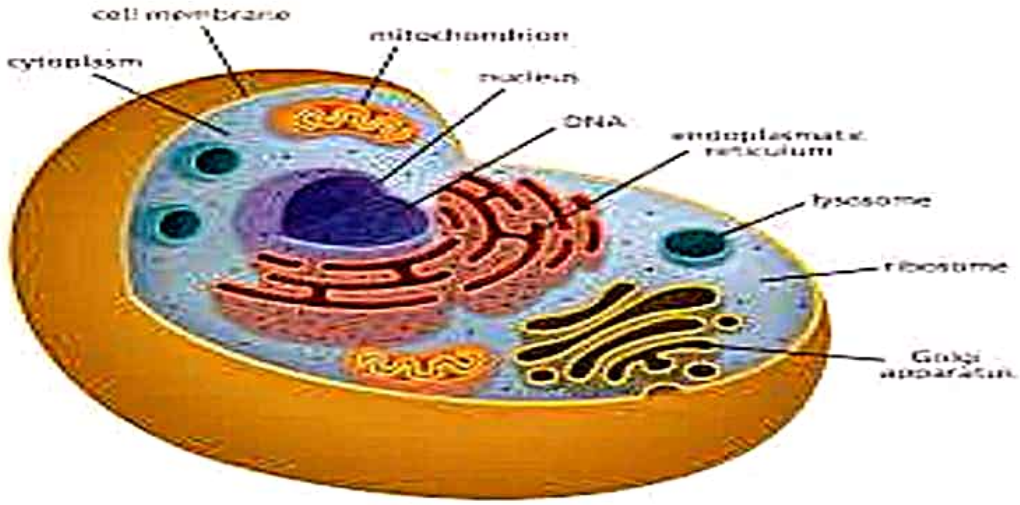
CELLS

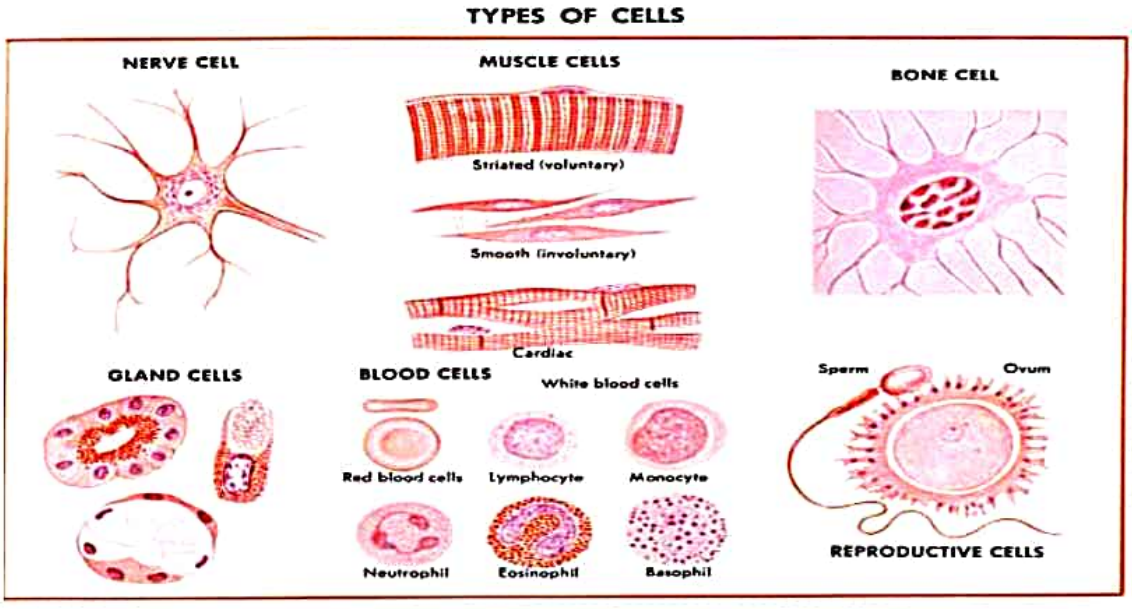
•The smallest functional unit of life is a cell, discovered by Robert Hooke in 1665.

• A cell can independently perform all necessary activities to sustain life.



•Hence cell is the basic unit of life.

•Inside the cell there are different parts performing different activities to keep the cell alive and functional. These part are called Cell Organelles.



•Dutch Microbiologist ANTONY VON LEEUWENHOEK who was the first to observe bacteria and protozoa.

•Leeuwenhoek made microscopes consisting of a single high-quality lens of very short focal length.

•J.E. Purkinje (1839) – first introduced the term 'Protoplasm'.

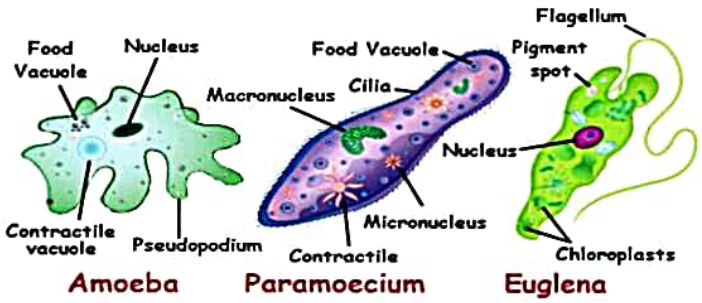
•Protoplasm is the living part of a cell that is surrounded by a plasma membrane.

Cells

- Cell is the fundamental unit of life .
- All the living organisms are made up of cell.
- It is the structural and functional unit of life because whole body is made up of cells.
- It is known as the fundamental unit of life because it regulates all the functions inside an organisms.
- The cell is a Latin word for "a little room".
- Robert Hook (1665) discovered Cell.

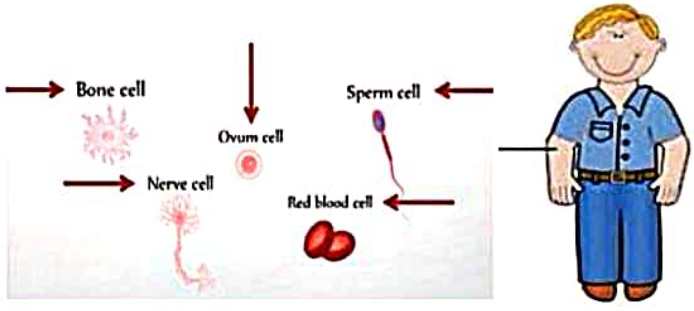
Unicellular Organisms:

- Composed of single cell.
- Single cell constitute the structure and entire function of the organisms.
- e.g. Amoeba, Paramoecium, Euglena.



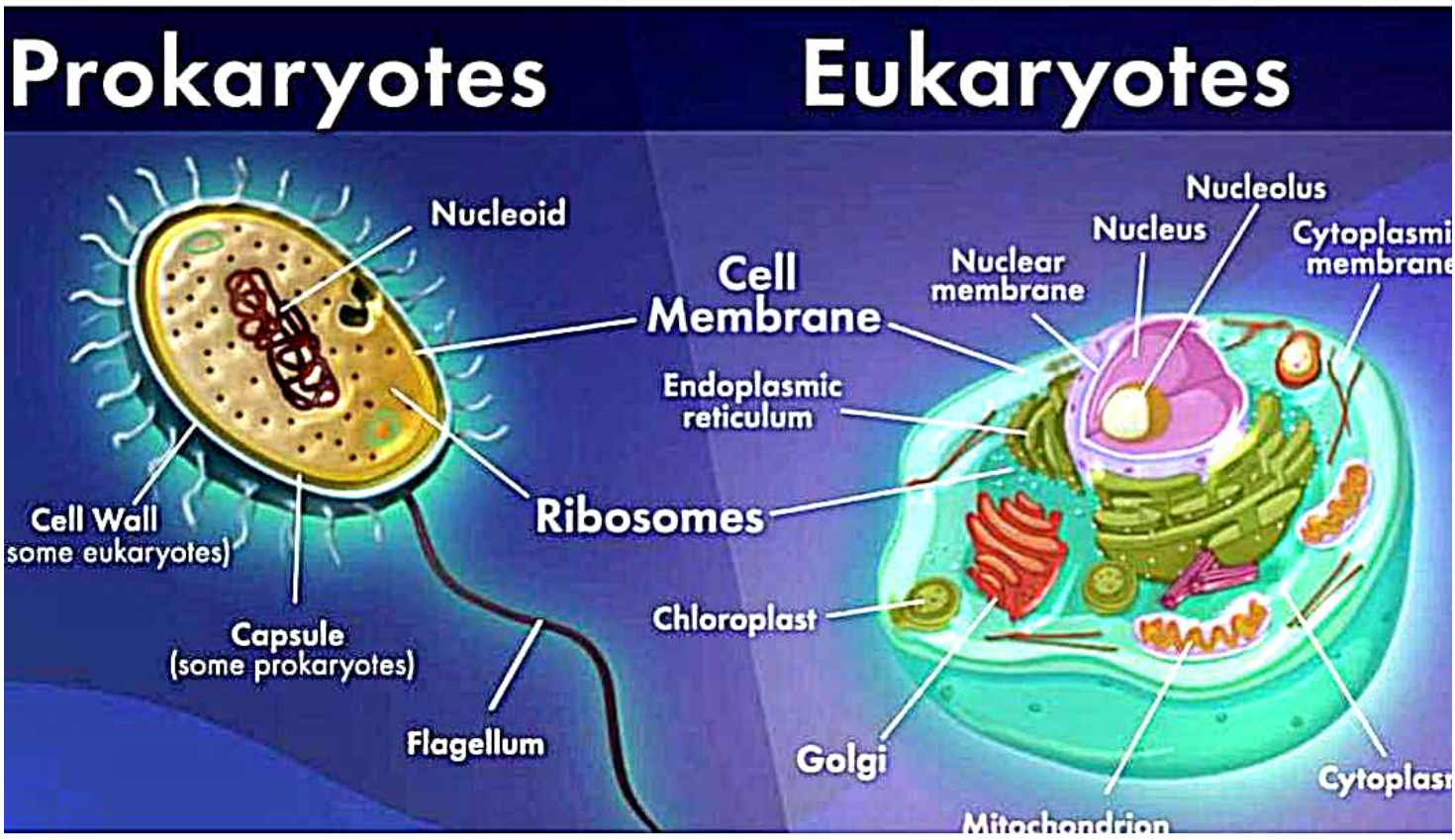
Multicellular Organisms:

- Composed of many cells
- Division of labour can be seen in these organisms
- e.g. plants , animals, human beings



DIFFERENCE BETWEEN PROKARYOTES & EUKARYOTES

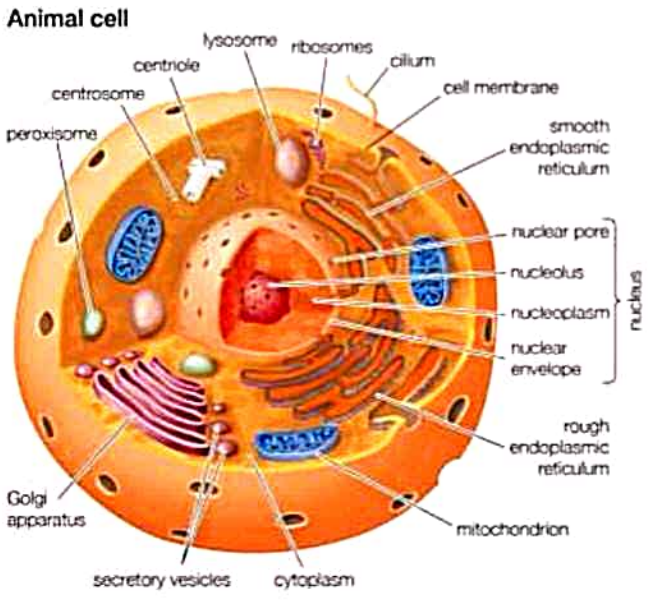
S.No.	Prokaryotes	Eukaryotes
(*i*)	Most prokaryotes are unicellular.	Most eukaryotes are multicellular.
(*ii*)	The nucleus is poorly defined due to the absence of a nuclear membrane.	The nucleus is well defined and is surrounded by a nuclear membrane.
(*iii*)	Nucleolus is absent.	Nucleolus is present.
(*iv*)	Cell organelles such as plastids, mitochondria, golgi bodies, etc. are absent.	Cell organelles such as plastids, mitochondria, golgi bodies, etc. are present.
(*v*)	Bacteria and blue-green algae are prokaryotic cells.	Fungi, plant, and animal cells are eukaryotic cells.

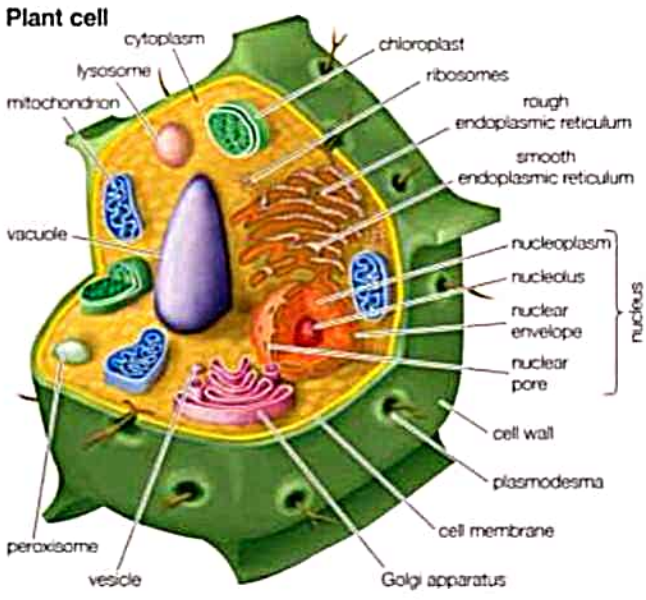


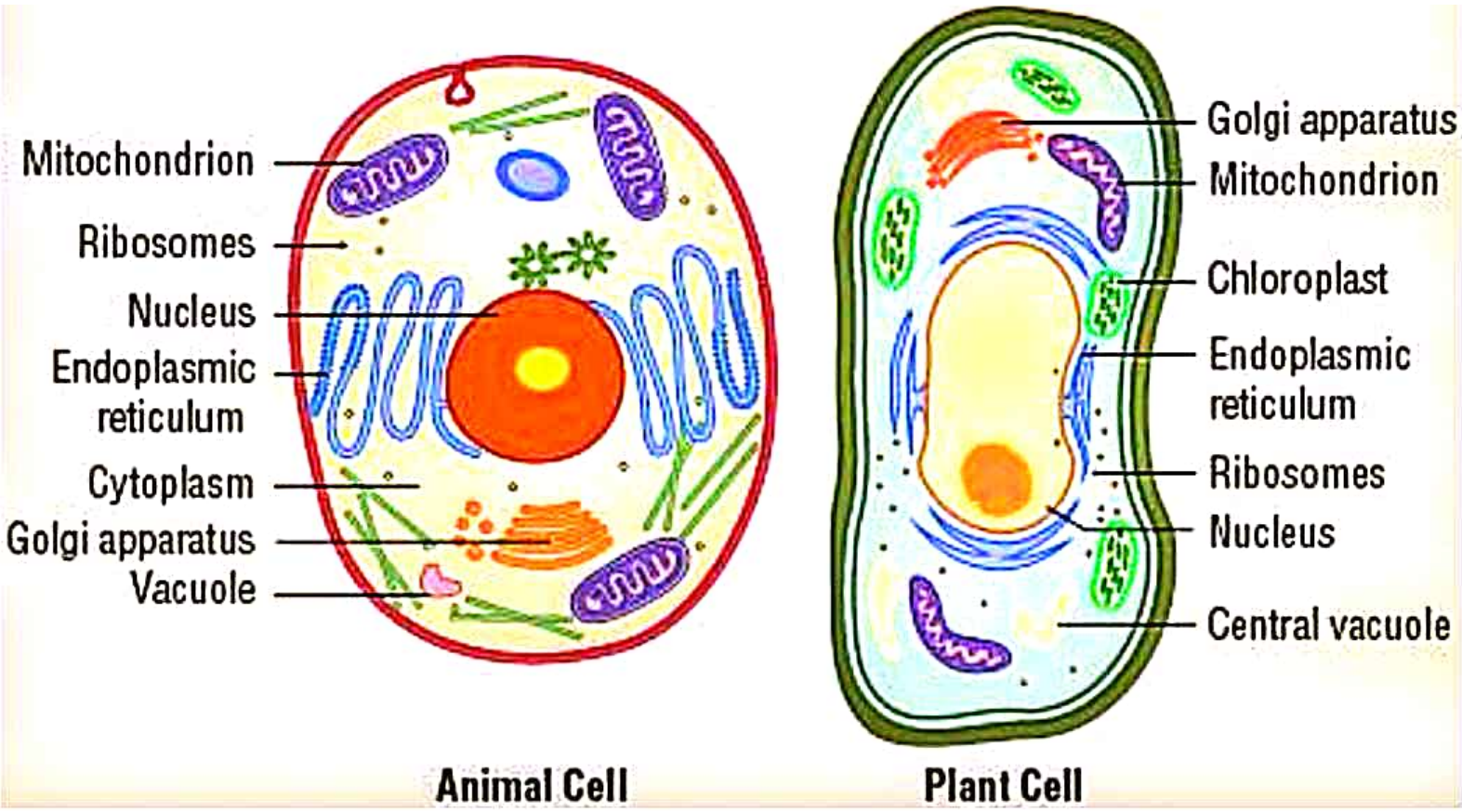
SIMILARITIES & DIFFERENCES BETWEEN ANIMAL & PLANT CELLS

ANIMAL CELL	Similarities	PLANT CELL
☐ Both have a nucleus, cytoplasm, plasma membrane, Golgi apparatus, mitochondria, endoplasmic reticulum and ribosomes		
ANIMAL CELL	Differences	PLANT CELL
Do not have fixed shape	Shape	Have fixed shape
Do not have cell wall	Cell wall	Have cell wall
Do not have vacuoles (or small)	Vacuoles	Large vacuoles
Do not have chloroplast	Chloroplasts	Have chloroplasts
Glycogen	Food storage	Starch
Have centrioles	Centrioles	Do not have centrioles

Structure of Animal & Plant Cell

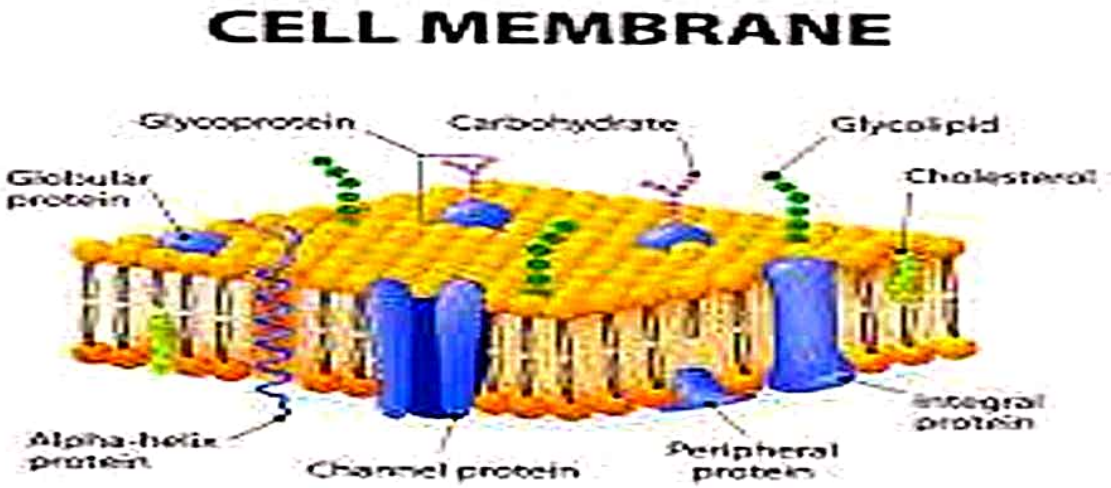





Mitochondrion
Ribosomes
Nucleus
Endoplasmic reticulum
Cytoplasm
Golgi apparatus
Vacuole
Golgi apparatus
Mitochondrion
Chloroplast
Endoplasmic reticulum
Ribosomes
Nucleus
Central vacuole
Animal Cell
Plant Cell

Various Cell Organelles & Their Functions:

1. Plasma/Cell membrane: This is the outermost covering of the cell that separates the contents of the cell from its external environment.



•It is a living part of the cell and is present in cells of plants, animals and microorganisms.

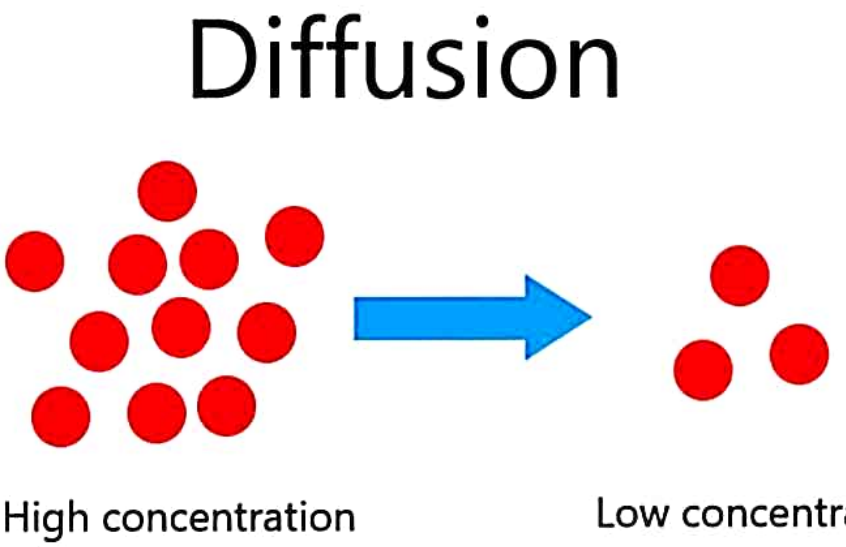
•It is composed of lipid and protein.

Function:

•As it is selectively permeable membrane, it allows the flow of limited substances in and ou of the cell.

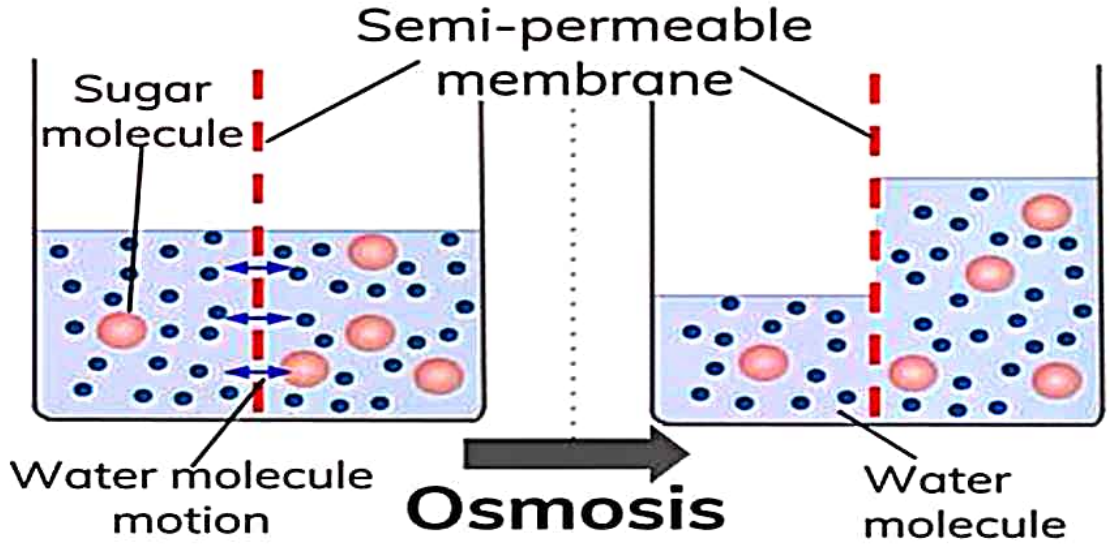
DIFFUSION:

Some substances like CO_2 or O_2 gases can move across the cell membrane by a process called diffusion.

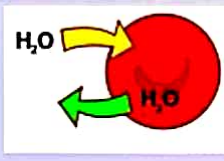
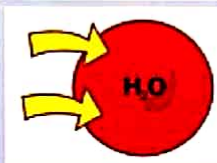


OSMOSIS:

The movement of water molecules (liquid) through such a selectively permeable membrane is called osmosis.



Hypertonic vs. Isotonic vs. Hypotonic 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
		

PLASMOLYSIS

When a living plant cell loses water through osmosis there is shrinkage or contraction of the contents of the cell, such a process is known as Plasmolysis. It takes place in a hypertonic solution ;and as its result a cell becomes shrunken in shape.

DEPLASMOLYSIS

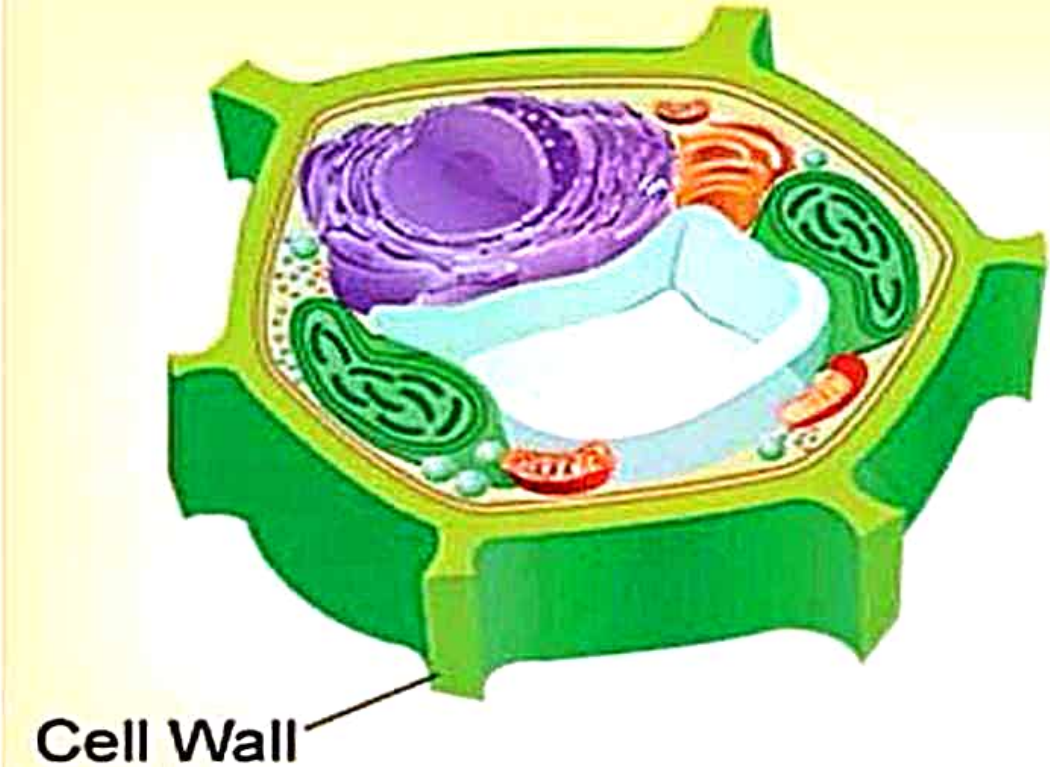
Deplasmolysis is the reverse of plasmolysis when a cell is placed in a hypotonic solution; and as its result a cell becomes turgid in shape.

2.CELL WALL

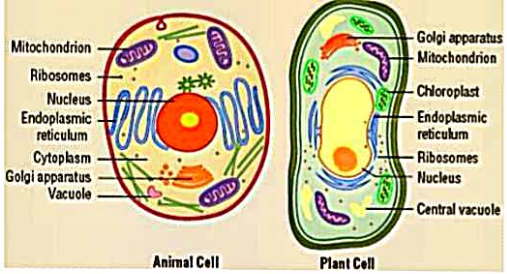
•Cell wall is non-living, thick and freely permeable covering made up of cellulose.

Functions:

•It determines the shape and rigidity to the plant cell.
•It helps in the transport of various substances in and out of the cell.



Cell Structure



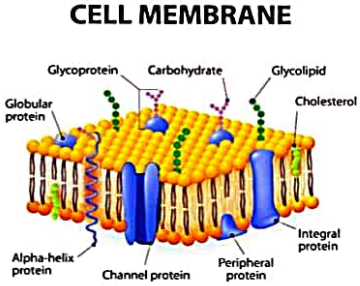
- Cells are made up of components called cell organelles.
- A cell is capable to live and perform all their respective functions due to the presence of cell organelles.
- The structure seen in almost every cell is same: Plasma membrane, nucleus and cytoplasm.

Cell Wall

- Found in plant cells outside the plasma membrane.
- Rigid covering made up of cellulose.
- Provide structural support to the plants.

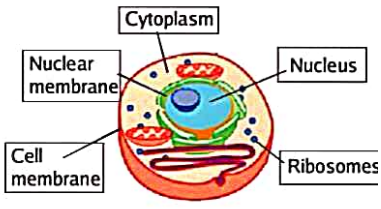
Plasma Membrane & its functions:

- It is the outermost covering of the cell.
- It is called as selective permeable membrane (because it prevents movement of some materials).
- It helps in diffusion and osmosis.
- Composed of bilayer of lipid and protein.



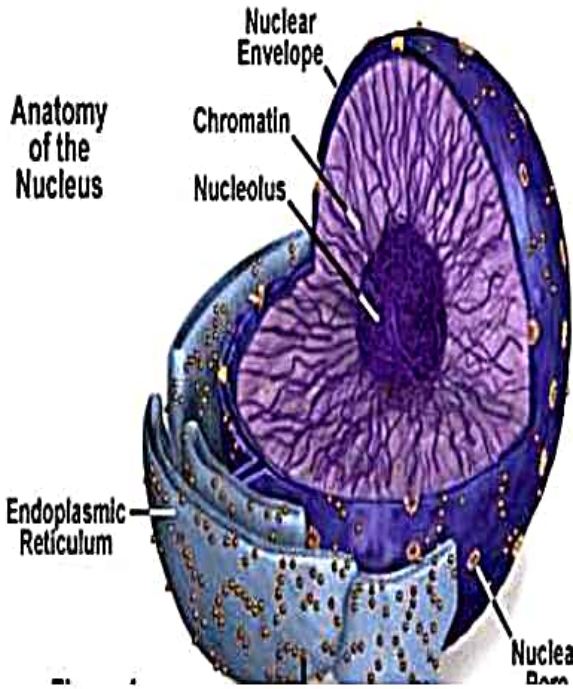
Cytoplasm

- Thick solution composed of water, salts and proteins that fills the cell.
- Surrounded by cell membrane.
- Nucleus of the cell is surrounded by the cytoplasm.



3.NUCLEUS

•Nucleus is dense and spherical organelle.
•Discovered by Robert Brown.
•Nucleus is bounded by two membranes, both forming nuclear envelope.
•Nuclear envelope contains many pores known as nuclear pores.
•The fluid which present inside the nucleus is called nucleoplasm.



Functions:

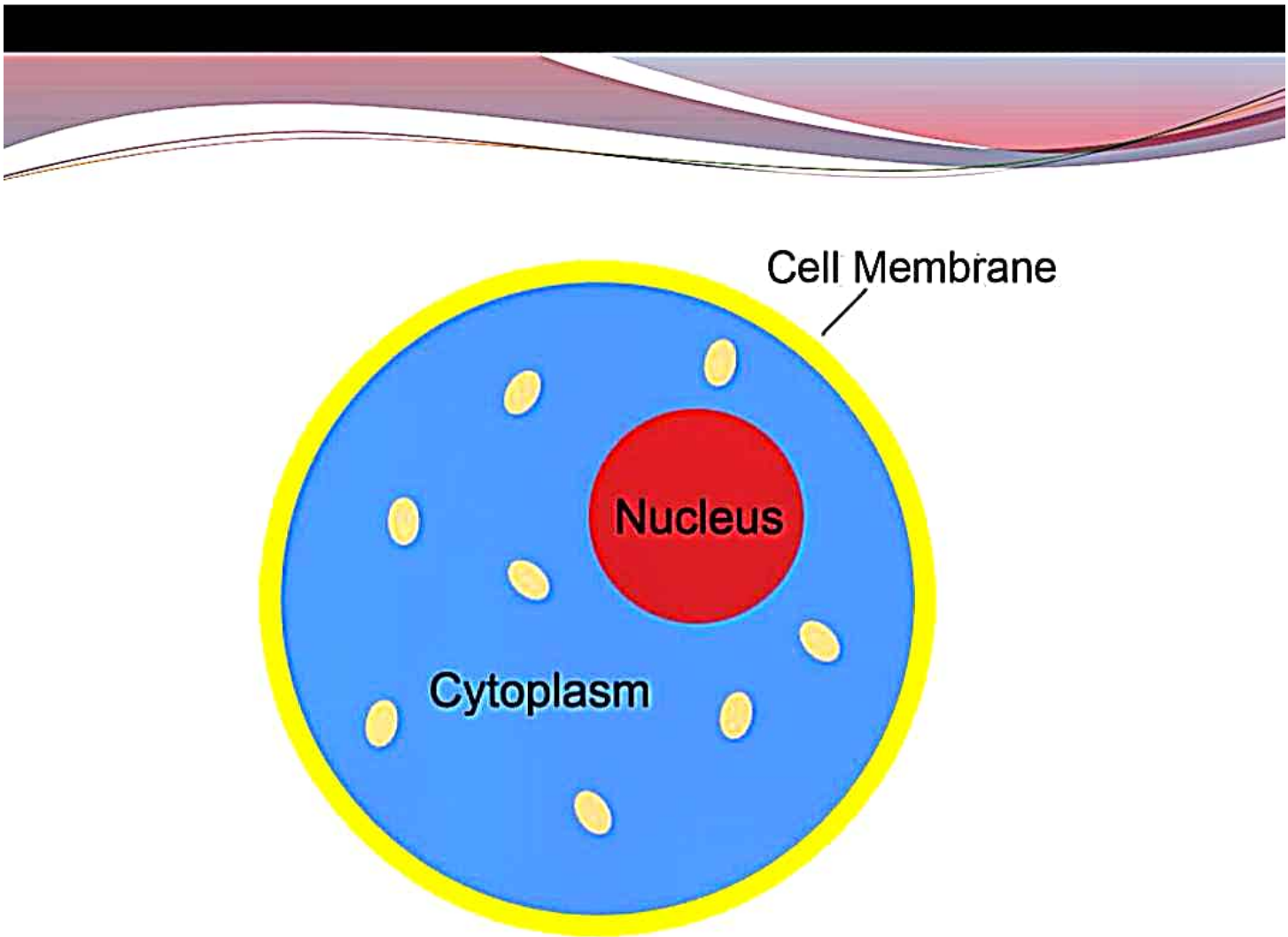
- Nucleus controls all the metabolic activities of the cell. Hence also called as ***"Brain of the Cell"***
- It regulates the cell cycle.
- Nucleus is the storehouse of genes. It is concerned with the transmission of hereditary traits from the parent to offspring.

(4.) CYTOPLASM

•It is a jelly-like, viscous, colourless semi-fluid substance that occurs between the plasma membrane and the nuclear membrane.

Functions:

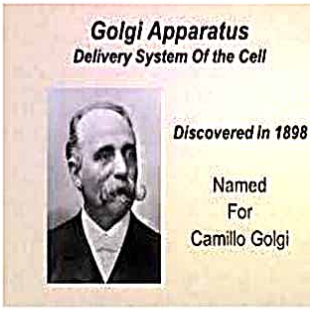
• Cytoplasm acts as a store of vital chemicals like amino acids, proteins, sugars, vitamins, etc.



5.GOLGI COMPLEX

•Golgi apparatus consists of a set of membrane bound, fluid filled vesicles, vacuoles and flattened cisternae (closed sacks).

•Golgi Apparatus discovered in 1898 by Italian physician Camillo Golgi during an investigation of the Nervous System.



•The sacs or folds of the Golgi apparatus are called cisternae.

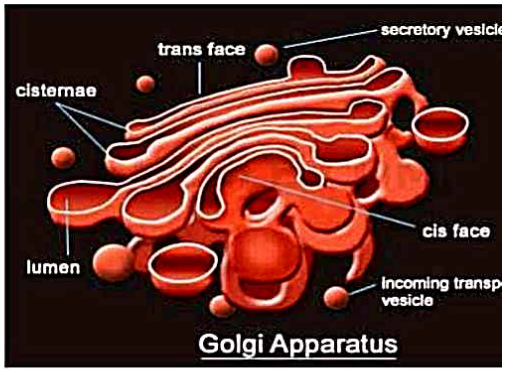
•In 1873 Italy, Camillo **Golgi** created the **Black Reaction** technique, which enabled scientists to stain and view the structure of neurons, the specialized cells that compose the nervous system.

•In this technique, cells are stained using potassium dichromate and silver nitrate. In 1873, Camillo Golgi used the chemical potassium dichromate to harden the tissue.

•Golgi received the highest honours and awards in recognition of his work. He shared the Nobel Prize for 1906 with **Santiago Ramón y Cajal** for their work on the structure of the nervous system.

Functions:

•It has been likened to the "***Cell's Post Office.***"



•A major function is the modifying, sorting and packaging of **proteins** for secretion. It is also involved in the transport of **lipids** around the **cell**, and the formation of lysosomes.

6.Lysosomes:

•Lysosomes are small, spherical, sac like structures which contain several digestive enzymes enclosed in a membrane.
•They are found in eukaryotic cells mostly in animals.

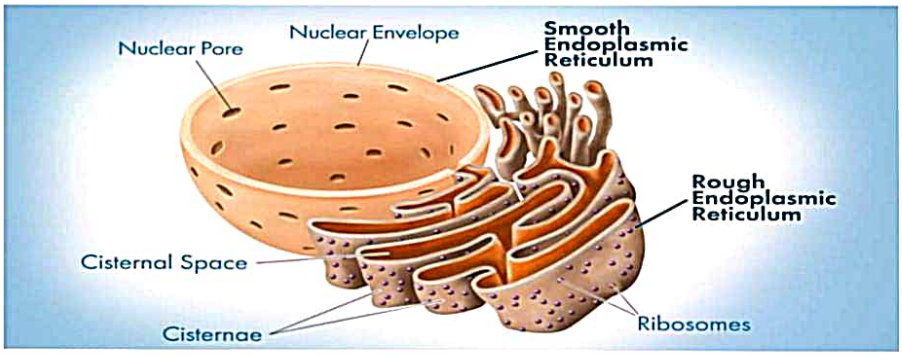
Functions:

•Lysosomes help in digestion of foreign substances and worn-out cell organelles.

•During the disturbance in cellular metabolism, for example when the cell gets damaged, lysosomes may burst and the enzymes digest their own cell.
Therefore, lysosomes are also known as*"Suicidal Bags"* of a cell.

7.Endoplasmic Reticulum

•It is a membranous network of tube like structures extending from nuclear membrane to plasma membrane.
•It is absent in prokaryotic cells and matured RBCs of mammals.



•There are two types of endoplasmic reticulum:
(i) Rough Endoplasmic Reticulum (RER): Here ribosomes are present on the surface for the synthesis of proteins.

(ii) Smooth Endoplasmic Reticulum (SER): Here ribosomes are absent and is meant for secreting lipids.

Functions:

•It helps in transport of various substances from nuclear membrane to plasma membrane or vice versa.

•RER helps in synthesis and transportation of proteins.

•SER helps in synthesis and transportation of lipids.

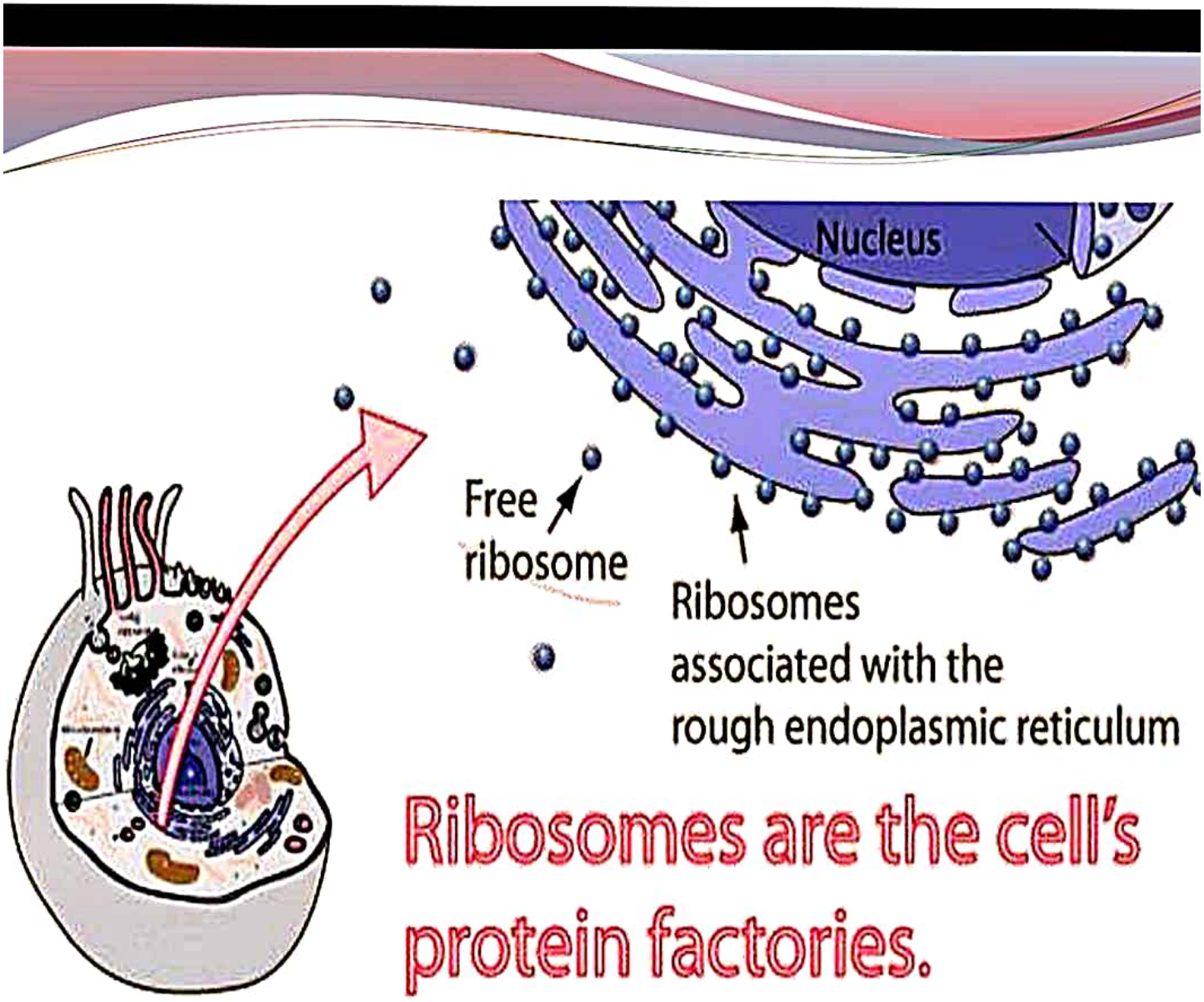
8.Ribosomes

•These are extremely small, dense and spherical bodies which occur freely in the matrix or remain attached to the endoplasmic reticulum.

•These are made up of ribonucleic acid (RNA) and proteins.

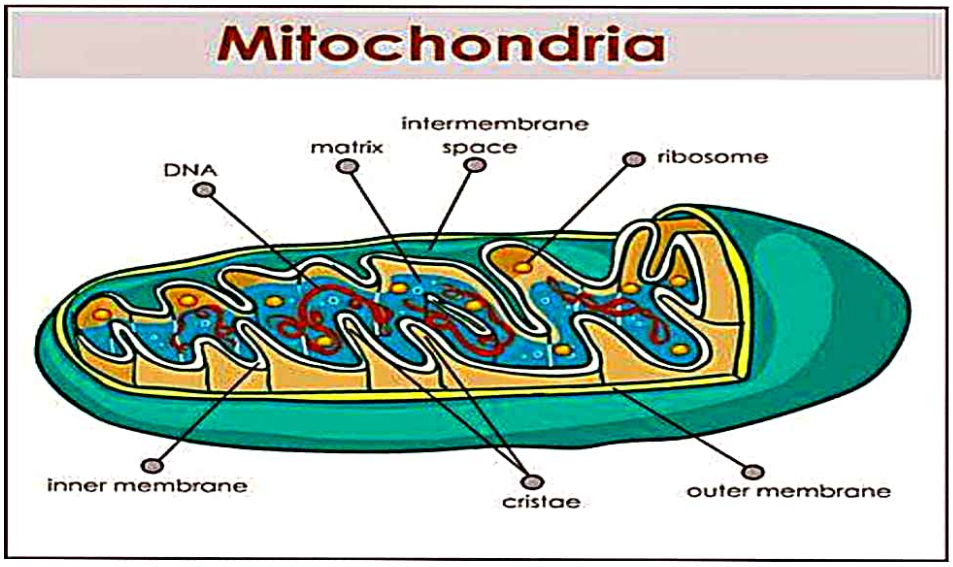
Function:

They play a major role in the synthesis of proteins.



9.Mitochondria

•Also called as *'Shoe-shaped Organelle'*
•It is a double membrane structure with outer membrane being smooth and porous whereas inner membrane being thrown into a number of folds called cristae.
•They contain their own DNA and ribosomes.

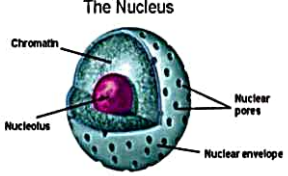


Functions:

•They are the sites of cellular respiration, hence provide energy for the vital activities of living cells.
•They store energy releases during reactions, in the form of ATP (Energy currency of the cell). Therefore, they are also called 'power house' of the cell.

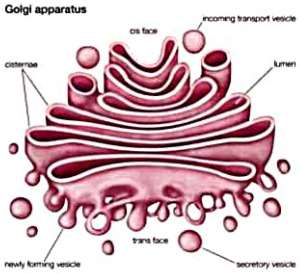
Nucleus

- Small, round and membrane bound structure near center of a cell.
- Fluid inside the nucleus in called nucleoplasm.
- Covered by double layer called nuclear membrane
- Plays a central role in cellular activities/reproduction.
- Nucleus contains thread like structure called chromatin material which gets condensed into chromosomes. The chromosomes contain information for inheritance of features from parents to next generations in the form of DNA(Deoxyribo Nucleic Acid) and protein molecules.
- The functional segments of DNA are called genes.



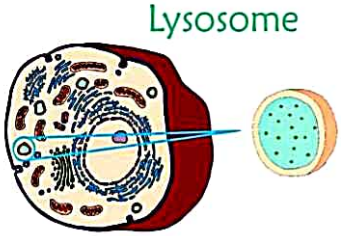
Golgi Apparatus

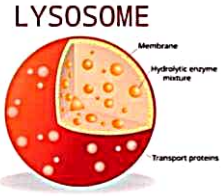
- First discovered by a scientist Camillo Golgi.
- It is a system of membrane bound vesicles called cisternae.
- It's function include the storage, modification and package of cell products.
- The complex sugars are made from simple sugars in the Golgi apparatus.
- It is also involved in the formation of lysosomes.



Lysosomes

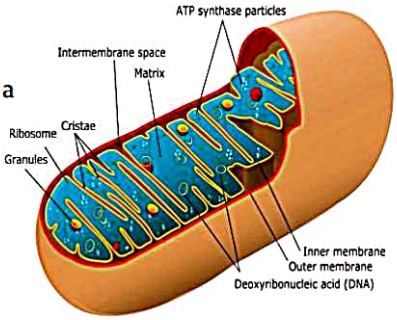
- Sac like structure in a cell surrounded by membrane
- contain powerful digestive enzymes(enzymes are made by RER) to digest the worn-out cell organelles, bacteria etc.
- When the cell gets damaged, lysosomes may burst and the enzymes digest their own cell, hence called as "**Suicidal bags of a cell**". It is a waste disposal system of the cell.





Mitochondria

- It is covered by a double membrane.
- Outer membrane is very porous and the inner membrane is deeply folded creating a large surface area for ATP (Adenosine Triphosphate) molecule synthesis.
- ATP is the energy currency of a cell; hence the Mitochondria are called as **Power House of a Cell.**
- Mitochondria have their own DNA and Ribosomes; therefore they can make their own proteins.

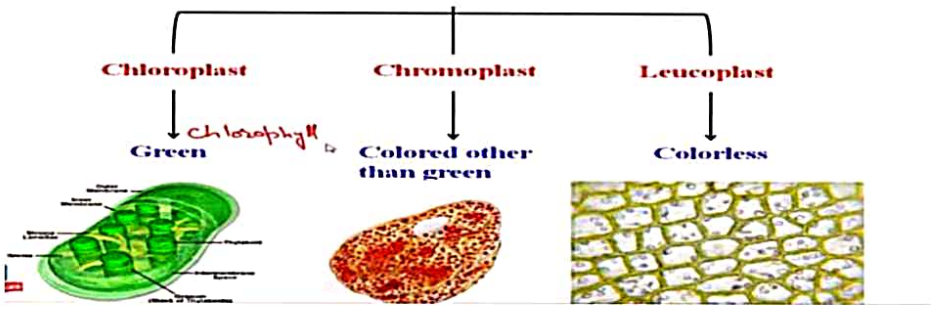


10.Plastids:

•Plastids are present in most of the plant cells and absent in animal cells.
•They are usually spherical or discoidal in shaped and double membrane bound organelles.
•They also have their own DNA and ribosomes.

Plastids are of three types:

(a) **Chloroplasts:** These are the green coloured plastids containing chlorophyll.
(b) **Chromoplasts:** These are the colourful plastids (except green colour).
(c) **Leucoplasts:** These are the colourless plastids.



Functions:

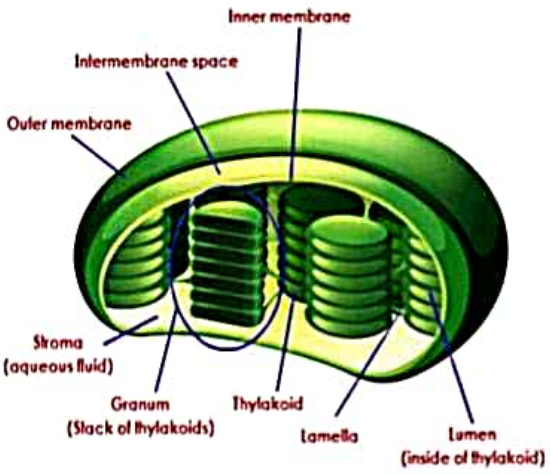
•Chloroplasts trap solar energy and utilise it to manufacture food for the plant.

•Chromoplasts impart various colours to flowers to attract insects for pollination.

•A leucoplast may also perform biosynthetic functions such as the synthesis of fatty acids, amino acids, and various other compounds and **storage** of starch, **lipids**, or **proteins**..

Plastids

- Double membrane bound structure
- present only in plant cells
- Have their own DNA and ribosomes
- Enfolding of membrane is called thylakoids and matrix is called stroma, seat for enzymatic actions



Three types of Plastids:

1. **Chromoplasts-** Colored Plastids: Contains various other pigment like yellow or orange.

2. **Leucoplasts :**White or colorless plastids; stores materials such as oils, proteins, fats etc.

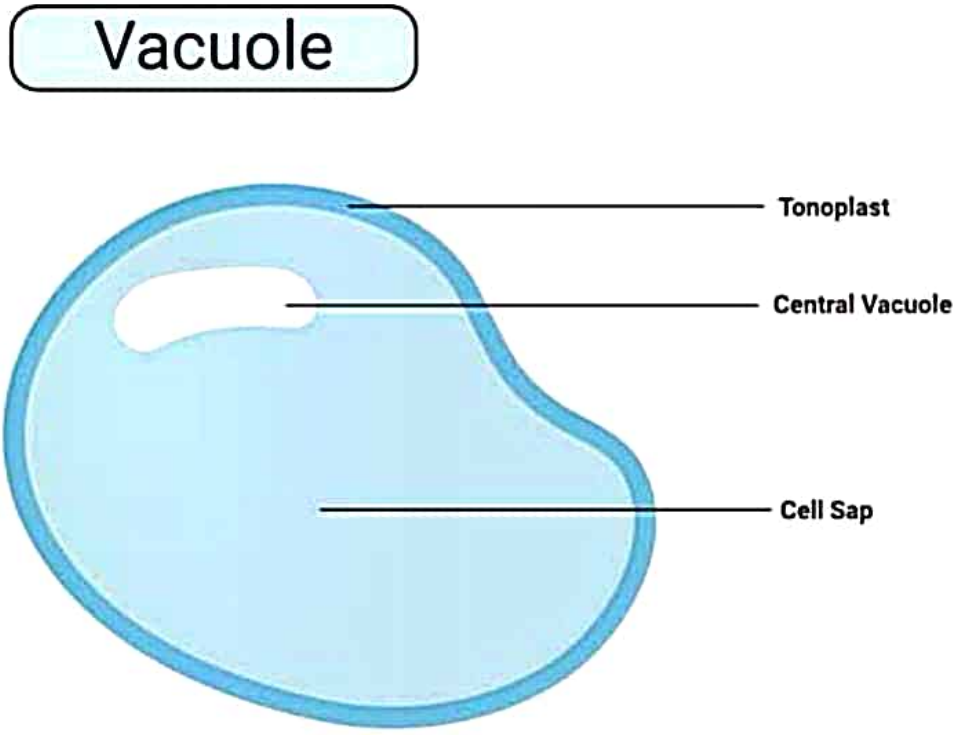
3.Chloroplasts – contain green pigment (chlorophyll) and useful in photosynthesis;

11.Vacuoles

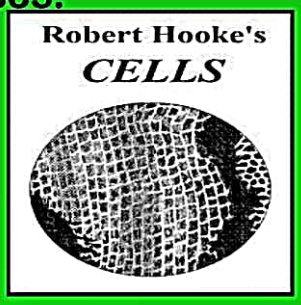
•Vacuoles are liquid/solid filled and membrane bound organelles.
•In plant cells, vacuoles are large and permanent. In animal cells, vacuoles are small In size and temporary.
•In mature plant cell, It occupies 90% space of cell volume.

Functions:

•They help to maintain the osmotic pressure in a cell.
•They provide turgidity and rigidity to the plant cell.



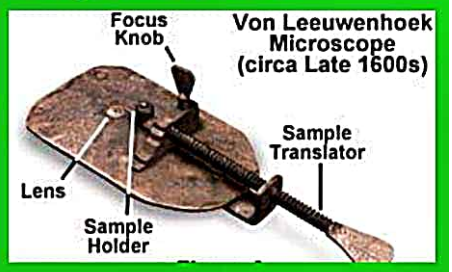
1.ROBERT HOOKE : The cell was first discovered and named by Robert Hooke in 1665.



- Hooke actually saw was the dead cell walls of plant cells (cork) as it appeared under the microscope.

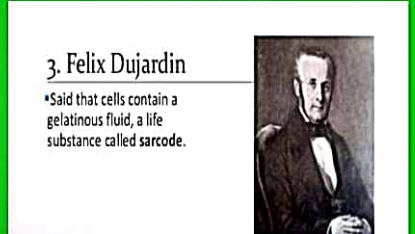
2.ANTONY VON LEEUWENHOEK:

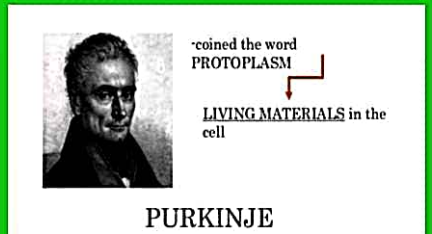
- Dutch microbiologist who was the first to observe bacteria and protozoa.
- Leeuwenhoek made microscopes consisting of a single high-quality lens of very short focal length.



3.PURKINJE & DUJARDIN :

- Dujardin (1835) – discovered the protoplasm and named as "sarcode". J.E. Purkinje (1839) – first introduced the term 'Protoplasm'.
- Protoplasm is the living part of a cell that is surrounded by a plasma membrane.
- Protoplasm contains the genetic material of a cell. It also controls the activity of the cell.





4.SCHLEIDEN & SCHWANN:

- **By the late 1830s, Botanist Matthias Schleiden and Zoologist Theodor Schwann were studying tissues and proposed the unified cell theory. The unified cell theory states that: all living things are composed of one or more cells; the cell is the basic unit of life; and new cells arise from existing cells**

M.J. Schleiden Theodor Schwann

5

5.RUDOLPH VIRCHOW:

Virchow is credited with several key discoveries. His most widely known scientific contribution is his cell theory, which built on the work of Theodor Schwann. ... Virchow's cellular theory was encapsulated in the epigram

"Omni cellula e cellula"

(all cells come from pre-existing cells), which he published in 1855.

6

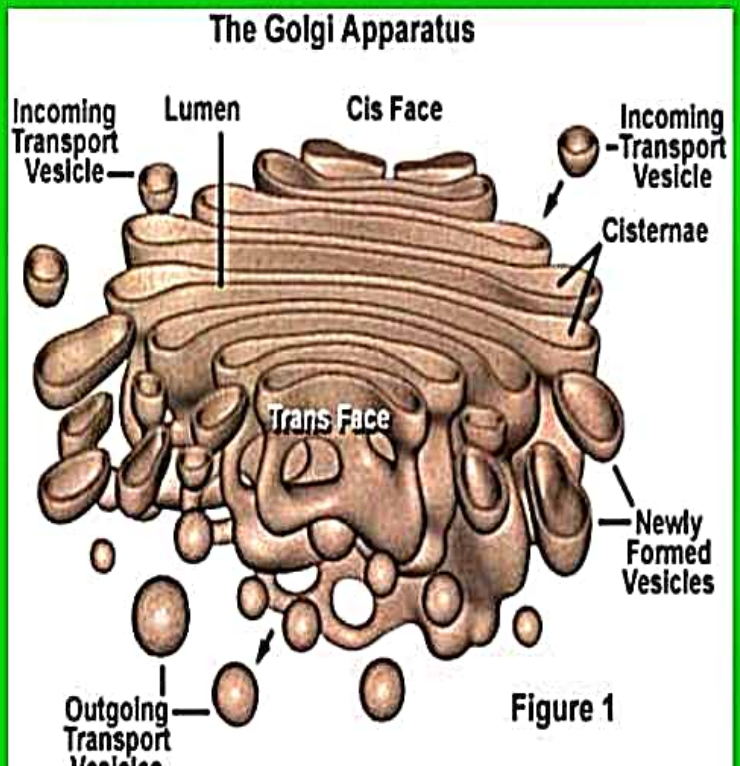
• 6.ROBERT BROWN :

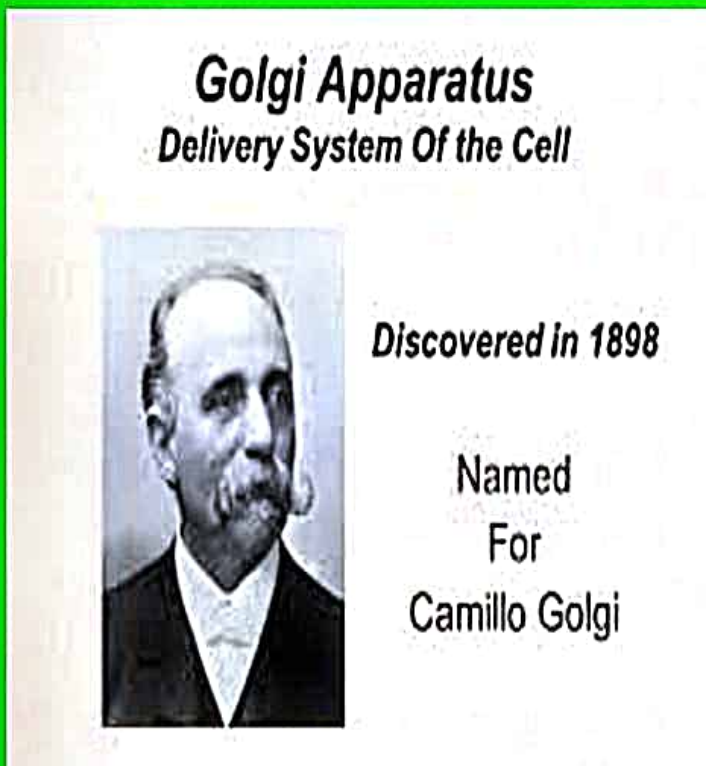
Scottish Botanist best known for his contributions of CELL'S NUCLEUS & of the continuous motion of minute particles in solution, which came to be called Brownian motion.

1831 – Robert Brown

- Saw central structure in plant cells, called this structure a nucleus

- **7.CAMILLO GOLGI:**
- **Golgi Apparatus discovered in 1898 by Italian physician Camillo Golgi during an investigation of the Nervous System.**
- **The Golgi body is an organelle found in most eukaryotic cells. ... The Golgi body has a number of functions, including sorting and processing proteins. Proteins are synthesized in the rough endoplasmic reticulum, then they travel to the Golgi body. While in the Golgi body, they are processed & packaged before being sent throughout the cell in various secretory processes.**





Q1.'Cell' is a Latin word which means...

a. a large room

b. a little room

c. An old room

d. None.

Answer: (b) A little room

Q2. Plant cell contains...

a. Chlorophyll

b. Cell wall

c. Nucleus

d. Plastid

e. All of the above.

Answer: (e) All of the above.

Q3. A plasma membrane is a selectively-permeable membrane while a cell wall is...

a. Semi-permeable b. fully-permeable

c. Selectively permeable d. Non-permeable.

Answer: a. Semi-permeable

Q4. Carbon dioxide moves out of the cell by the process.....

a. Osmosis b. Actively

c. Diffusion d. None of the above

Answer: c. Diffusion

Q5. A plasma membrane consists of:

a. Chitin

b. Cellulose

c. Protein and lipid

d. Fibre.

Answer: c. Protein and lipids.

The Fundamental Unit Of Life

Exercise-5.1 Page: 59

1. Who discovered cells, and how?

Solution:
in 1665, Robert Hooke discovered cells while examining a thin slice of cork through a self-designed microscope. He observed that the cork resembled the structure of a honeycomb consisting of numerous tiny compartments. The miniscule boxes are referred to as cells.

2. Why is the cell called the structural and functional unit of life?

Solution:
Cells form the structure of an entity. A group of cells form a tissue, further an organ and ultimately an organ system. They perform fundamental functions and life processes such as respiration, digestion, excretion etc in both unicellular and multicellular entities. They perform all the activities independently. Hence, cells are referred to as structural and fundamental units of life.

Exercise-5.2.1 Page: 61

3. How do substances like CO_2 and water move in and out of the cell? Discuss.

Solution:
CO_2 moves by diffusion - These cellular waste accumulates in high concentrations in the cell, whereas the concentration of CO_2 in the external surroundings is comparatively lower. This difference in the concentration level inside and out of the cell causes the CO_2 to diffuse from a region of higher(within the cell) to a lower concentration.

H_2O diffuses by osmosis through the cell membrane. It moves from a region of higher concentration to a lower concentrated region through a selectively permeable membrane until equilibrium is reached.

4. Why is the plasma membrane called a selectively permeable membrane?

Solution:
The plasma membrane is called as a selectively permeable membrane as it permits the movement of only a certain molecules in and out of the cells. Not all molecules are free to diffuse.

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Exercise-5.2.2-5.2.4 Page: 63

5. 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 2. Nuclear region: _____ _____ and known as _____ 3. Chromosome: single 4. Membrane-bound cell organelles absent.	1. Size: Generally l µm) 2. Nuclear region: defined and surrou nuclear membrane 3. More than one chromosome. 4. _____ _____ _____

Solution:

Prokaryotic Cell	Eukaryotic Cell
1. Size: Generally small (1-10 µm) 1 µm = 10^{-6}m 2. The nuclear region is poorly defined due to the absence of a nuclear membrane and known as the nucleoid. 3. There is a single chromosome. 4. Membrane-bound cell organelles absent.	1. Size: Generally large (5-100 µm) 2. Nuclear region: well defined and surrounded by a nuclear membrane. 3. There are more than one chromosomes. 4. Membrane-bound cell organelles present.

Exercise-5.2.5 Page: 65

6. Can you name the two organelles we have studied that contain their own genetic material?

Solution:

The two organelles which have their own genetic material are:

1. Mitochondria

2. Plastids

7. If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?

Solution:

In the event of any damage to cells and when revival of cells is not possible, Lysosomes burst and enzymes digest such cells. This is why lysosomes are often referred to as 'suicide bags'.

8. Why are lysosomes known as suicide bags?

Solution:

When there is damage to the cell and when revival is not possible, lysosomes may burst, and the enzymes digest their own cell. Consequently, lysosomes are known as suicide bags.

9. Where are proteins synthesised inside the cell?

Solution:

Protein synthesis in cells takes place in ribosomes. Hence, ribosomes are also referred to as protein factories. Ribosomes are particles that are found attached to the rough endoplasmic reticulum.

Exercise Page: 67

1. Make a comparison and write down ways in which plant cells are different from animal cells.

Solution:

The following table depicts the differences between plant cells and animal cells.

Characteristic	Plant Cell	Animal Cell
Cell wall	Present	Absent
Shape of cell	Distinct edges, shape is either rectangular or square shaped.	Round and irregular shape
Nucleus	Present. Lies on one side of the cell	Present. Lies in the center of the cell
Lysosomes	Rarely present	Always present
Plastids	Present	Absent
Structure of Vacuoles	Single or a few large vacuole that is centrally located	Presence of numerous and small vacuoles

2. How is prokaryotic cell different from a eukaryotic cell?

Solution:

The following are the differences between prokaryotic and eukaryotic cells.

Prokaryotic Cell	Eukaryotic Cell
1. Size: Generally small (1-10 µm) 1 µm = 10^{-6}m 2. The nuclear region is not well defined as the nuclear membrane is absent and is referred to as the nucleoid. 3. There is a single chromosome. 4. Membrane-bound cell organelles absent.	1. Size: Generally large (5-100 µm) 2. Nuclear region: well defined and girdled by a nuclear membrane. 3. There are more than one chromosomes. 4. Membrane-bound cell organelles present.

3. What would happen if the plasma membrane ruptures or breaks down?

Solution:

If plasma membrane ruptures or breaks down then molecules of some substances will freely move in and out of the cells. As plasma membrane acts as a mechanical barrier, exchange of material from its surroundings through osmosis or diffusion in a cell won't take place. Consequently, the cell would die due to the disappearance of the protoplasmic material.

4. What would happen to the life of a cell if there was no Golgi apparatus?

Solution:

The Golgi apparatus consists of stacks of membrane-bound vesicles whose functions are as follows:

- storage of substances
- packaging of substances
- manufacture of substances

Without the golgi apparatus, the cells will be disabled from packing and dispatching materials that were produced by the cells. The golgi apparatus is also involved in the formation of cells. Hence, in the absence of golgi apparatus, cells will not be produced.

5. Which organelle is known as the powerhouse of the cell? Why?

Solution:

Mitochondria are known as the powerhouse of the cell. It is because it releases the energy required for different activities of life. Mitochondria releases energy in the form of ATP(Adenosine triphosphate) molecules, essential for numerous chemical activities of life. Hence ATP is often referred to as 'energy currency of the cell'.

6. Where do the lipids and proteins constituting the cell membrane get synthesised?

Solution:

Lipids and proteins are synthesised in the ER [Endoplasmic Reticulum].

How does an Amoeba obtain its food?

Solution:

Through the process of endocytosis, an Amoeba obtains its food. As its cell membrane is flexible enough, food particles are engulfed forming a food vacuole girdling it which is assisted by the pseudopodia. Amoeba secretes digestive enzymes to bring about digestion of the engulfed particle once food is trapped.

9. Carry out the following osmosis experiment:

Take four peeled potato halves and scoop 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.

Solution:

(i) Water accumulates in the hollowed portions of B and C as a difference in the water concentration

is observed. Thereby, endosmosis occurs as the cells act as a semipermeable membrane.

(ii) Potato A is essential in this experiment as it is significant to compare different scenarios seen in

potato cups B, C and D. The potato A in this experiment clearly shows that the potato cavity on its

own cannot bring about water movement.

(iii) Cup in A does not show any change in the water flow concentration for osmosis to occur, which

requires the concentration to be higher than the other. Cells in cup D are dead, thus there is no

existence of a semipermeable membrane for water flow. Consequently, osmosis does not occur.

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

Solution:

There are two ways in which a cell divides:

- Mitosis
- Meiosis

Mitosis is the type of cell division that is involved in the growth and repair of body whereas meiosis is a type of cell division which results in the formation of gametes.