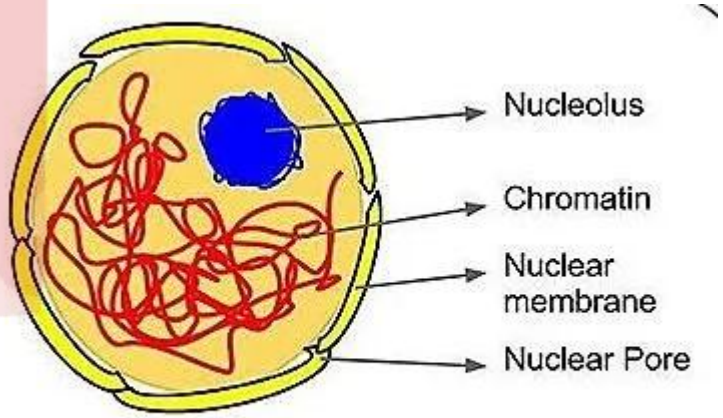
- The viscous fluid present inside the plasma membrane is called cytoplasm.
- Contains many specialised cell organelles.
- Each cell organelles are enclosed by membranes



Nucleus

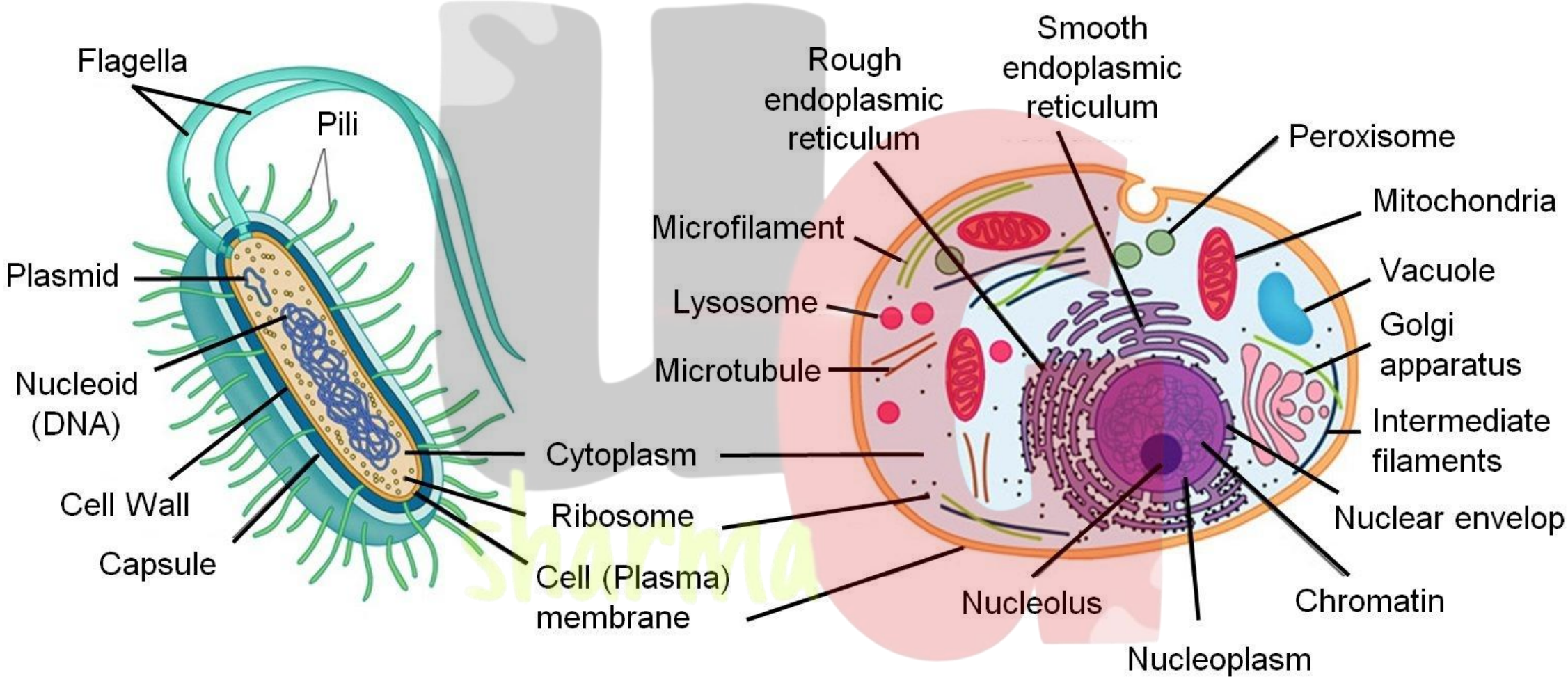
- The nucleus is a small, round and membrane bounded a structure found in cell.
- Fluid inside nuclear membrane is called nucleoplasm.
- It controls the cell growth and reproduction because it contains cell's hereditary information.
- It is covered by dual layer called nuclear membrane.
- Due to presence of pores in nuclear membrane, materials can travel from inner side to outer side i.e. cytoplasm.
- The nucleus contains some thread like structures called chromatin. It exists during resting stage of cell.
- Chromatin contain DNA (Deoxy-ribonucleic acid), RNA (Ribo nucleic acid) & proteins.
- The nucleus contains some rod shaped structure in a cell which contains hereditary information called chromosomes.
- Chromosomes are made up of DNA and nuclear proteins.
- Chromosomes are founded when chromatin condenses together just before cell division.





A Nucleus

EUKARYOTES Vs PROKARYOTES

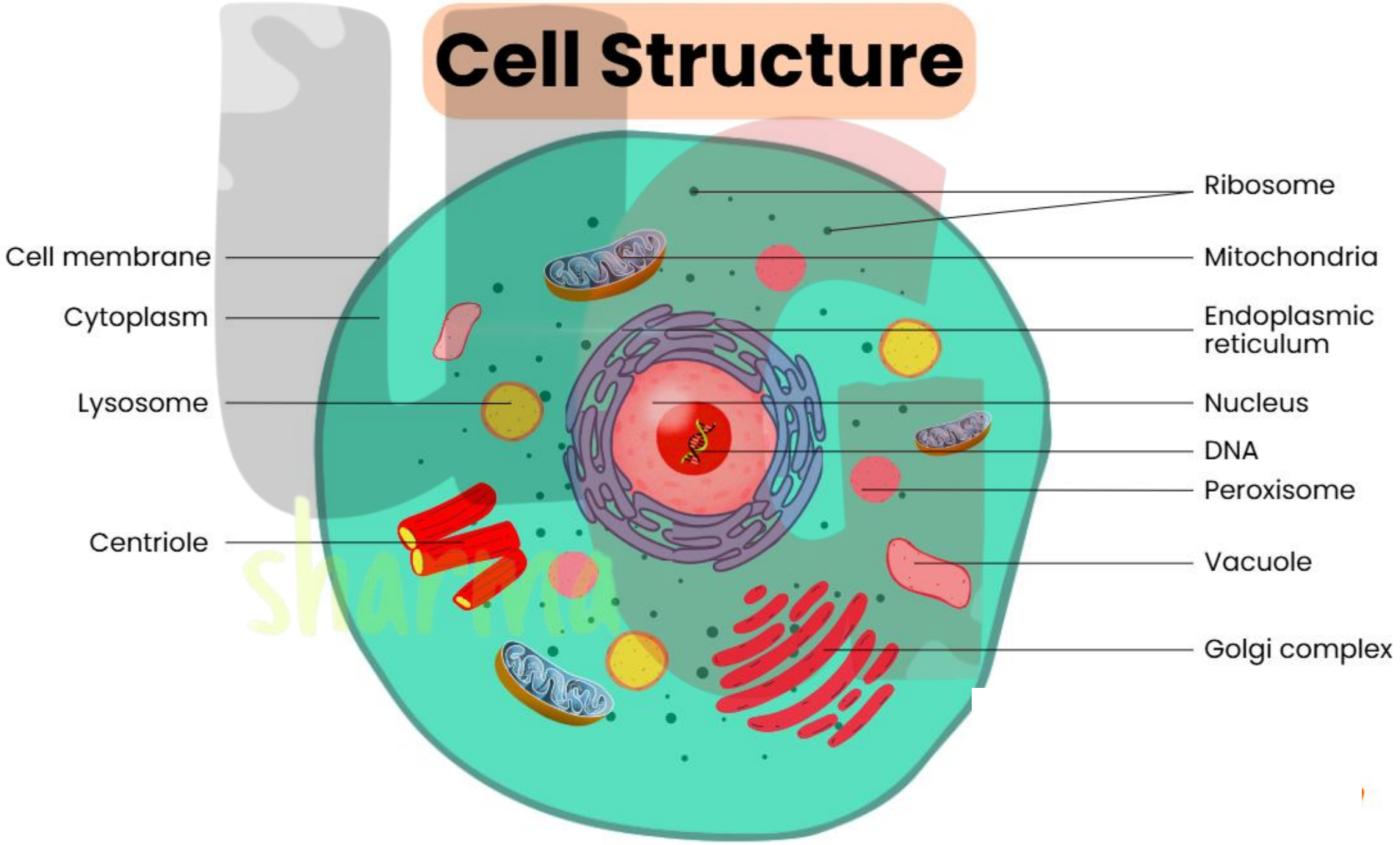


Eukaryotes **Prokaryotes**

Difference between prokaryotic and eukaryotic cell

Prokaryotes	Eukaryotes
Nucleus is **not well organized**	Nucleus is **well organized**
Nuclear membrane is **absent**	Nuclear membrane is **present**
They are **mostly single cellular**	They are **mostly multicellular**
Nucleolus is **absent**	Nucleolus is **present**
Cell organelles such as mitochondria, golgi bodies, ribosomes **are absent**	**Cell organelles** such as mitochondria, golgi bodies, ribosomes **are present**
Example - Blue green algae and Bacteria	**Example -** Animals, plants and other organisms

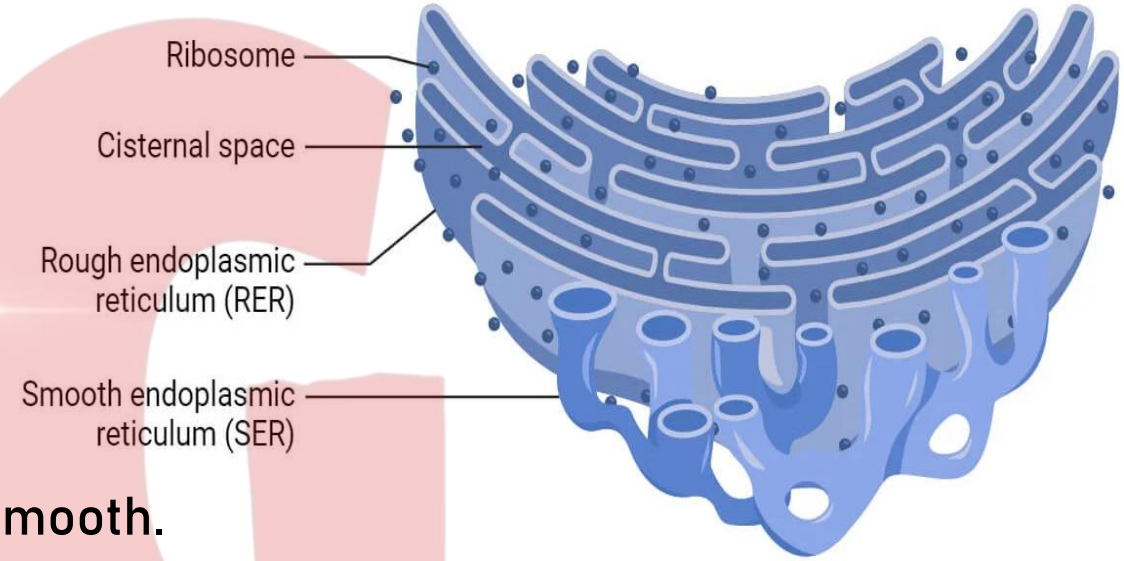
Cell organelles .



Endoplasmic reticulum

- ER is network of membrane present in cytoplasm (outside nucleus).
- Appears as network of tube.
- There are two types of ER :-

i. Smooth endoplasmic reticulum (SER)
ii. Rough endoplasmic reticulum (RER)



1. **Smooth endoplasmic reticulum** :-

- Made of tubules.
- Due to absence of ribosome on its surface, it is smooth.
- Manufacture of fats molecules or lipids.

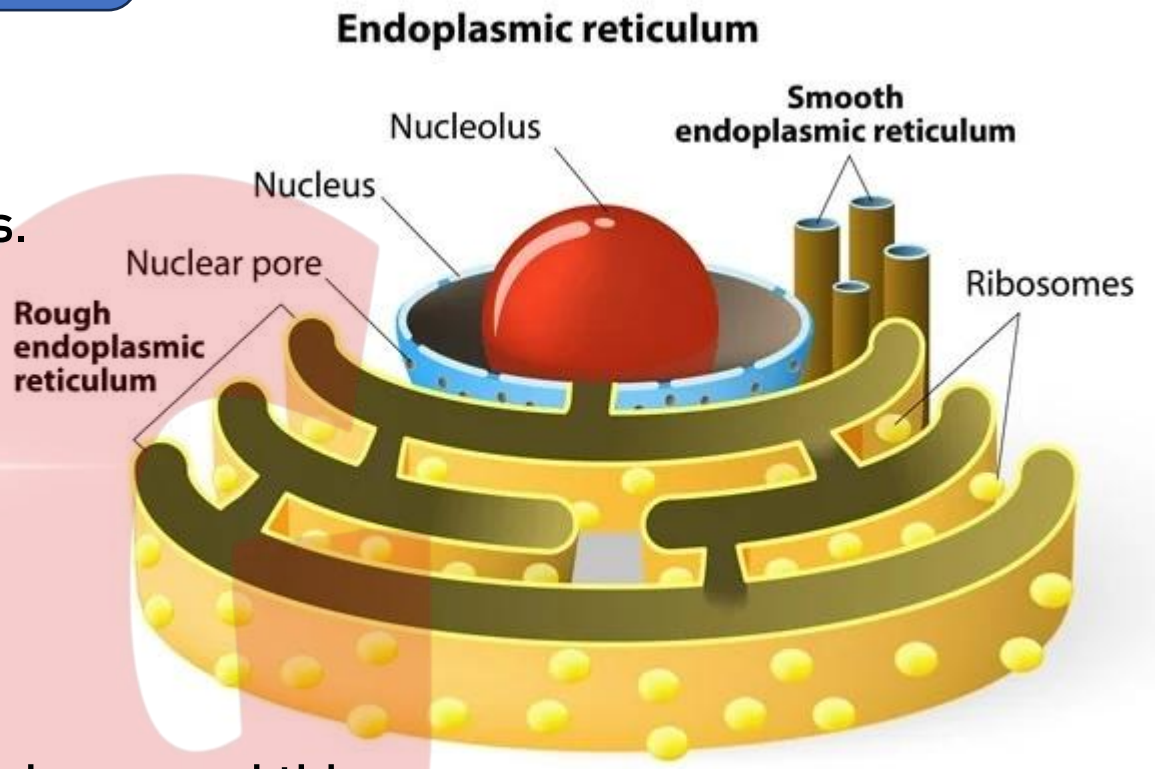
2. **Rough endoplasmic reticulum** :-

- Made up of vesicles.
- Due to presence of ribosome in its surface, it is rough.
- Manufacture of proteins (due to presence of ribosome)

Endoplasmic reticulum

❖ **Function of ER :-**

- Transport material between cytoplasm and nucleus.
- Some proteins and lipids are used to function as enzymes (biochemicals) and hormones
- SER help in detoxification of poisonous.
- ER form fats, steroid (protein), etc

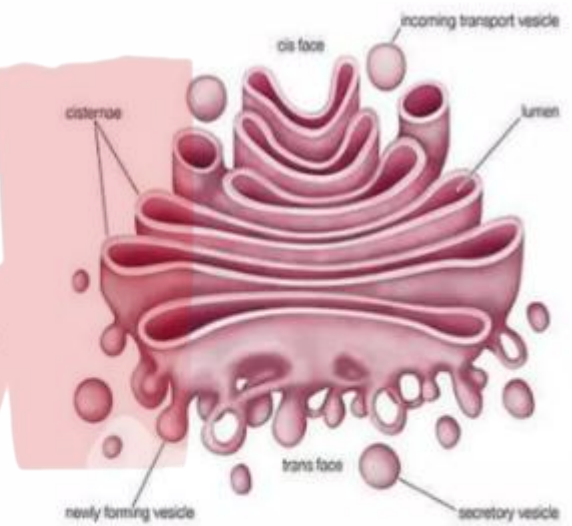


Some of proteins and lipids help in building cell membrane and this process is non as **membrane biogenesis**

Protein also sent to various places in cell depending on needs

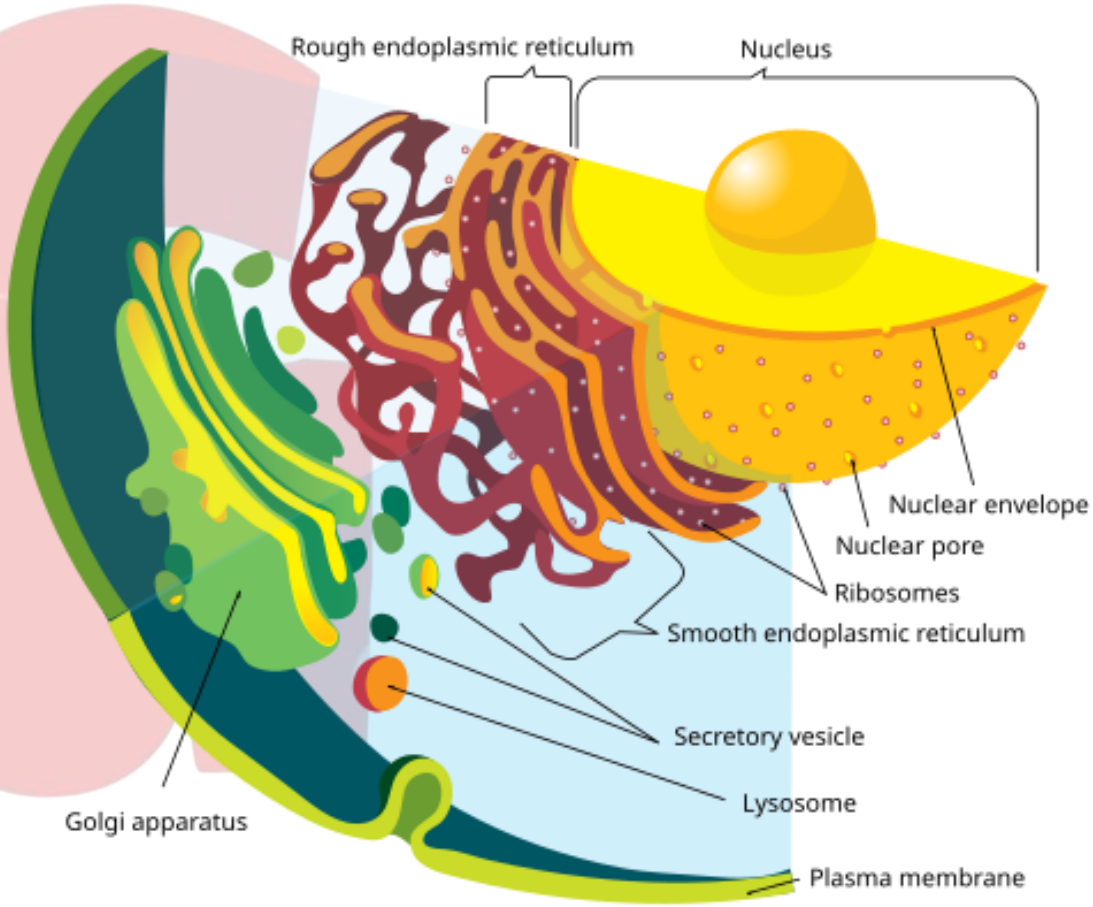
GOLGI APPARATUS

- First discovered by Camillo Golgi.
- It consist of a system of membrane- bound vesicles arranged parallel to each other in stacks called cisterns.
- The material synthesized near the ER is packaged and dispatched to various targets inside and outside the cell through the Golgi apparatus.
- Its functions include storage , modification and packaging of products in vesicles.
- Involved in the formation of the lysosome.



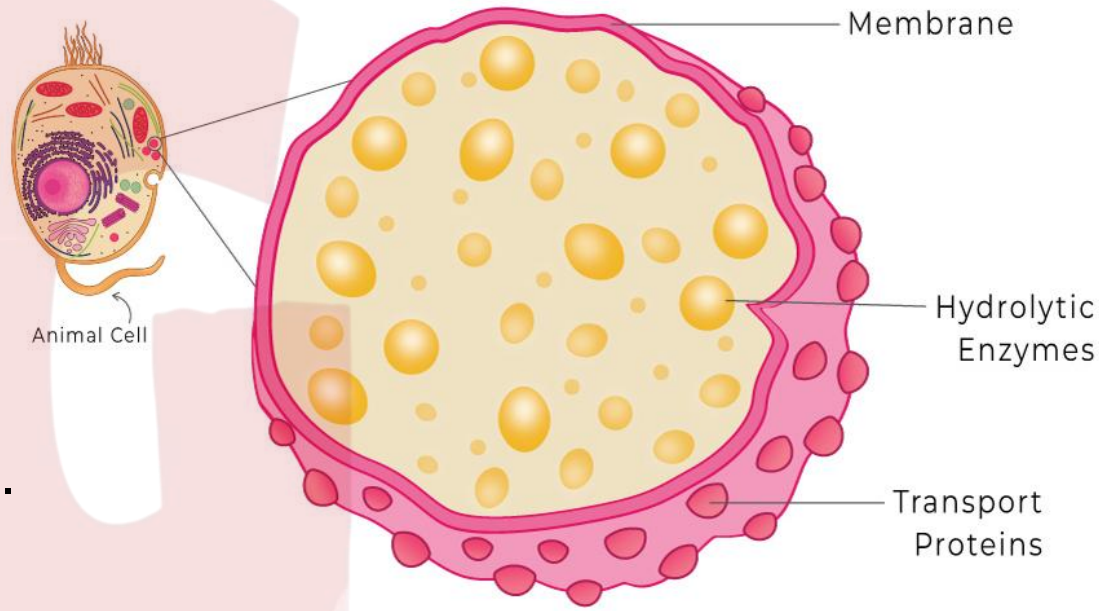
NOTE :- Connect to membrane of ER

The materials (as protein, lipid etc) formed in endoplasmic reticulum is transferred to Golgi apparatus it pack these materials and then transferred to different parts inside or outside the cell depends on requirement.



Lysosomes

- These are tiny like granules containing digestive enzymes.
- These digestive enzymes formed by SER.
- These are bounded by single membrane.



FUNCTIONS :-

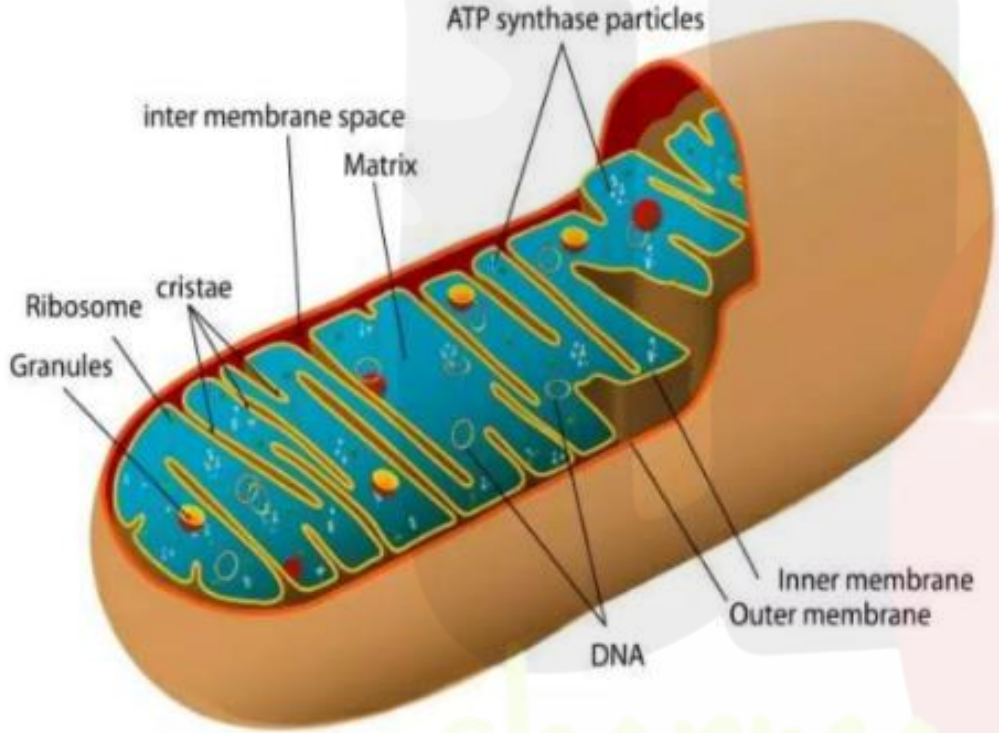
- The main function is digestion.
- They act as a kind of waste disposal.
- It helps in digestion of foreign & and cell materials.

Why lysosomes are called suicide bag of cell ?

The lysosome contain very powerful hydrolytic enzymes which are capable for breaking down organic matter. When a cell gets damaged then lysosome burst and enzymes digest there own cell. Hence, the lysosomes are known as ‘ suicide bags ‘ of cells.

MITOCHONDRIA

- Known as the powerhouse of the cell.
- The energy required for various chemical activities is released by the mitochondria in the form of ATP molecules.(Adenosine triphosphate).
- ATP is known as the energy currency of the cell.
- Mitochondria have two membrane coverings.
- Outer membrane is very porous.
- Inner membrane is deeply folded.
- Mitochondria are able to make their own proteins as they have their own DNA and ribosomes .



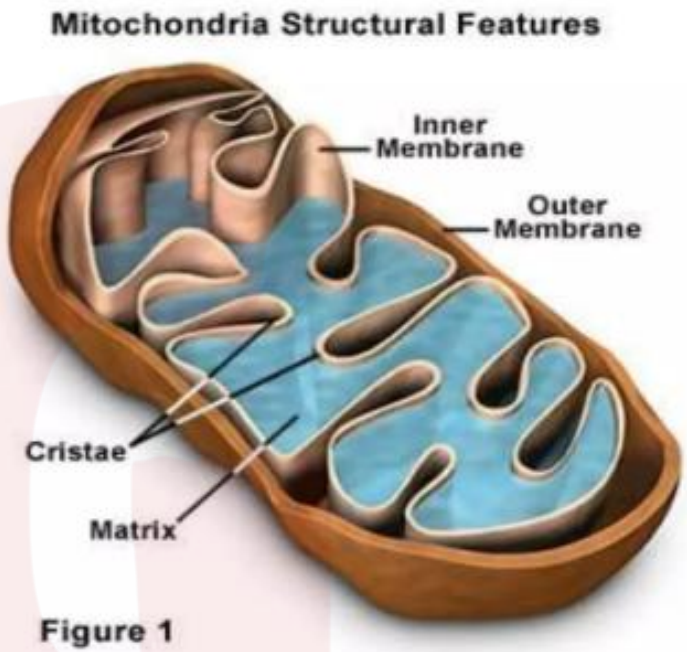


Figure 1

Mitochondria

PLASTIDS

- Plastid is a membrane-bound organelle found in the cells of plants, algae, and some other eukaryotic organisms.
- Present in plant cells.
- Two types- 1) Chromoplasts (coloured)
  2) Leucoplasts (colourless)
- Plastids containing green pigment chlorophyll are called Chloroplasts.
- Leucoplasts store materials as starch, oils and protein granules.
- Plastids contain membrane layers embedded in a material called stoma.
- Has a similar structure like the mitochondria.
- Have their own DNA and ribosomes.

VACUOLES

- Storage sac for solid or liquid contents.
- Small size vacuoles are present in animals.
- Large in plants.
- In plant cells, vacuoles are full of cell sap and provide turgidity and rigidity to the cell.
- Vacuoles store amino acids, sugars, various organic acids and some proteins.
- In Amoeba, the food vacuole contains the food items that the Amoeba has consumed.
- Vacuoles play an important role in expelling excess water and some wastes from the cell.

Ribosomes

- It is a minute particle consisting of RNA (ribonucleic acid)
- Ribosomes are the main sites of protein synthesis. And the protein transported by endoplasmic reticulum.

Cell Division

The process by which new cells are made is called cell division. Each new cells is known as daughter cell.
There are two main types of cell division, that is, mitosis and meiosis.

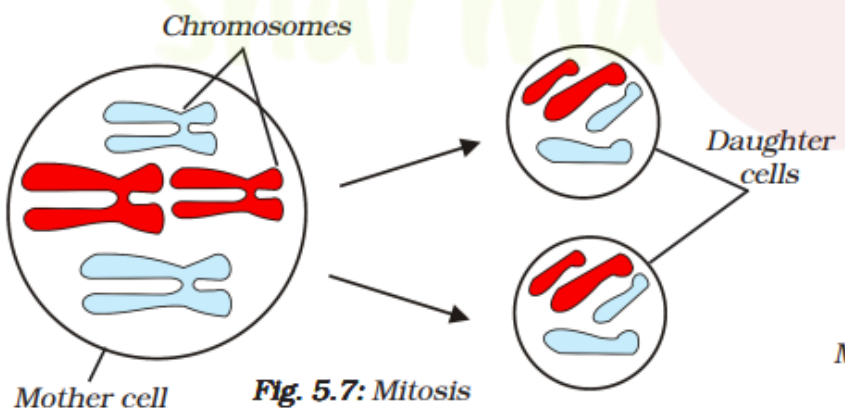


Fig. 5.7: Mitosis

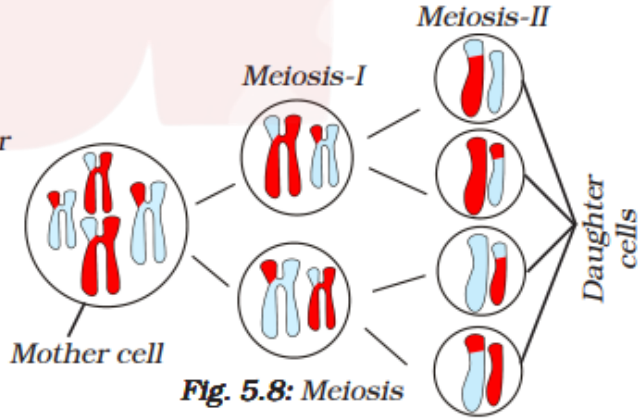
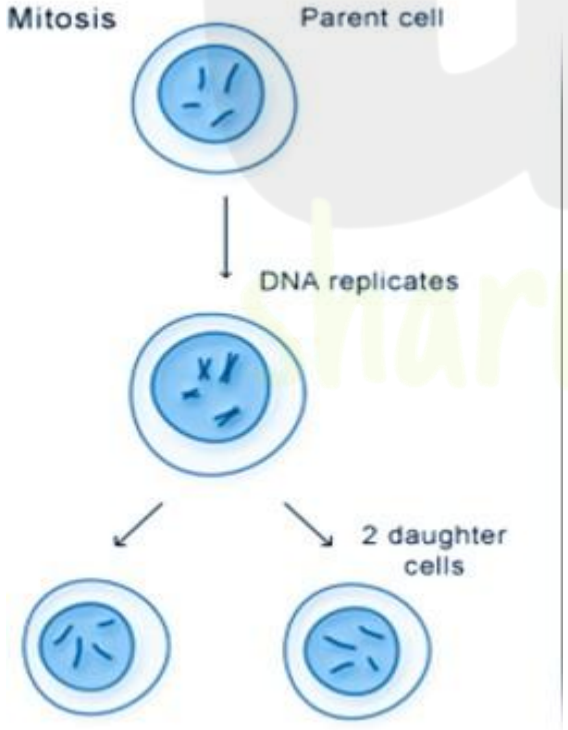
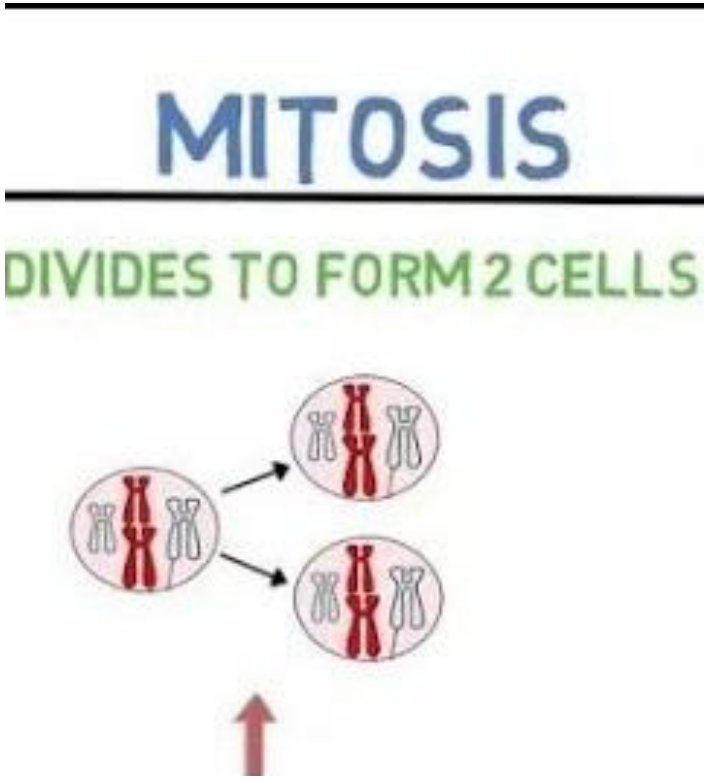


Fig. 5.8: Meiosis

Mitosis

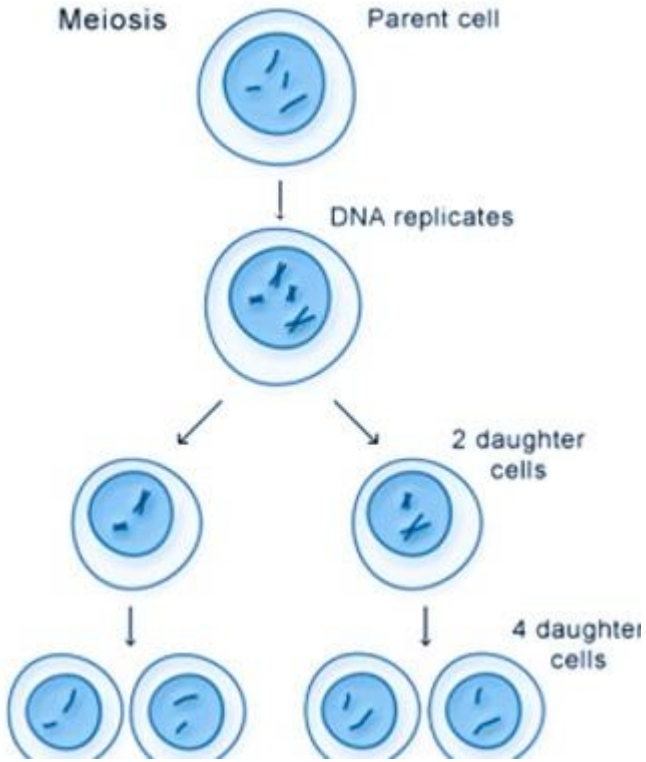
- The process of cell division by which most cells divide for growth is called mitosis.
- In this process, each cell, called the mother cell, divides to form two identical daughter cells.
- The daughter cells have the same number of chromosomes as the mother cells.
- Mitosis helps in the growth and repair of tissues in organisms.





Meiosis

- The process of cell division by which specific cells of reproductive organs or tissues in animals and plants divide to form gametes is called meiosis.
- When a cell divides by meiosis, it produces four new cells instead of just two.
- The new cells only have half the number of chromosomes as the mother cells.
- Meiosis helps in the production of gametes—sex cells, sperm, and eggs.



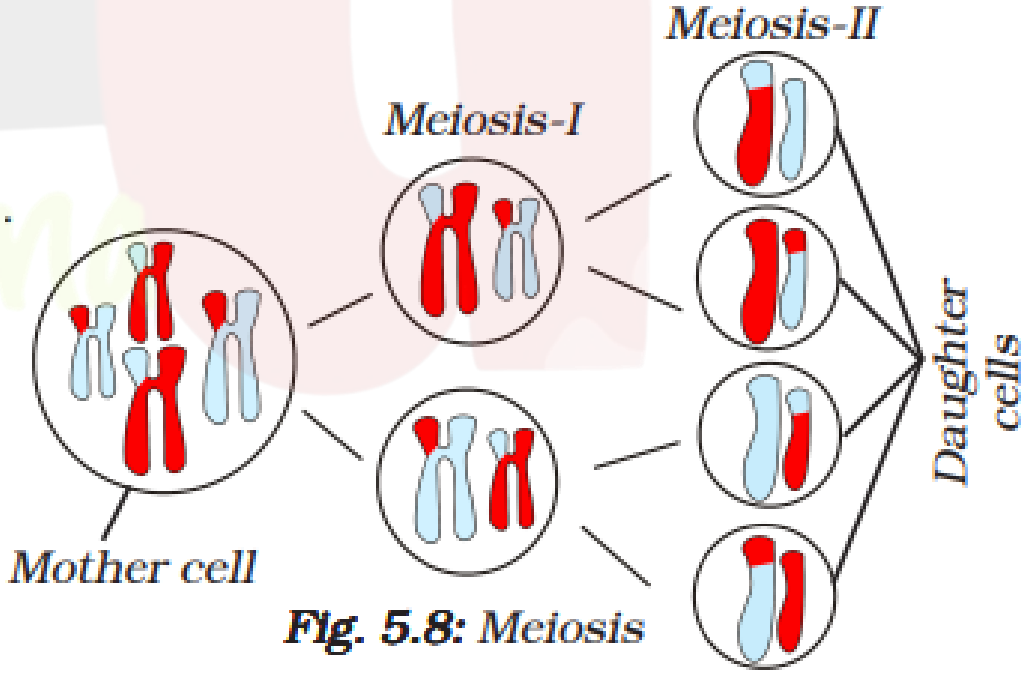
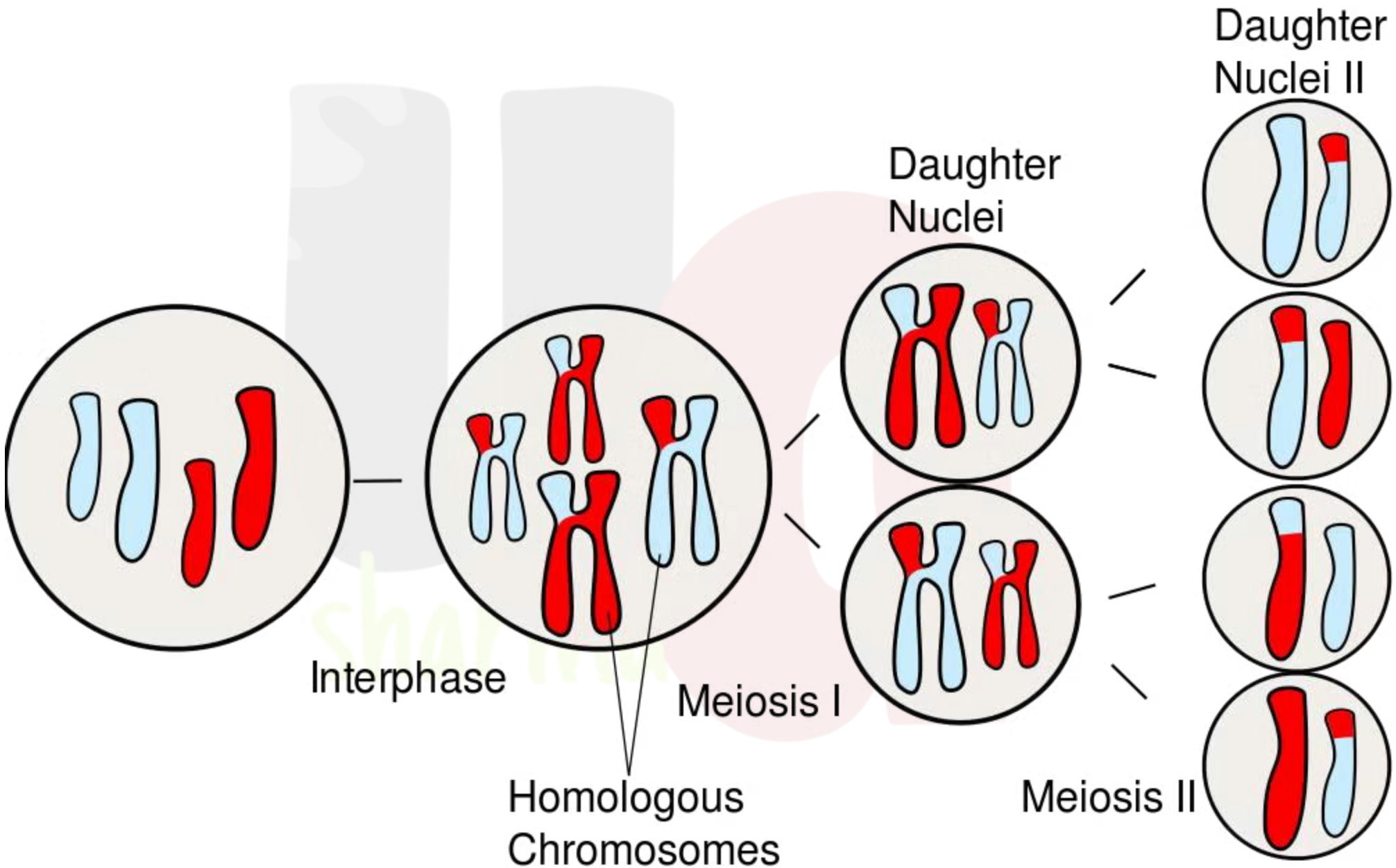
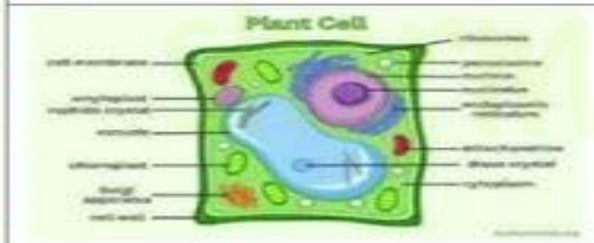
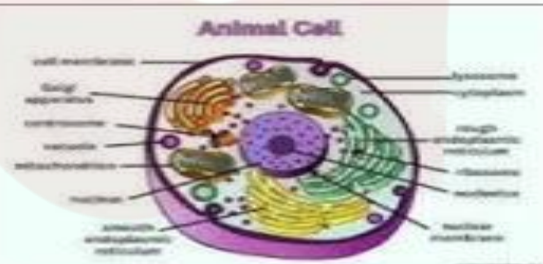


Fig. 5.8: *Meiosis*


Daughter
Nuclei II
Daughter
Nuclei
Interphase
Meiosis I
Homologous
Chromosomes
Meiosis II

Difference between plant cell and animal cell

Plant cell	Animal cell
1.A plant cell is usually large.	1.Animal cell is comparatively small in size
2.The cell wall is present	2.The cell wall is absent
3.Centrosome is absent	3.Centrosome is present
4.Vacuole large and prominent, one or more	4.Vacuole if any are small and temporary
5.Cytoplasm not so dense	5.Cytoplasm denser and more granular
6.Plastids present	6.Plastids absent
7.Nucleus is peripheral	7.Nucleus is present in the centre
	

Questions

1. *How do substances like CO_2 and water move in and out of the cell? Discuss.*
2. *Why is the plasma membrane called a selectively permeable membrane?*

Question

1. *Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.*

Prokaryotic Cell	Eukaryotic Cell
1. Size : generally small (1-10 μm) 1 μm = 10^{-6} m	1. Size: generally large (5-100 μm)
2. Nuclear region: _____ _____ and known as__	2. Nuclear region: well defined and surrounded by a nuclear membrane
3. Chromosome: single	3. More than one chromosome
4. Membrane-bound cell organelles absent	4. _____ _____ _____

Questions

1. *Can you name the two organelles we have studied that contain their own genetic material?*
2. *If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?*
3. *Why are lysosomes known as suicide bags?*
4. *Where are proteins synthesised inside the cell?*

Exercises

1. Make a comparison and write down ways in which plant cells are different from animal cells.
2. How is a prokaryotic cell different from a eukaryotic cell?
3. What would happen if the plasma membrane ruptures or breaks down?
4. What would happen to the life of a cell if there was no Golgi apparatus?
5. Which organelle is known as the powerhouse of the cell? Why?
6. Where do the lipids and proteins constituting the cell membrane get synthesised?
7. How does an *Amoeba* obtain its food?
8. What is osmosis?

9. Carry out the following osmosis experiment:

- Take four peeled potato halves and scoos each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now,
  - (a) Keep cup A empty
  - (b) Put one teaspoon sugar in cup B
  - (c) Put one teaspoon salt in cup C
  - (d) Put one teaspoon sugar in the boiled potato cup D.

  Keep these for two hours. Then observe the four potato cups and answer the following:
  - (i) Explain why water gathers in the hollowed portion of B and C.
  - (ii) Why is potato A necessary for this experiment?
  - (iii) Explain why water does not gather in the hollowed out portions of A and D.

10. Which type of cell division is required for growth and repair of body and which type is involved in formation of gametes?