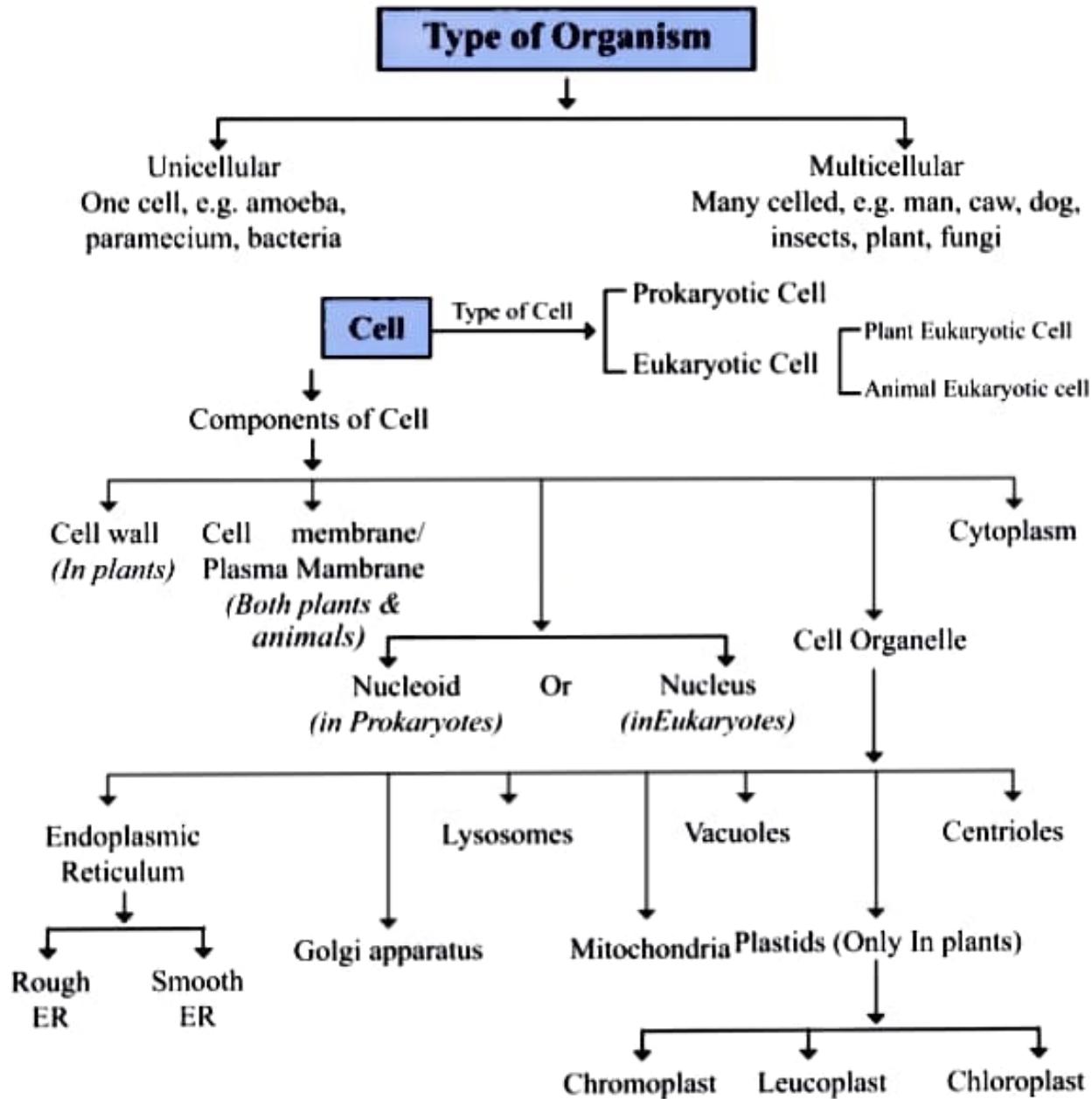




Chapter - 5

Fundamental Unit Of Life: Cell

CONCEPT MAPPING



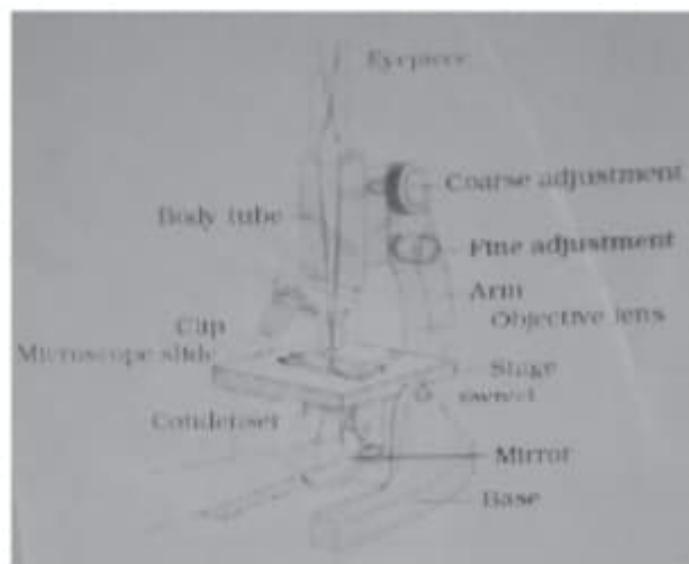


Fig. 5.1 : Compound microscope

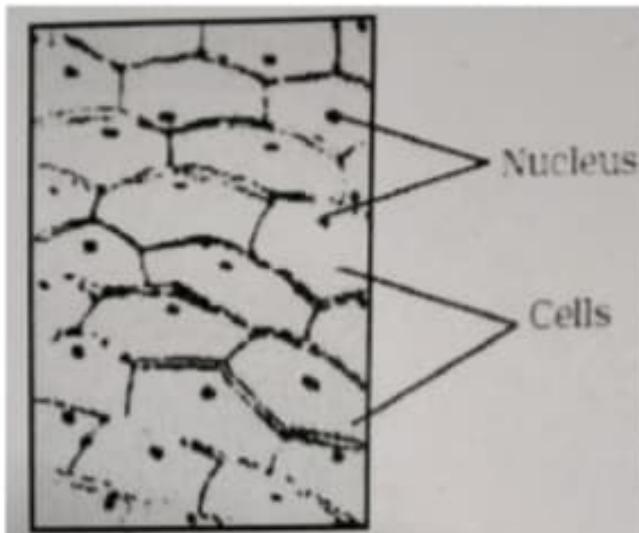


Fig. : Onion Peel Cells

- All living forms are composed of microscopic units called as 'Cells'.
- A cell is the basic structural and functional unit of all life forms.
- Study of structure and composition of cell is called as 'Cytology'.
- Cell was first discovered and observed by Robert Hooke in a thin dead slice of cork in the year 1665.
- First free living cell was discovered by A. V. Leeuwenhoek, in 1674.
- Protoplasm is an aggregate of various chemicals such as water, ions, salts and other organic molecules like proteins, carbohydrates, fats, nucleic acids, vitamins etc. along with cell organelle & nucleus.
- Its consistency differs under different condition, It exists in sol-gel states.

Cell Theory :

Two biologists, Schleiden and Schwann (1838) gave the Cell theory which states that :

- (i) All plants and animals are composed of cells.
 - (ii) Cell is the basic unit of life.
 - (iii) All cell arise from pre-existing cells.
- Viruses are the exceptions of cell theory.

CELL

- Cell theory :

Two biologists, Schleiden and Schwann (1838) gave the Cell theory which states that :

- (i) All plants and animals are composed of cells.
- (ii) Cell is the basic unit of life.
- (iii) All cells arise from pre-existing cells.

- Viruses are the exceptions of cell theory (they have no cells)

TYPES OF CELLS

Prokaryotic Cell
(Single celled)

Eukaryotic Cell
(Multi-celled)

Prokaryotic Cells

Eukaryotic Cells

- | | |
|--|---|
| <ul style="list-style-type: none">• Very minute in size ($1\text{-}10^6\text{ m}$)• Always unicellular• Nucleolus absent• Single chromosome present• Ex: Bacteria | <ul style="list-style-type: none">• Fairly large in size (5-100 μm)• May be unicellular or multicellular• Nucleolus Present• More than one chromosome Present• Ex: All plant and Animal |
|--|---|

Types of Organism

Unicellular Organism

Multicellular Organism

Characteristics	Unicellular Organisms	Multicellular organisms
• Cell number	Single cell	Large no. of cells
• Function	All functions are performed by single cell	Different functions performed by different cells.
• Reproduction	Involves the single cell	Specialised cells (germ cells)
• Life span	Short	Long.
• Examples:	Amoeba, Paramecium bacteria etc.	Plant, fungi & Animals

Cell Size : Size of cell is variable depending upon the type of organism.

- Size of typical cell in a multicellular organism ranges from $0.2 \mu\text{m}$ to 18 cm . (μm ~~micron~~ Micrometer)
- The largest Cell is ostrich Egg (15 cm long, 13 cm wide & 1.4 kg weight)
- The longest cell is nerve cell (upto 1 m)
- Smallest cells so far known are mycoplasma.

Cell Shape : Cells are of variable shapes and sizes. Their shape is according to the function. Generally cells are spherical but they may be elongated (nerve cell), branched (pigmented), discoidal (RBC). Spindle-shaped (muscle cell) etc.



Squamous Epithelium



Smooth Muscle Fibres
from the Intestine



Cartilage cells
Dendrite



Nerve Cell with Axon and Dendrites



Ciliated Epithelium
from the Trachea



Striped Muscle Fibres



Bone Cell



Columnar Cells
from the Stomach



Muscle Fibres
from the Heart



Red Blood
Cells or
Erythrocytes



White Blood
Cell



Sperm



Ovum

Different kinds of cell found in the human body

■ Components of cell :

- (i) Plasma membrane
- (ii) Nucleus
- (iii) Cytoplasm

■ Cell Membrane / Plasma Membrane :

- (a) Plasma membrane is selectively permeable in nature means, it allows or permits the entry and exit of some materials in and out of the cell.
- (b) Cell membrane is also called plasma membrane / plasma lemma.
- (c) It is the limiting boundary of each cell which separates the cytoplasm from its surroundings.
- (d) It is found in both plant as well as animal cells.
- (e) It is made up of Proteins and Lipids where proteins are sandwiched b/w layers of lipids.
- (f) It is flexible and can be folded, broken and reunited.

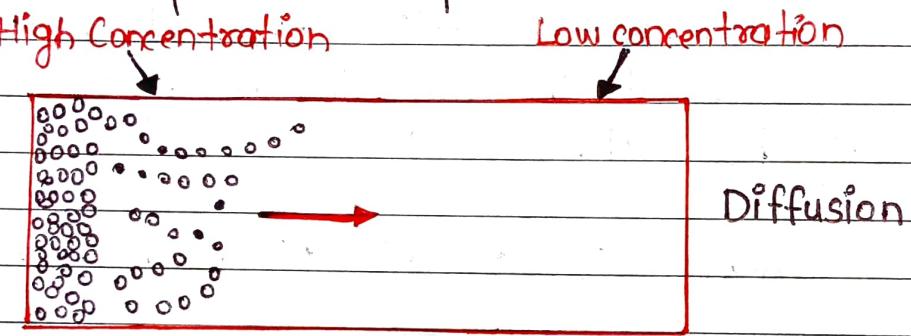
(i) Functions of Plasma Membrane :

- (a) It regulates the movement of molecules inside and outside the cell.
- (b) It helps in maintaining the distinct composition of cell.

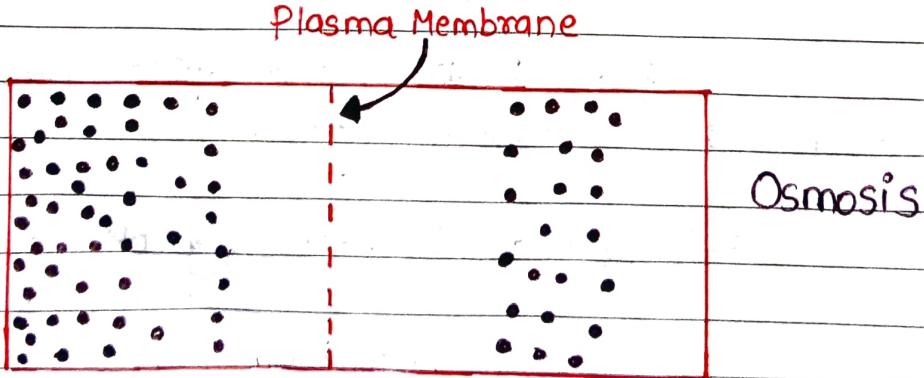
(ii) Transportation of molecules across the plasma membrane :-

This can be done in following ways :-

- Diffusion :- Movement of solutes or ions from higher concentration to lower concentration is called diffusion. It does not require energy therefore, it is called as passive transport.



- Osmosis :- The movement of solvent or water from higher concentration to lower concentration through a semi-permeable membrane is called as Osmosis.



- Endomosis :- Movement of solvent into cell is called Endomosis.
- Exomosis :- Movement of solvent outside the cell is called Exomosis.

Types of Solutions on the Basis of Concentration and its effect on cell:

60

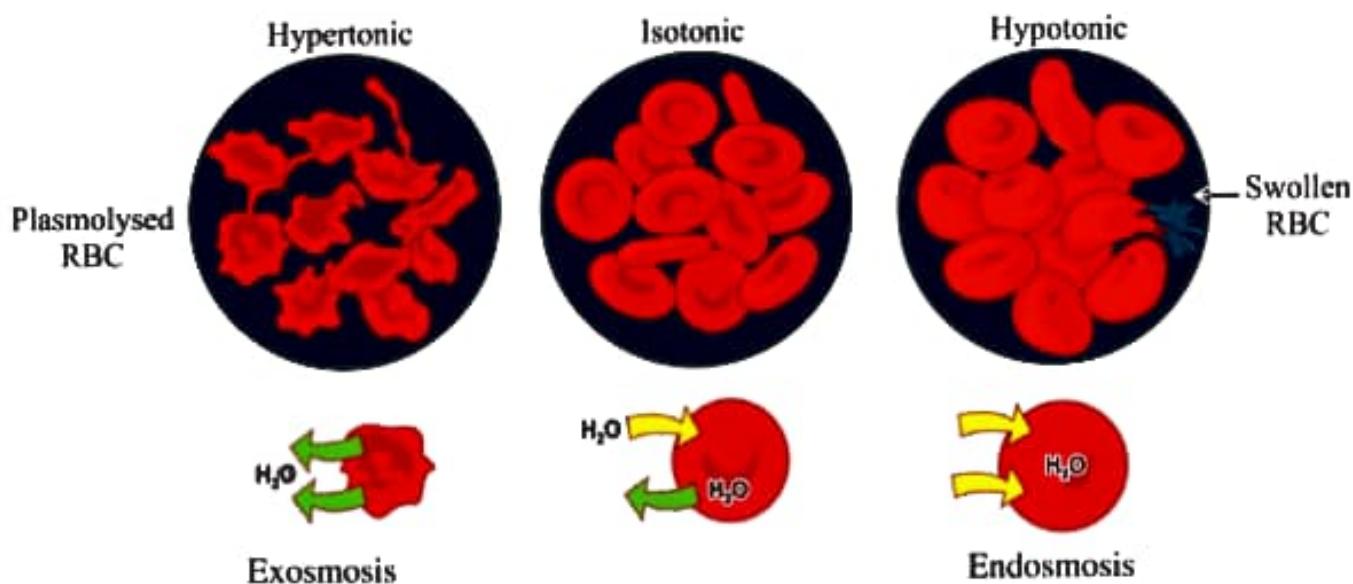


Fig. : Effect of different types of solution on RBC's placed in them.

- Isotonic Solution :** When the concentration of the solution outside the cell is equal to the concentration of cytoplasm of the cell, it is called as isotonic solution.
- Hypertonic Solution :** When the concentration of the solution outside the cell is more than the inside the cell. Due to this, cell loses water and becomes plasmolysed. **Plasmolysis:-** Shrinking of the protoplasm away from the cell wall due to Excessive loss of water (Exosmosis)
- Hypotonic Solutions :** When the concentration of the solutions outside the cell is lesser than that of cytoplasm of cell, cell swells up and bursts. due to excessive end osmosis.

■ Cell Wall :

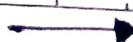
- It is the outermost covering of the plant cells.
- It is absent in animal cells.
- Cell wall is rigid, strong, thick porous and non-living structure. It is made up of cellulose and hemicellulose. Cell walls of two adjacent cells are joined by a layer called middle lamella and microscopic channels called plasmodesmata for transport.

Functions of Cell Wall :

- (a) It provides definite shape to the cell.
- (b) It provides strength to the cell.
- (c) It is permeable and allows entry of molecules of different sizes.

■ Nucleus :

- Nucleus is the most important cell organelle which directs and controls all its cellular activities.
- It is called as 'Headquarter of the cell' .
- It was discovered by Robert Brown in 1831 .
- In Eukaryotes , a well defined nucleus is present while in Prokaryotes , a well defined nucleus is absent.
- Prokaryotes contain a Primitive nucleus called Nucleoid.



- It has double layered covering called as nuclear membrane.
- Besides nuclear membrane, nucleus also contains nucleolus and chromatin material made up of chromatin.
chromatin made up of DNA and protein that ultimately Condense and form chromosome.
- chromosomes or chromatin material consist of DNA which stores and transmits hereditary information for the cell to function, grow and reproduce.

The functional segment of DNA (Deoxyribonucleic acid) is Known as GENE .

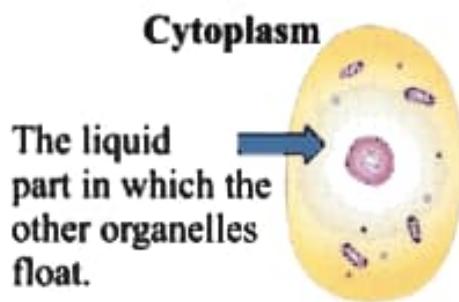
● Functions of Nucleus :

- (a) It controls all the metabolic activities of the cell and regulates the cell cycle.
- (b) It helps in transmission of hereditary characters from parents to their offsprings.

इसके लिए PRINTED NOTES से पढ़ें।



Cytoplasm

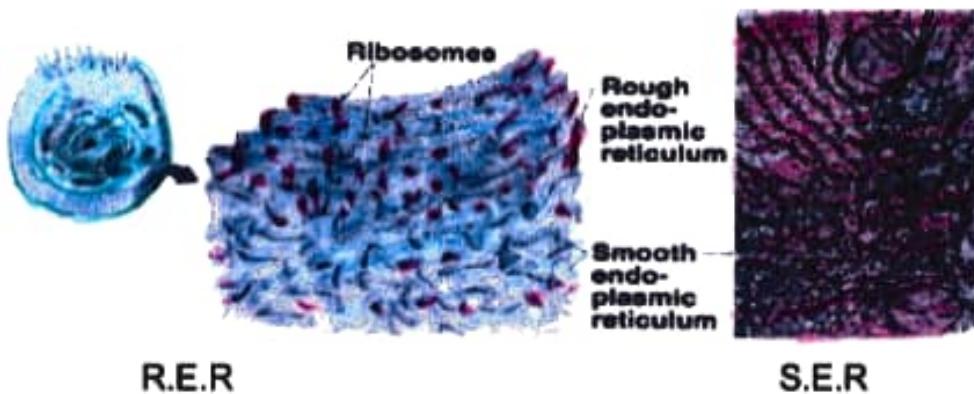


- Cytoplasm was discovered by Kolliker in 1862.
- It is the site of both biosynthetic and catabolic pathways.
- It can be divided into two parts:
 - (i) **Cytosol**: Aqueous soluble part contains various fibrous proteins forming cytoskeleton. It contains about 90% water, 7% Protein 2% carbohydrates & 1% etc.
 - (ii) **Cell organelles**: Living part of the cells having definite shape, structure and function bounded by plasma membrane. There are single membrane bound, double membrane bound and non membrane bound Cell organelles.

Single Membrane bound cell organelles	Double Membrane bound cell organelles	Non Membrane bound cell organelles
eg. ER, Lysosomes, Golgi bodies, & Vacuoles Peroxisomes	eg. Mitochondria, Plastids These 2 also have their own DNA material	eg. Ribosome, Centrosomes, Microtubules

Endoplasmic Reticulum

- It is the network of membrane bound tubules and sheet present in the cytoplasm.
- It was discovered by Porter, Claude and Fullam.
- These are present in all cells except prokaryotes and mammalian erythrocytes.



Endoplasmic reticulum is of two types :

Smooth ER

- Made of tubules mainly.
- Helps in steroid, lipids and Polysaccharide synthesis.
- Ribosomes are absent.
- Helps in membrane biogenesis.

Rough ER

- Made of Cisternae and vesicles.
- Helps in protein synthesis.
- Contains ribosome on its surface.

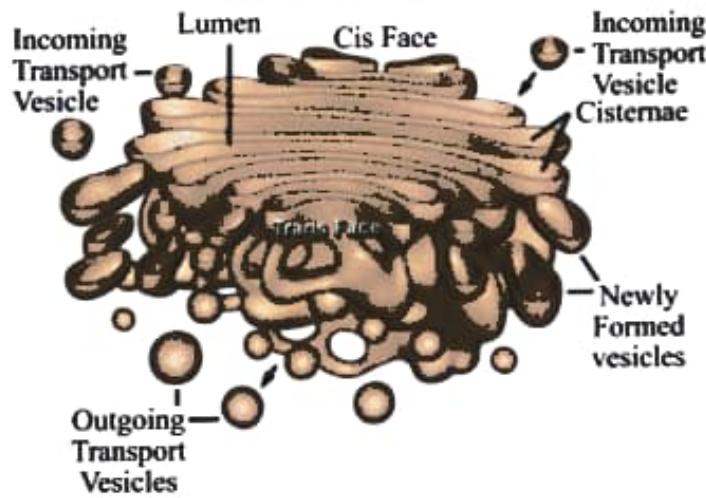
Function of ER :

- It is the only organelle which serves as a channel for the transport of materials between various regions of cytoplasm and between cytoplasm and nucleus.
- It also functions as a cytoplasmic framework to provide surface some of the biochemical activities. It forms endoskeleton of cell.
- It helps in synthesis of fats, protein, steroids, cholesterol etc.
- SER plays a crucial role in detoxification of drugs and poisonous by products.
- Membrane biogenesis: Protein & Lipids produced by ER are used to produce cell membrane.

Golgi Apparatus

Golgi apparatus consists of a system of membrane bounded fluid filled vesicles arranged parallel to each other in stacks called Cisternae along with some large and spherical vacuoles. It was discovered by Camilo Golgi. It is absent in prokaryotes, mammalian RBC's & sieve cells.

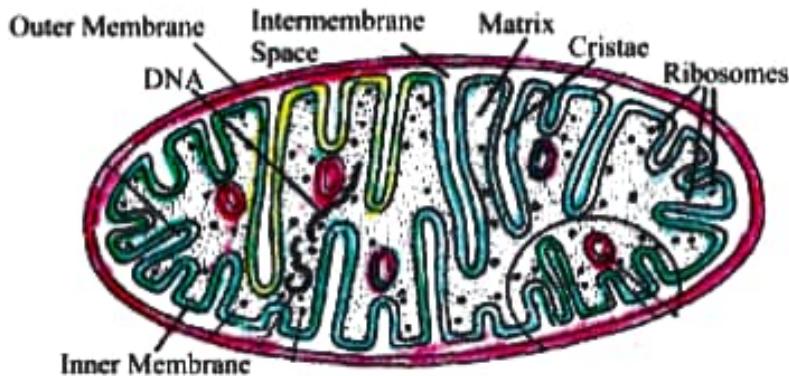
The Golgi Apparatus



Functions of Golgi apparatus :

- Its function include the storage, modification, Packaging & secretion of products in vesicles.
- It involved in the formation of lysosomes.
- It is secretary in nature.
- It helps in melanin synthesis.
- It involved in the synthesis of cell wall & plasma membrane also

Mitochondria



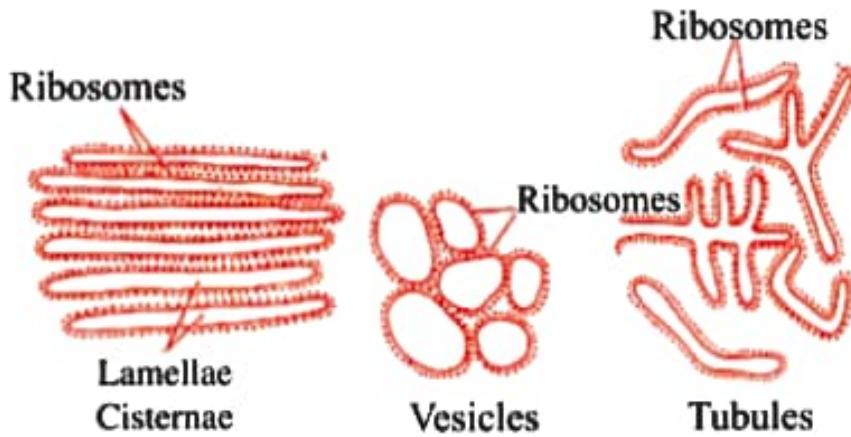
It is a rod shaped structure found in cytoplasm of all eukaryotic cells except mammalian RBC's.

- These are also absent in prokaryotes.
- It was first seen by Kolliker in insect cells in 1880.
- It is also called as 'Power House of the Cell' or the 'Storage Battery'.
- It is double membranous structure where outer membrane has specific proteins while inner membrane is folded inside to form chambers called Cristae.
- Mitochondria has its own DNA & Ribosomes

Functions of Mitochondria :

- (a) Its main function is to produce, store and release the energy in the form of ATP. (Adenosine Triphosphate) The energy currency of the cell.
- (b) It is the site for cellular respiration (Krebs cycle) in which ATP are produced.

Ribosomes



(Ribosomes located on different cell organelles and their parts)

- Ribosomes are the sites of protein synthesis.
- All structural and functional proteins (enzymes) coded by the nuclear DNA are synthesized upon cytoplasmic ribosomes. The DNA codes are transcribed into messenger RNA (mRNA) molecules. Which comes out the Nucleus and Translated (Protein synthesis) by Ribosomes attached to RER in the form of Proteins.

Functions of Ribosomes :

Ribosomes are the main site of protein synthesis. Synthesized proteins are transported by endoplasmic reticulum.

Plastids

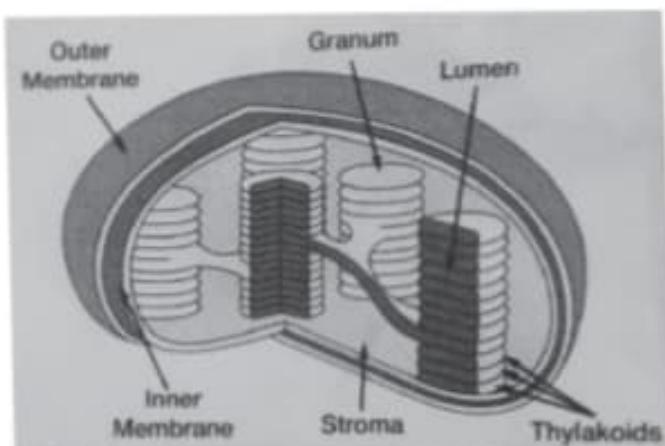
- It is double membranous discoidal structure, found only in plant cells.
- Besides being discoidal or rhombic in plant cells, they occur in variable shapes like in (algae.) They can be 'U' - shaped, spiral, coiled, ribbon- shaped etc.

Depending upon the type of pigment present in them, they are of following three types :

- (i) Leucoplast – The primary function is storage of starch, oil, proteins. White, found in non- photosynthesis tissue of plant such as Root, bulb, seeds, etc. They can change into other type of plastids.
- (ii) Chromoplast – These are coloured plastids except green it imparts colour to fruits & flowers.
- (iii) Chloroplast – Green in colour, found in aerial parts of plants

These are found only in plant cell. It helps in the process of photosynthesis so it is called the 'Kitchen of cell in plant.'

Chloroplast:



Chloroplast have following two parts:

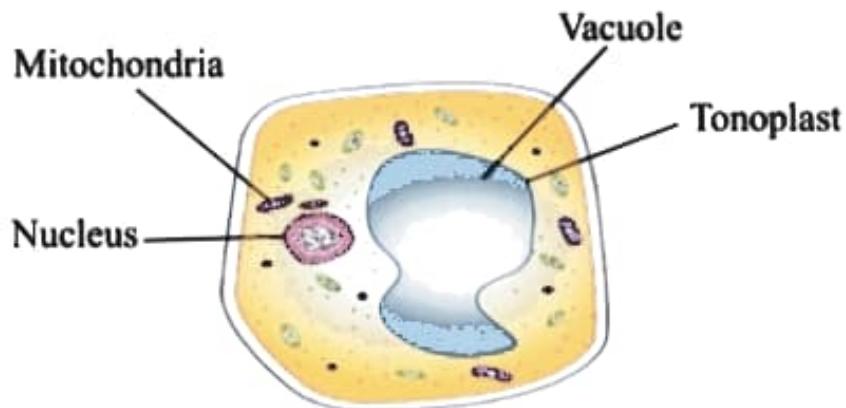
- (i) **Grana :** It constitutes the lamellar system. These are found layered on top of each other. These stacks are called Grana. Each granum of the chloroplast is formed by superimposed closed compartments called Thylakoids.

Function : They are the sites of light reaction of photosynthesis as they contain photosynthetic pigment chlorophyll. Photosynthetic units.

- (ii) **Stroma :** It is a granular transparent substance also called as matrix. Grana are embedded in it. Besides Grana they also contain lipid droplets, starch grains, ribosomes etc.

Function : This is the site of dark reaction of photosynthesis. Also helps in protein synthesis due to presence of ribosomes.

Vacuoles

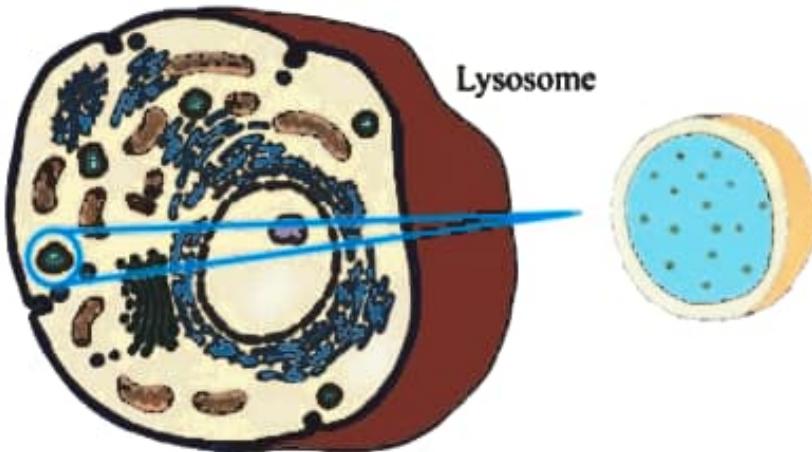


- These are membrane bounded regions in the cytoplasm containing water and other substances.
- They are bounded by a single membrane called Tonoplast.
- In animal cells vacuoles are absent or smaller in size in plant cells a single large vacuole is found which occupies about 90% of the volume of cell.

Functions :

It helps in maintaining osmotic pressure in a cell & stores toxic metabolic products (Waste product water, sugar, protein etc.) of plant cell.

Lysosome (Suicidal Bag)



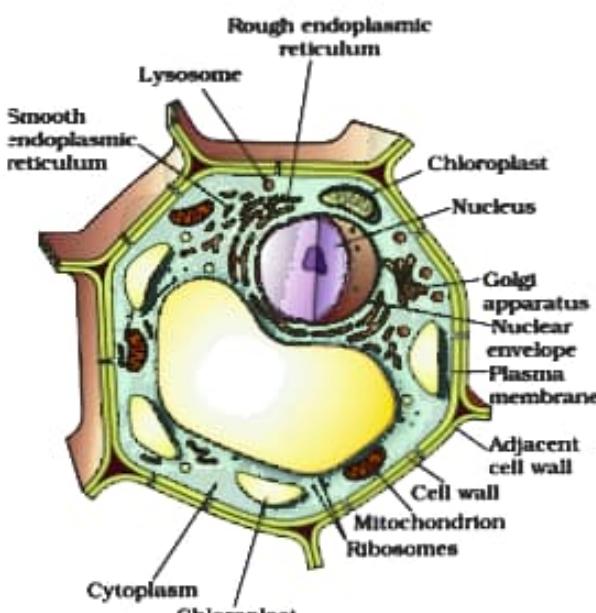
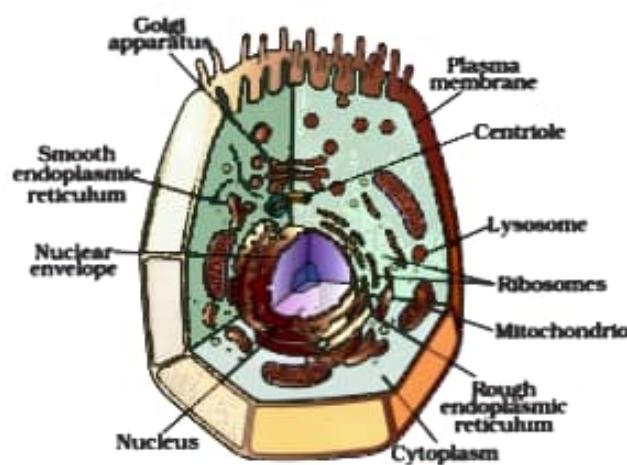
- They are tiny membrane bound vesicles containing powerful digestive enzymes for intracellular digestion.
- Lysosome absent in RBC's
- Lysosomes are synthesised by golgi body & enzyme present in it are synthesised by RER.

Functions :-

- (a) Their main function is phagocytosis = digestion.
- (b) They are kind of waste disposal system.
- (c) They help in digesting foreign materials & cells.

Suicidal Bag : During disturbances in cellular metabolism (i.e., in case of cell damage). lysosomes burst and their enzymes are released into the cytoplasm and they digest their own cell. So they are also called 'Suicidal Bag'.

Difference between Animal cell and Plant cell

Plant Cell	Animal Cell
<ul style="list-style-type: none"> Contain chloroplasts for photosynthesis. Have a cell wall to maintain structure and rigidity. Usually do not contain lysosomes and Peroxisomes. Cells are square and rigid or geometric shaped. Limited movement. Have one large central vacuole. 	<ul style="list-style-type: none"> No chloroplasts No cell wall Contain cilia and/or flagella Cells are fluid and flexible, many shapes. Cells can move around. Has small or no vacuoles. Have lysosome 

Cell Division : New cells are formed in organisms in order to grow, to replace old, dead and injured cells, and to form gametes required for reproduction. The process by which new cells are made is called cell division.

There are two main types of cell division:

- Mitosis :** The process of cell division by which most of the cells divide for growth is called mitosis. In this process, each cell called mother cell divides to form two identical daughter cells (Fig. 5.7). The daughter cells have the same number of chromosomes as mother cell. It helps in growth and repair of tissues in organisms.
- Meiosis :** Specific cells of reproductive organs or tissues in animals and plants divide to form gametes, which after fertilisation give rise to offspring. They divide by a different process called meiosis which involves two consecutive divisions. When a cell divides by meiosis it produces four new cells instead of just two (Fig. 5.8). The new cells only have half the number of chromosomes than that of the mother cells.

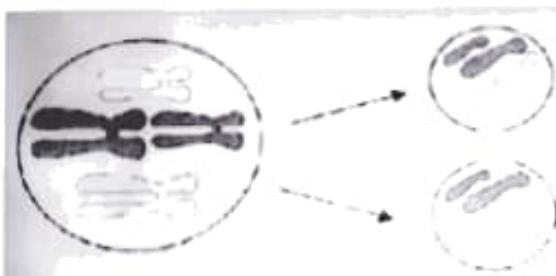


Fig. 5.7: Mitosis



Fig. 5.8: Meiosis

QUESTIONS

VERY SHORT ANSWER TYPE QUESTIONS

1. Name the largest cell of living world ?
2. Who gave the fluid mosaic model of plasma membrane ?
3. Which cell organelle is called as the 'Head quarter of cell' ?
4. Which cell organelle is called as 'Power house of cell' ?
5. Which cell organelle contains enzymes for ATP production ?
6. In mitochondria, which portion contains specific proteins ?
7. Which cell organelle is called as 'Digestive bag' ?
8. Which organelle controls osmotic pressure in a cell ?

SHORT ANSWER TYPE QUESTIONS

1. What is the composition of protoplasm ?
2. Define cell ?
3. What is the difference between diffusion and osmosis ?
4. Why plasma membrane is called as selectively permeable membrane ?
5. Define Cristae ?
6. State any two function of Golgi body ?
7. Name various type of plastids present in a plant cell ?
8. State the main function of lysosome ?
9. Which cell organelles is known as powerhouse of cell and why ?
10. What is the function of SER ?

LONG ANSWER TYPE QUESTIONS

1. Draw a neat and labelled diagram of mitochondria.
2. Differentiate between plant and animal cell with suitable figures.
3. Write a short note on Nucleus.
4. Explain the effect of concentration of solution on the cell ?
5. Who proposed cell theory. What are its postulates ?
6. Draw a neat labelled diagram of plant cell ?
7. How does unicellular organism differ from Multicellular organism ?
8. What are plastids? Explain its structure and types ?
9. What are the functions of vacuoles ?
10. Expand the following : ATP, DNA, RNA alongwith its function.

OBJECTIVE TYPE QUESTIONS

Fill in the Blanks :

1. and proposed the cell theory.
2. Nucleus in the cell is discovered by
3. Mitochondria are found in cells
4. A can be made into crystal. (bacterium, virus, amoeba)
5. The main constituent of cell-wall in plant is
6. organelle is the power house of the cells.
7. Chromosomes are made up of nucleic acid and

MCO:

Match the following :

C1

- A. Smooth Endoplasmic reticule
 - B. Nucleoid
 - C. Food Vacuoles
 - E. Mitochondria
 - D. Pasties

C2

1. Amoeba
 2. Nulls
 3. Baitena
 4. Detoxification
 5. Lewoplast
 6. Suicidal Bags.

- **Assention :** Cell in the fultiaval and strutnal unit of life.
Reason : Cell perform all the life process and from the struture of the liting beings.

True and False:

1. Plant cell will plasmolysed when placed in a hypotonic solution.
 2. Animal cell will shrink in a hypertonic solution.
 3. Mitochondria is known as power house of cell.
 4. Cell wall is present in plant cell.