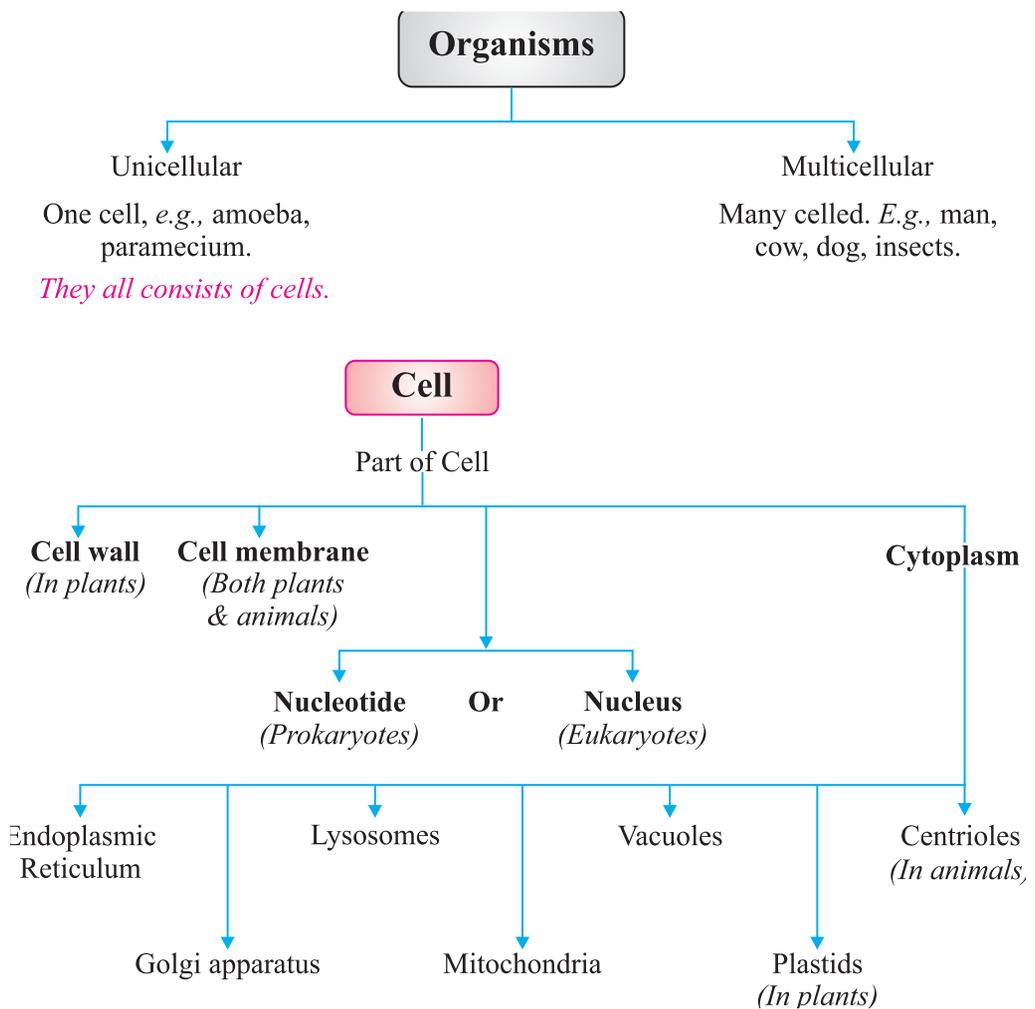




Chapter - 5

Fundamental Unit Of Life: Cell

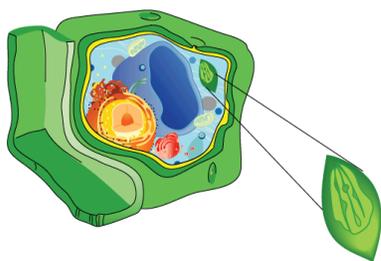
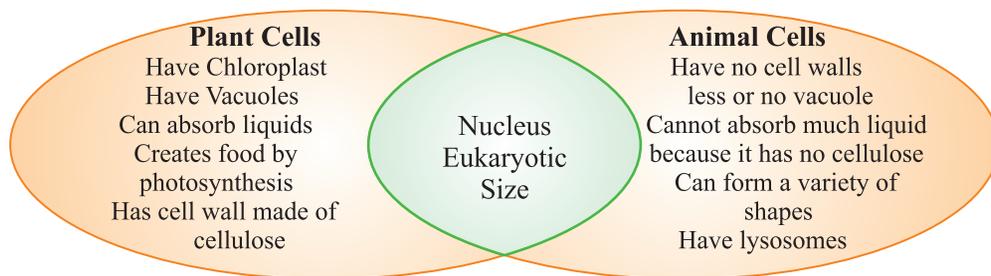
CHAPTER AT A GLANCE



Study Key Points :

Discovery of Cell, Types of Cell & Organism, Unicellular & Multicellular,

Prokaryotic & Eukaryotic, Plant Cell & Animal Cell, Cell Shape, Cell Size, Cell Membrane, Cell wall, Diffusion & Osmosis, Nucleus, Cytoplasm, Endoplasmic Reticulum, Golgi Apparatus, Mitochondria, Ribosomes, Plastid, Vacuoles, Lysosomes.



Plant Cells with Chloroplasts



Red Blood Cells

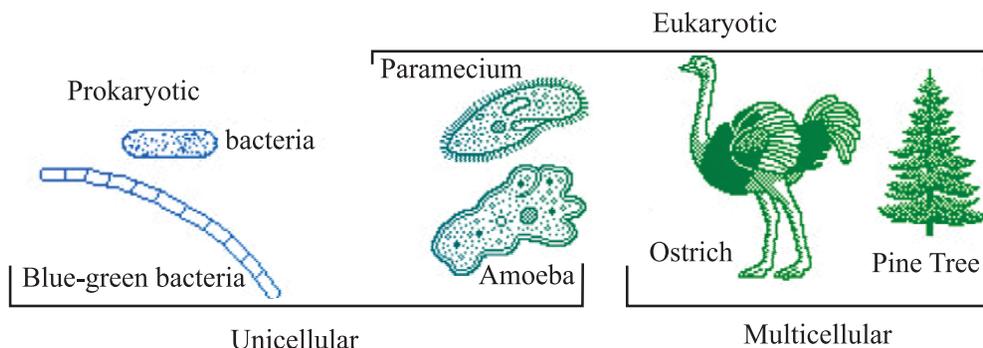
- All living forms are composed of microscopic units called as ‘Cells’.
- A cell is the basic structural and functional unit of all life forms.
- Study of structure and composition of cell is called as ‘Cytology’.
- Cell was first observed by Robert Hooke in a dead cork slice in the year 1665.
- First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

Cell Theory :

Two biologists, Schleiden and Schwann 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.

Types of Cell & Organism :

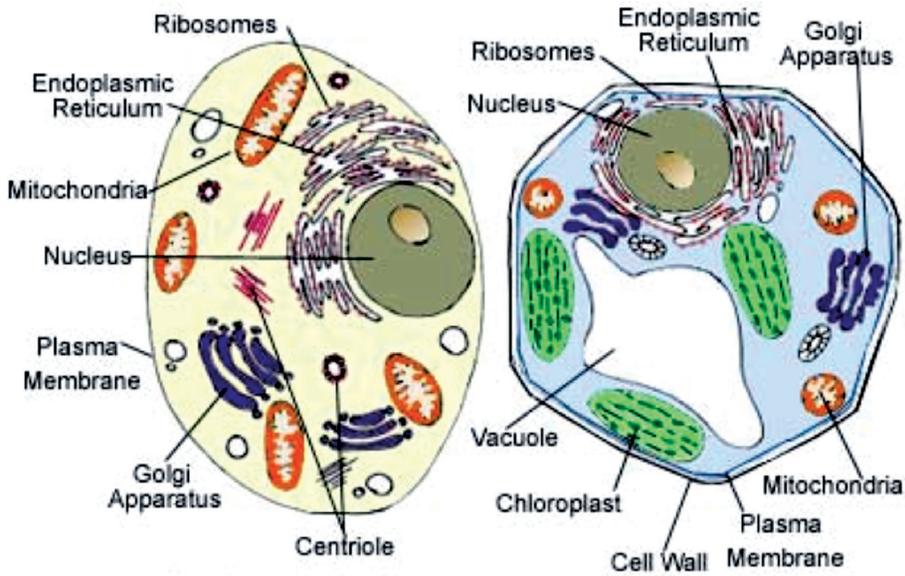


On the Basis of Number of Cells :

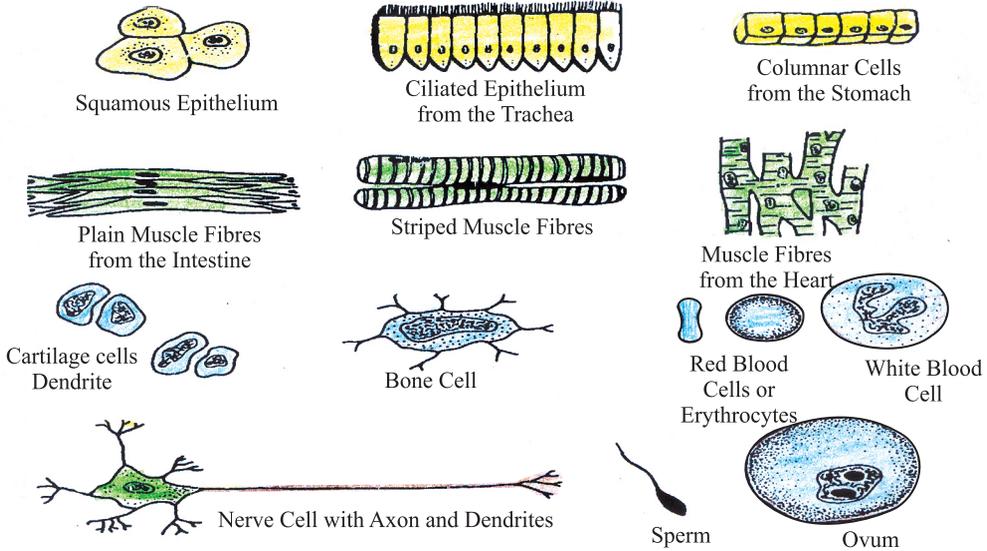
Characteristics	Unicellular organism	Multicellular organism
Cell number	Single cell	Large number of cells
Function	All functions are performed by single cell	Different cells perform different specific functions.
Division of labour	Not performed	Cells specified to perform different functions.
Reproduction	Involves the same single cell	Specialised cells, germ cells take part in reproduction.
Life span	Short	Long

On the Basis of Type of Organization

Prokaryotic Cells	Eukaryotic Cells
Very minute in size.	Fairly large in size.
Nuclear region (nucleoid) not surrounded by a nuclear membrane.	Nuclear material surrounded by a nuclear membrane.
Single chromosome present.	More than one chromosome present.
Nucleolus absent.	Nucleolus present.
Membrane bound cell organelles are absent.	Membrane bound cell organelles are present.
Cell division by fission or budding (no mitosis).	Cell division by mitosis or meiosis.



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.



Different kinds of cell found in the human body

Cell Size : Size of cell is variable depending upon the type of organism. Some are microscopic while some are visible with naked eyes. Their size may vary from 0.2 mm to 18 cm.

- Size of a typical cell in a multicellular organism ranges from 20-30 μ m.

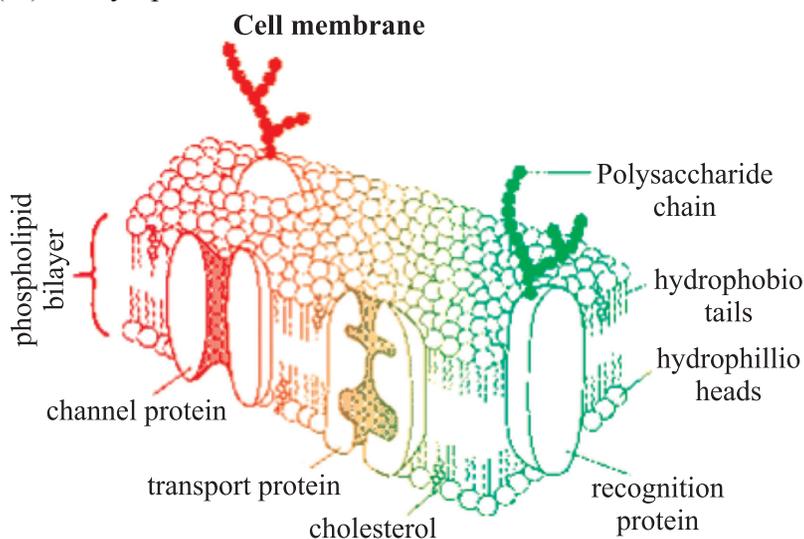
- The largest cell is ostrich egg (15 cm in diameter with shell & 8 cm in diameter without cell).
- The longest cell is nerve cell (upto 1 m or more).
- Smallest cells so far known are PPLOs e.g., mycoplasma (0.1 mm in diameter).
- Human egg is 0.1 mm in diameter.

Components of Cell

There is an occurrence of division of labour within a cell as they all got certain specific components called 'Cell organelles'. Each of them perform a specific function.

The three basic components of all the cells are :

- Plasma membrane
- Nucleus
- Cytoplasm



The Plasma Membrane

Cell Membrane :

- Cell membrane is also called as plasma membrane or plasma lemma.
- It is the limiting boundary of each cell which separates the cytoplasm from its surroundings.
- It is found in both plant as well as animal cells.
- It is the outermost covering of a cell in case of animals and lies below the cell wall in case of plants.
- It is made up of proteins and lipids where proteins are sandwiched

between bilayer of lipids.

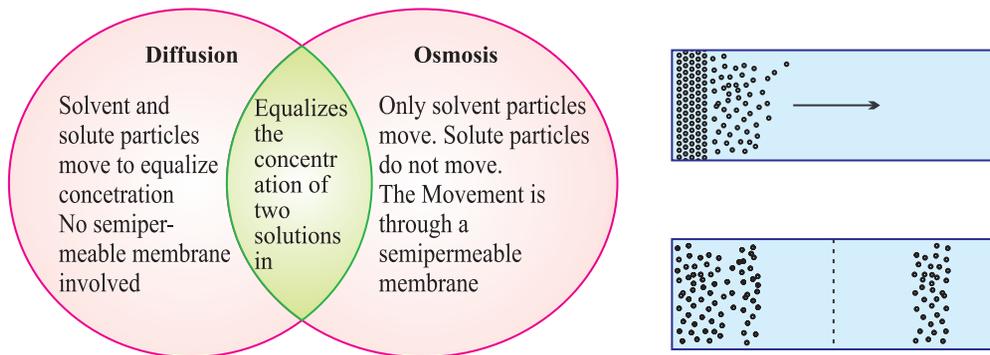
- (f) Plasma membrane is selectively permeable in nature. It allows or permits the entry and exit of some materials in and out of the cell.
- (g) Singer and Nicholson gave the fluid mosaic model of plasma membrane. According to them, it consists of a protein layer sandwiched between two layers of lipids. It is in quasifluid state. It is 75A thick.
- (h) It is flexible and can be folded, broken and reunited.

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 the cell.

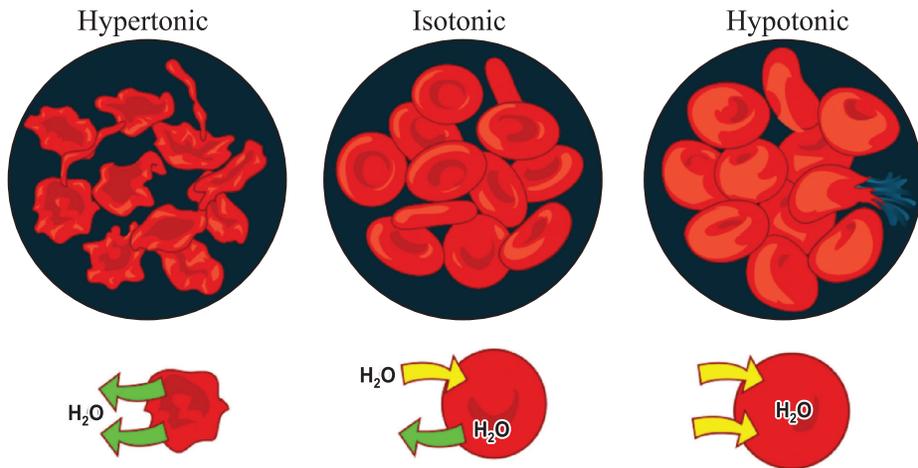
(ii) Transportation of molecules across the Plasma Membrane :

This can be done by following ways :



- **Diffusion** : Movement of solutes or ions from higher concentration to lower concentration is called as diffusion. It does not require energy therefore, it is called as passive transport.
- **Osmosis** : The movement of solvent or water from higher concentration (solvent) to lower concentration (solvent) through a semipermeable membrane is called as osmosis Or the movement of solvent or water from lower concentration to higher concentration of solution through a semipermeable membrane is called as osmosis.
- **Osmosis can also be called as ‘Diffusion of solvents’.**
- **Endomosis** : Movement of solvent into the cell is called as Endomosis.
- **Exosmosis** : Movement of solvent outside the cell is called as Exomosis.

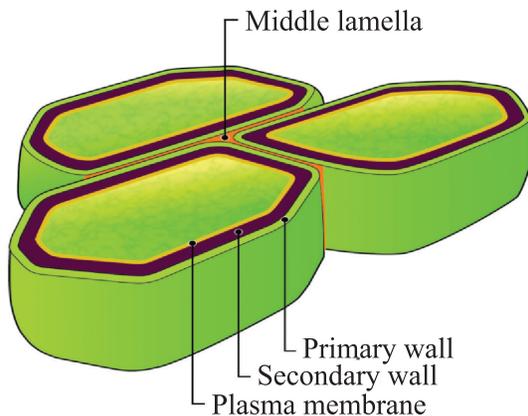
Types of Solutions on the Basis of Concentration



- (a) **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.
- (b) **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.
- (c) **Hypotonic Solution** : When the concentration of the solution outside the cell is lesser than that of cytoplasm of cell. Due to this, cell swells up and bursts.

Cell Wall

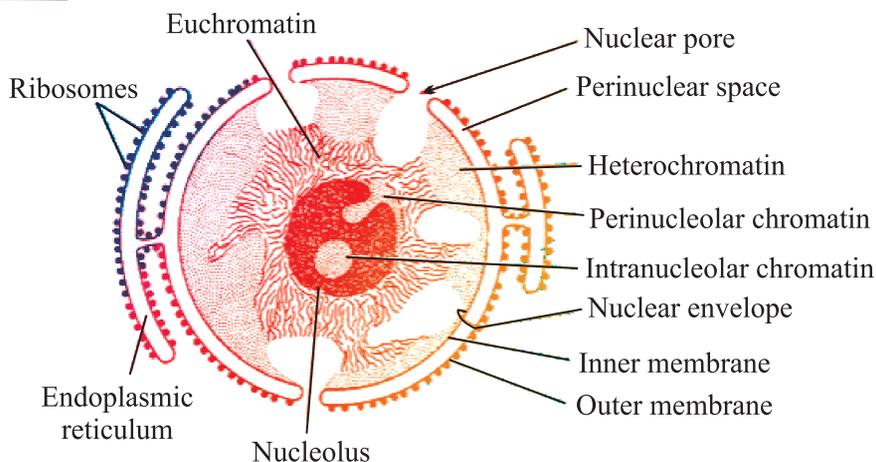
- It is the outermost covering of the plant cells.
- It is absent in animal cells.
- Cell wall is rigid, strong, thick, porous and non-living structure. It is made up of cellulose and hemicelluloses. Cell walls of two adjacent cells are joined by a layer called middle lamellae.



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.
- (d) It has the characteristics of repair and regeneration.

Nucleus

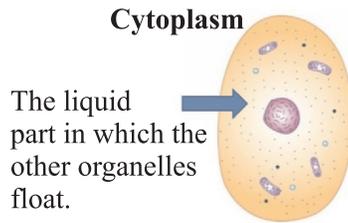


- Nucleus is the most important cell organelle which directs and controls all its cellular activities.
- It is called as ‘Headquarter of the cell’.
- It was discovered by Robert Brown in 1831.
- In Eukaryotes, a well-defined nucleus is present while in Prokaryotes, a well-defined nucleus is absent.
- Prokaryotes contain a primitive nucleus.
- It has double layered covering called as nuclear membrane.
- Nuclear membrane has pores which regulate the movement of materials in & out of the cell.
- Besides nuclear membrane, nucleus also contains nucleolus and chromatin material and the substance filled inside the nucleus is nucleolus.
- Chromosomes or chromatin material consists of DNA which stores and transmits hereditary information for the cell to function, grow and reproduce.

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 off springs.

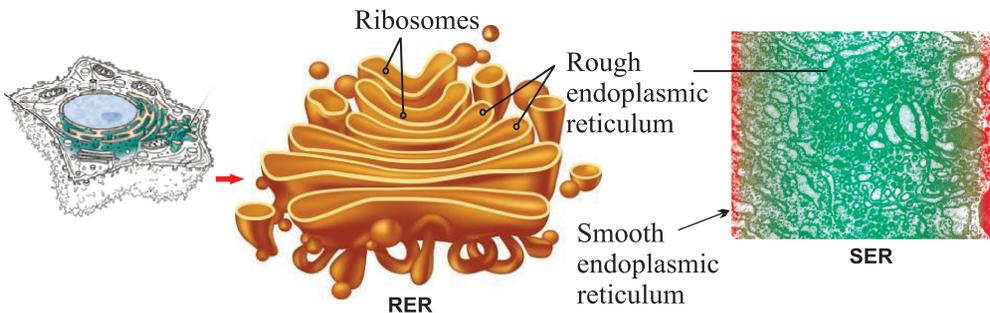
Cytoplasm



- 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.
 - (ii) **Cell organelles** : Living part of the cells having definite shape, structure and function bounded by plasma membrane.

Endoplasmic Reticulum

- It is the network of membranes 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.

Functions of ER :

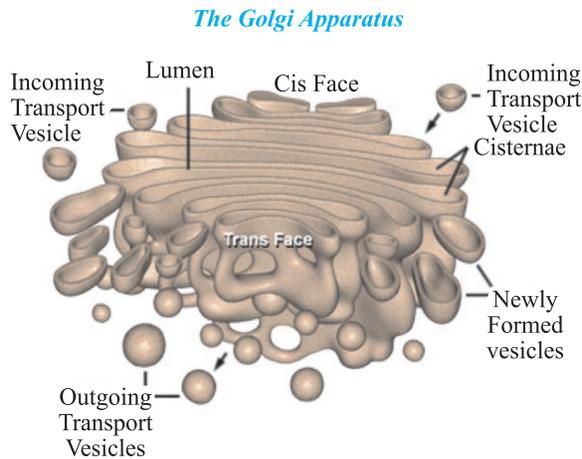
- (a) It is the only organelle which can move within a cell so it serves as a channel for the transport of materials between various regions

of cytoplasm and between cytoplasm and nucleus.

- (b) It also functions as a cytoplasmic framework to provide space for some of the biochemical activities. It forms endoskeleton of cell.
- (c) It helps in synthesis of fats, steroids, cholesterol etc.
- (d) SER plays a crucial role in detoxification of drugs and poisonous by-products.

Golgi Apparatus

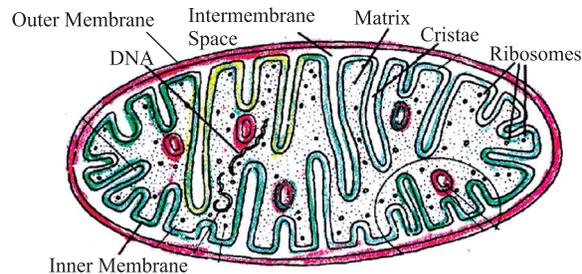
Golgi apparatus consists of a system of membrane bounded vesicles arranged parallel to each other in stacks called Cisternae along with some large and spherical vacuoles. It was discovered by Camilo Golgi. In plants Golgi membrane is bounded. It is single membrane bounded. It is absent in prokaryotes,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



Functions of Golgi apparatus :

- (a) It helps in formation of lipids.
- (b) It helps in formation of middle lamellae.
- (c) It is secretory in nature.
- (d) It helps in melanin synthesis.
- (e) Lipids and proteins synthesized in endoplasmic reticulum are packed at Golgi complex. They provide the site for assembly of new membrane material.

Mitochondria



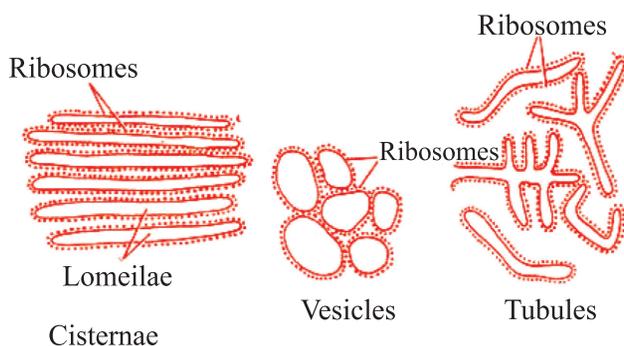
It is a rod shaped structure found in cytoplasm of all eukaryotic cells except mammalian RBC's.

- These are also absent in prokaryotes.
- It was first seen by Kolliker in insect cells.
- Maximum mitochondria are found in metabolically active cells.
- 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.

Functions of Mitochondria :

- (a) Its main function is to produce and store the energy in the form of ATP.
- (b) It is the site of Krebs cycle of respiration.

Ribosomes



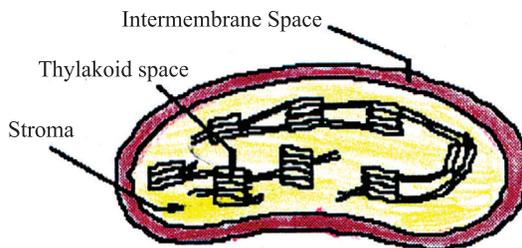
Ribosomes are the sites of protein synthesis.

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 in the chromosomes of the nucleus.

Functions of Ribosomes :

- (a) Ribosomes are the main site of protein synthesis. Synthesized proteins are transported by endoplasmic reticulum.

Plastid



- 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 :

- Leucoplast – White, found in underground parts
- Chromoplast – Red, brown
- 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 Plants’.

Chloroplast have following two parts :

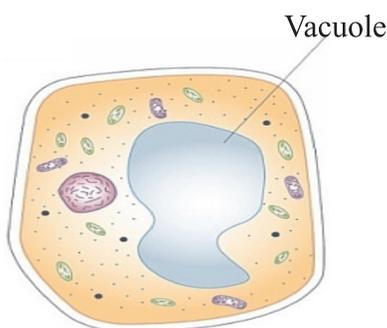
- Grana :** It constitutes the lamellar system. These are found layered on top of each other. These stacks are called Grana. Each granum of the chloroplast is formed by superimposed closed compartments called Thylakoids.

Function : They are the sites of light reaction of photosynthesis as they contain photosynthetic pigment chlorophyll. In each thylakoid, Quantasomes are present which are called as Photosynthetic units.

- 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



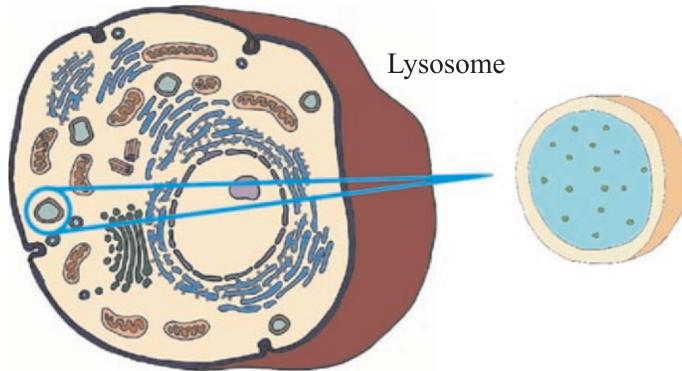
- These are membrane bounded regions in the cytoplasm containing water and other substances.
- They are bounded by a single membrane called Tonoplast.
- In animal cells vacuoles are smaller in size and numerous while in plant

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 of plant cell.

Lysosome



- They are tiny sac-like granules containing enzymes of intracellular digestion.
- They are bounded by a single membrane.
- They occur in animal cells and a few plant cells.
- They do not have a definite shape or size.

Functions :

- (a) Their main function is phagy = 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’.

Differences between Animal cell and Plant cell

Plant Cell

- 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.

Animal Cell

- No chloroplasts
- No cell wall
- Contain cilia and/or flagella
- Cells are fluid and flexible, many shapes.

- Limited movement.
- Cells can move around.
- Have one large central vacuole.
- Has small vacuoles.

QUESTIONS

VERY SHORT ANSWER TYPE QUESTIONS (1 Mark)

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

SHORT ANSWER TYPE QUESTIONS (2 Marks)

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 ?

LONG ANSWER TYPE QUESTIONS (5 Marks)

1. Draw a neat and labelled diagram of mitochondria.
2. Differentiate between plant and animal cell with suitable figures.