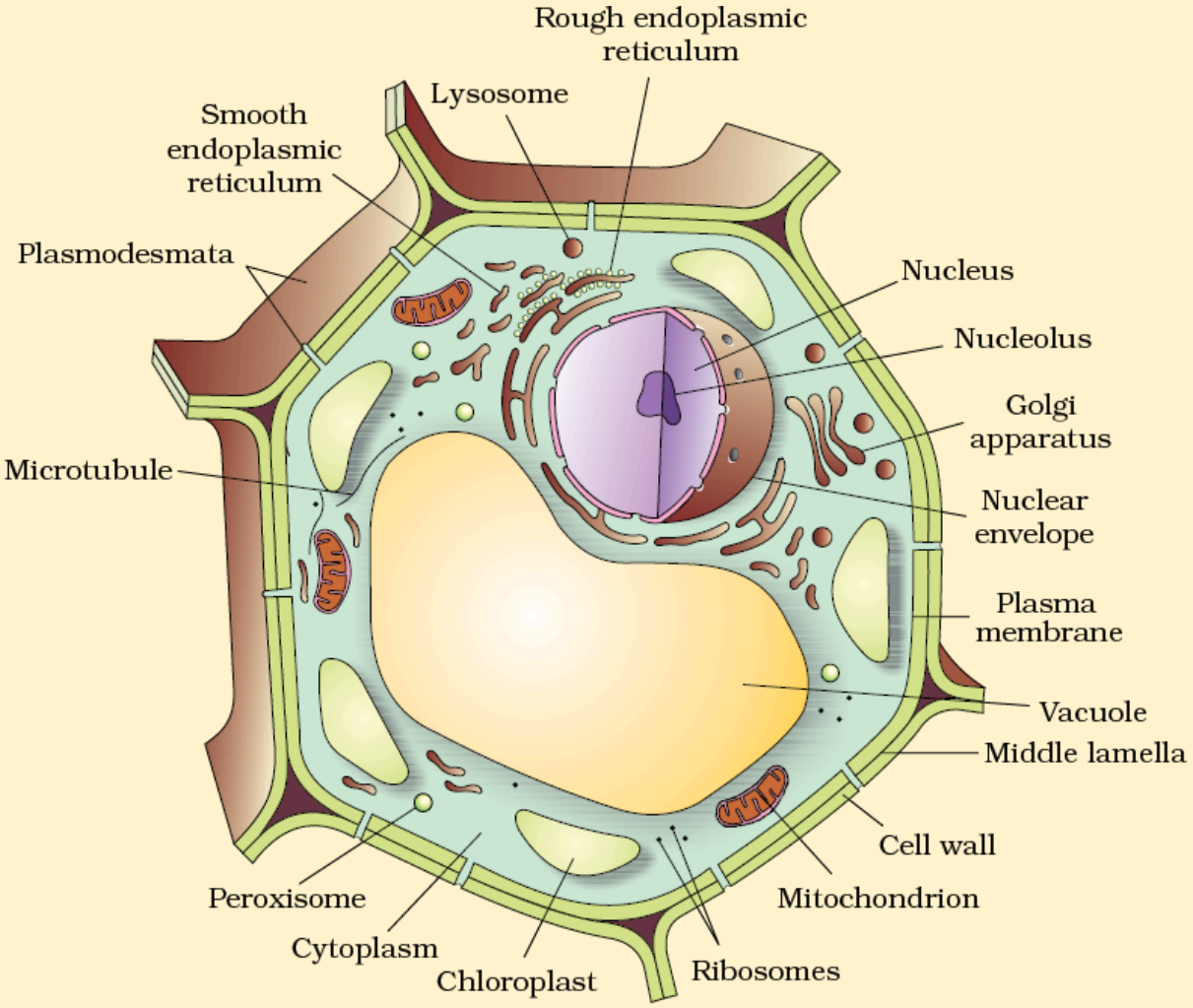
Chapter-05 : The fundamental unit of life

- Cell was discovered in a thin cork slice with the help of a primitive microscope by Robert Hooke in 1665. Cork resembled the structure of a honeycomb consisting of many little compartments. Cork is a substance which comes from the bark of a tree. Robert Hooke called these boxes cells. Cell is derived from Latin word 'cellule' which means 'a little room'.

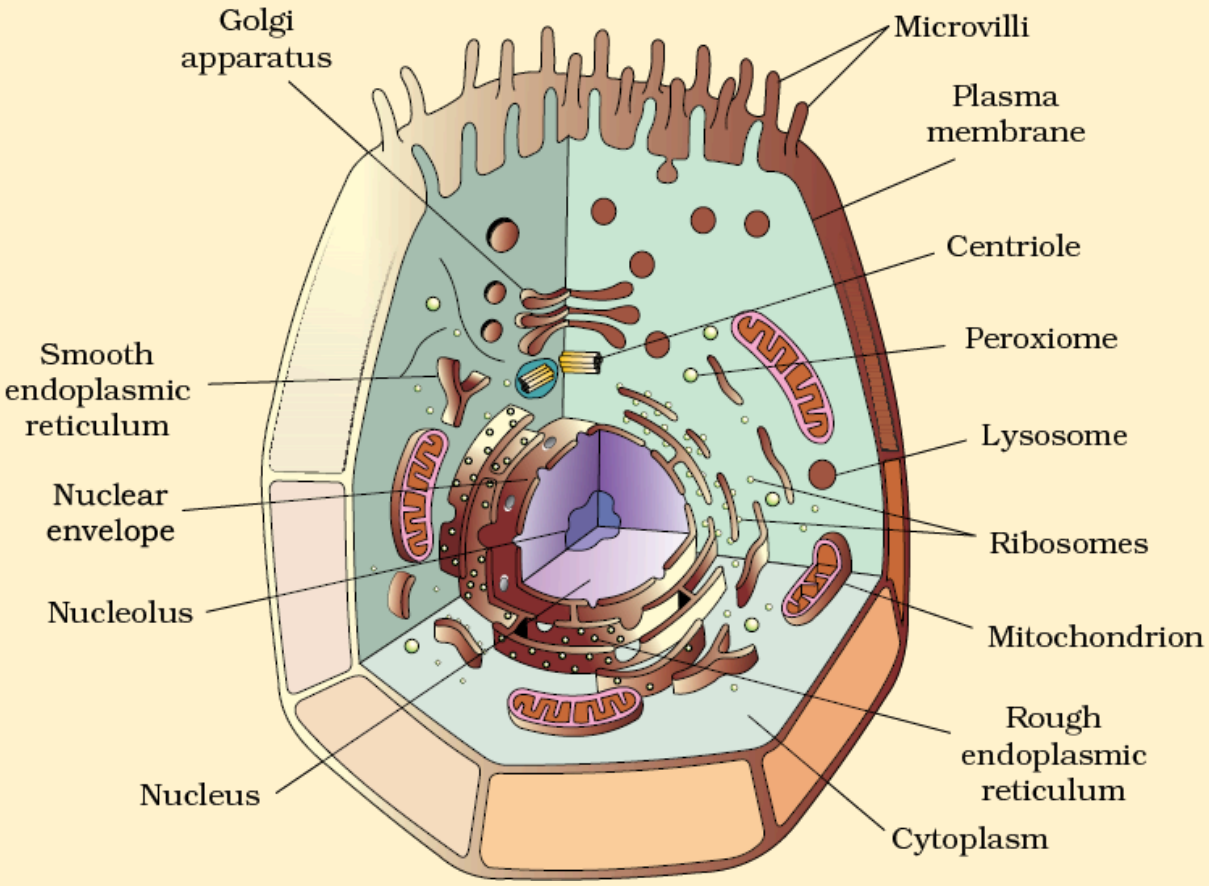
- The free living cell in pond water for the first time was discovered by Leeuwenhoek in 1674 with the help of improved microscope.
- The nucleus in the cell was discovered by Robert Brown in 1831.
- The term protoplasm (fluid substance of the cell) was coined by Purkinje in 1839.

- All the plants and animals are composed of cells and that the cell is the basic unit of life (cell theory) was presented by Schleiden (1838) and Schwann (1839).
- The cell theory was further expanded by Virchow (1855) by suggesting that all cells arise from pre-existing cells.
- The organism which is made up of single cell is called unicellular organisms. e.g. - Amoeba, Chlamydomonas, Paramecium and bacteria.
- The organism which is made up of more than one cell is called multicellular organisms. e.g. – Frog, Bird, Human, Snake etc.
- Every multicellular organism has come from a single cell. Thus all cells come from pre-existing cells.
- The shape and size of cells are of different kinds because they perform the specific function.
- There is a division of labour in multicellular organisms such as human beings. This means that different parts of the human body perform different functions. Similarly, division of labour is also seen within a single cell.
- Each cell has specific components (cell organelles) which perform a special function such as making new material, clearing up the waste material from the cell. These organelles together constitute the basic unit called the cell.
- Cell is the fundamental structural unit of living organisms. It is also the basic functional unit of life.



Website :) “harsitbiowallah.github.io” :) youtube:) “harist bio wallah”

Full lecture video on youtube



Cell wall :

- It is the outermost covering of the plant cell. It provides rigidity to the cell.
- The plant cell wall is mainly composed of cellulose. Cellulose is a complex substance and provides structural strength to plants.
- When a living plant cell loses water through osmosis there is shrinkage or contraction of the contents of the cell away from the cell wall. This phenomenon is known as plasmolysis.
- Cell walls permit the cells of plants, fungi and bacteria to withstand very dilute (hypotonic solution) external media without bursting. In this medium, the cells tend to take up water by osmosis. The cell swells, building up pressure against the cell wall. The wall exerts an equal pressure against the swollen cell which prevent from bursting.

Plasma membrane or Cell membrane or Plasmalemma :

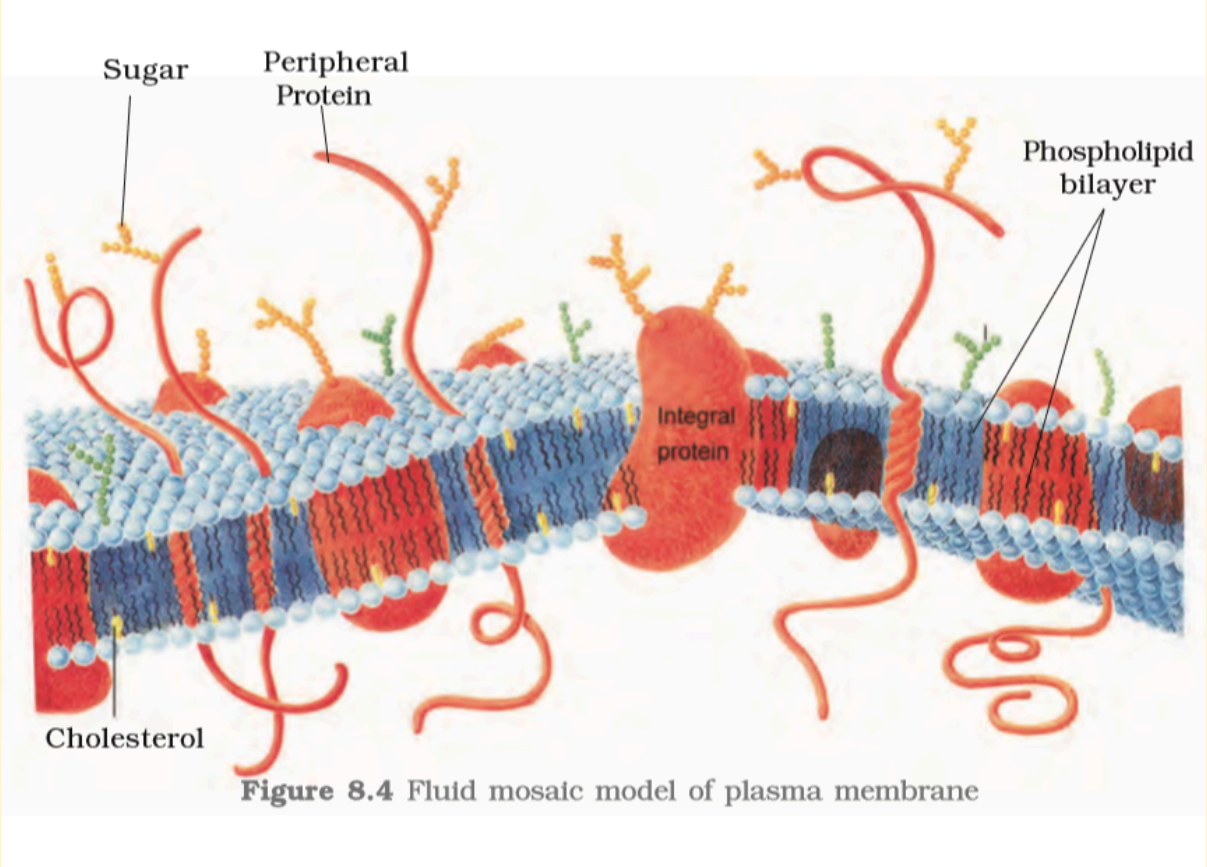


Figure 8.4 Fluid mosaic model of plasma membrane

- It is the outermost covering of the animal cell. It separates the contents of the cell from its external environment. It is the second outermost covering of the plant cell. The plasma membrane allows or permits the entry and exit of selected materials in and out of the cell.It also prevents the movement of some other materials. Therefore, the cell membrane is called a selectively permeable membrane.
- Carbon dioxide or oxygen can move across the cell membrane by a process called diffusion. The spontaneous movement of a substance from a region of high concentration to a region of low concentration is called diffusion.

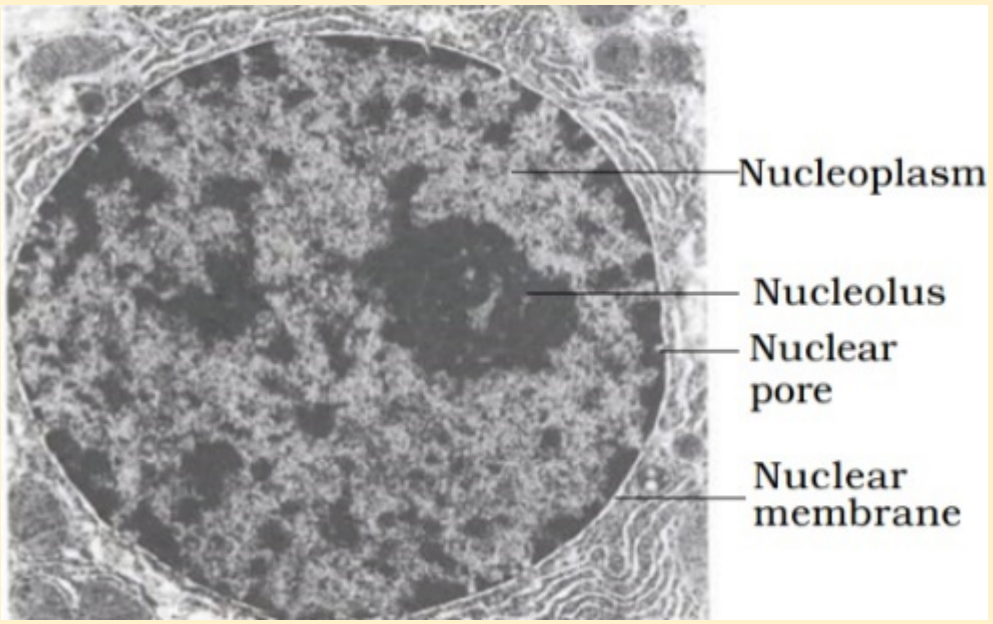
- Thus, diffusion plays an important role in gaseous exchange between the cells as well as the cell and its external environment. Water also obeys the law of diffusion.
- The movement of water molecules through a selectively permeable membrane is called osmosis. The movement of water across the plasma membrane is also affected by the amount of substance dissolved in water.
- Thus, osmosis is the passage of water from a region of high water concentration through a semi-permeable membrane to a region of low water concentration.
- The plasma membrane is flexible and is made up of organic molecules called lipids and proteins. The flexibility of the cell membrane also enables the cell to engulf in food and other material from its external environment. Such processes are known as endocytosis. Amoeba acquires its food through endocytosis.

Types of solution :

- If the medium surrounding the cell has a higher water concentration than the cell (outside solution is very dilute) then the cell will gain water by osmosis. Therefore, the cell will swell. Such a solution is known as a hypotonic solution.
- If the medium has exactly the same water concentration as the cell then there will be no net movement of water across the cell membrane. Such a solution is known as an isotonic solution.
- If the medium has a lower concentration of water than the cell (outside solution is very concentrated) then the cell will lose water by osmosis. Such a solution is known as a hypertonic solution. Therefore, the cell will shrink.

- Thus, osmosis is a special case of diffusion through a selectively permeable membrane.
- Unicellular freshwater organisms and most plant cells tend to gain water through osmosis. Absorption of water by plant roots is also an example of osmosis.
- Thus, diffusion is important in exchange of gases and water in the life of a cell.

Nucleus :



- The nucleus has a double layered covering called nuclear membrane. The nuclear membrane has pores which allow the transfer of material from inside the nucleus to the cytoplasm.
- The nucleus contains chromosomes which are visible as rod-shaped structures only when the cell is about to divide. Chromosomes contain information for inheritance of features from parents to next generation in the form of DNA (Deoxyribo Nucleic Acid) molecules. Chromosomes are composed of DNA and protein.
- DNA molecules contain the information necessary for constructing and organising cells. Functional segments of DNA

are called genes. Chromatin material (DNA thread) gets organized into chromosomes.

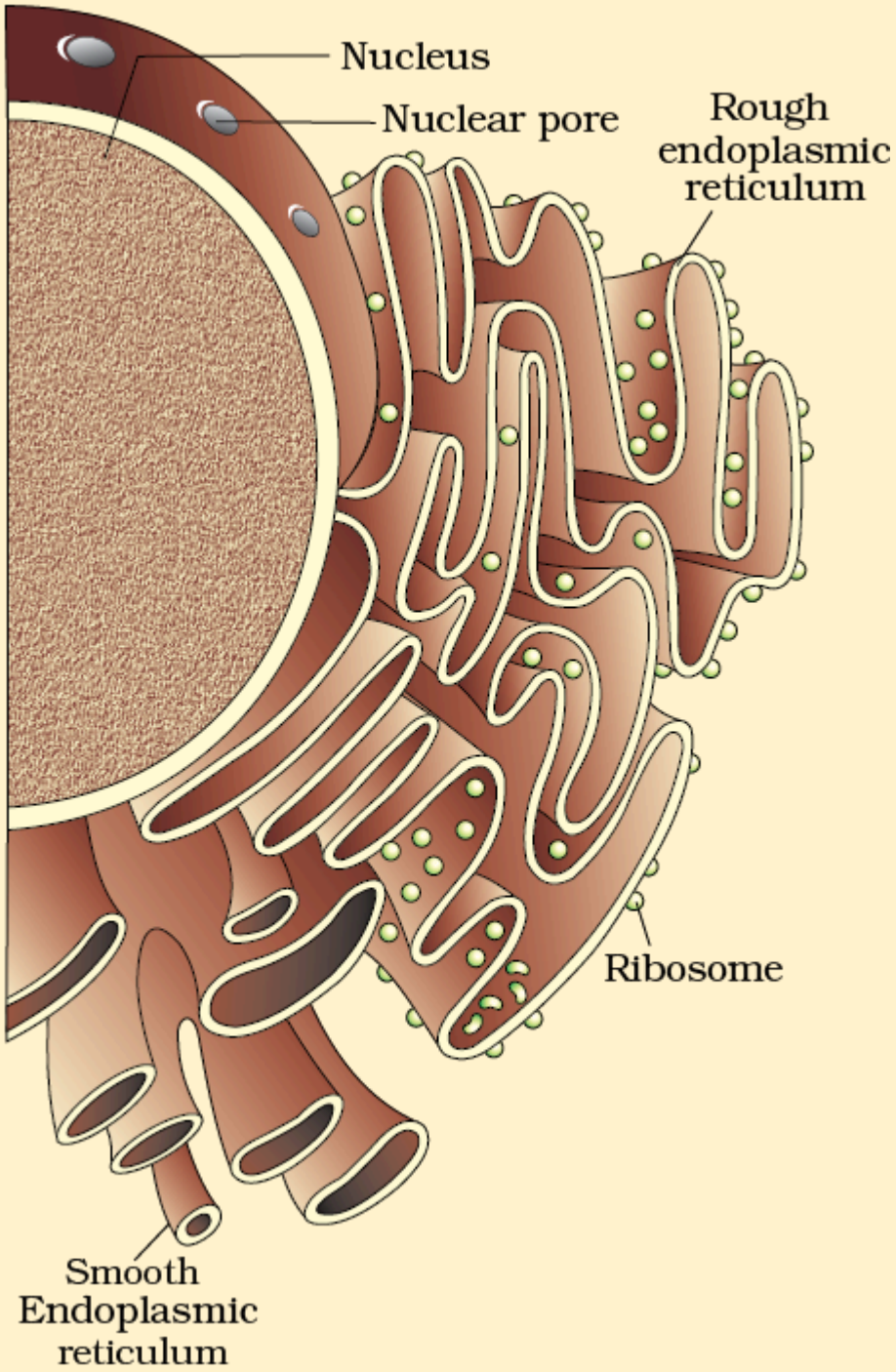
- The nucleus plays a central role in cellular reproduction. It also plays a crucial role in chemical activities of the cell. In bacteria, the nuclear region of the cell may be poorly defined due to the absence of a nuclear membrane and contain only nucleic acids is called a nucleoid.

- Those organisms whose cells lack a nuclear membrane called prokaryotes. Organisms with cells having a nuclear membrane are called eukaryotes.
- The chlorophyll in photosynthetic prokaryotic bacteria is associated with membranous vesicles but not with plastids as in eukaryotic cells.

Cytoplasm :

- The fluid content present inside the plasma membrane is called cytoplasm. It also contains many specialised cell organelles such as Endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, plastids etc. Each organelle performs a specific function for the cell.
- Cell organelles are enclosed by membranes. The membrane bound cell organelles are absent in prokaryotes and present in eukaryotes.
- Viruses lack any membranes and hence do not show characteristics of life until they enter a living body and use its cell machinery to multiply.

Endoplasmic reticulum :

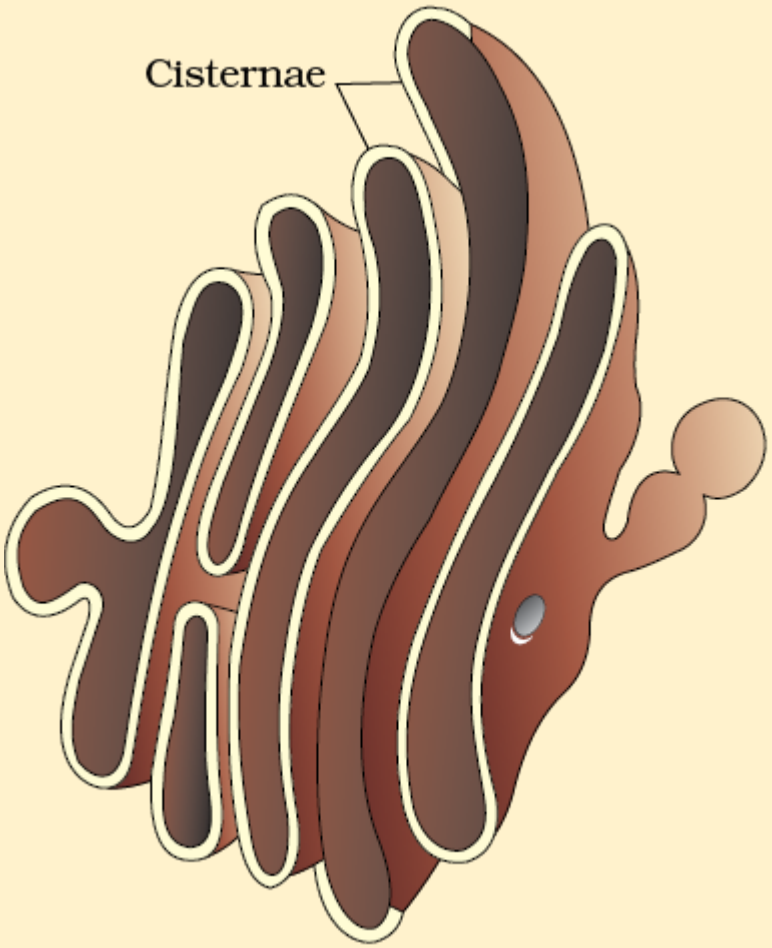


- The ER membrane is similar in structure to the plasma membrane.
- Two types of ER – Rough endoplasmic reticulum (RER) and Smooth endoplasmic reticulum (SER).
- RER looks rough under a microscope because it has particles called ribosomes attached to its surface. The ribosomes are

the sites of protein synthesis. The manufactured proteins are then sent to various places in the cell depending on need.

- The SER helps in the manufacture of fat molecules for cell function.
- Some of these proteins and lipids help in building the cell membrane known as membrane biogenesis.
- Some other proteins and lipids function as enzymes and hormones.
- ER serves as channels for the transport of materials (especially proteins) between various regions of the cytoplasm or between the cytoplasm and the nucleus.
- The ER also functions as a cytoplasmic framework providing a surface for some of the biochemical activities of the cell.
- In the liver cells, SER plays a crucial role in detoxifying many poisons and drugs.

Golgi apparatus :



- The Golgi apparatus was first described by Camillo Golgi. It consists of a system of membrane-bound vesicles arranged approximately parallel to each other in stacks called cisterns.
- The material synthesised near the ER is packaged and dispatched to various targets inside and outside the cell through the Golgi apparatus. Golgi apparatus helps in storage, modification and packaging of products in vesicles.
- The Golgi apparatus is also involved in the formation of lysosomes.

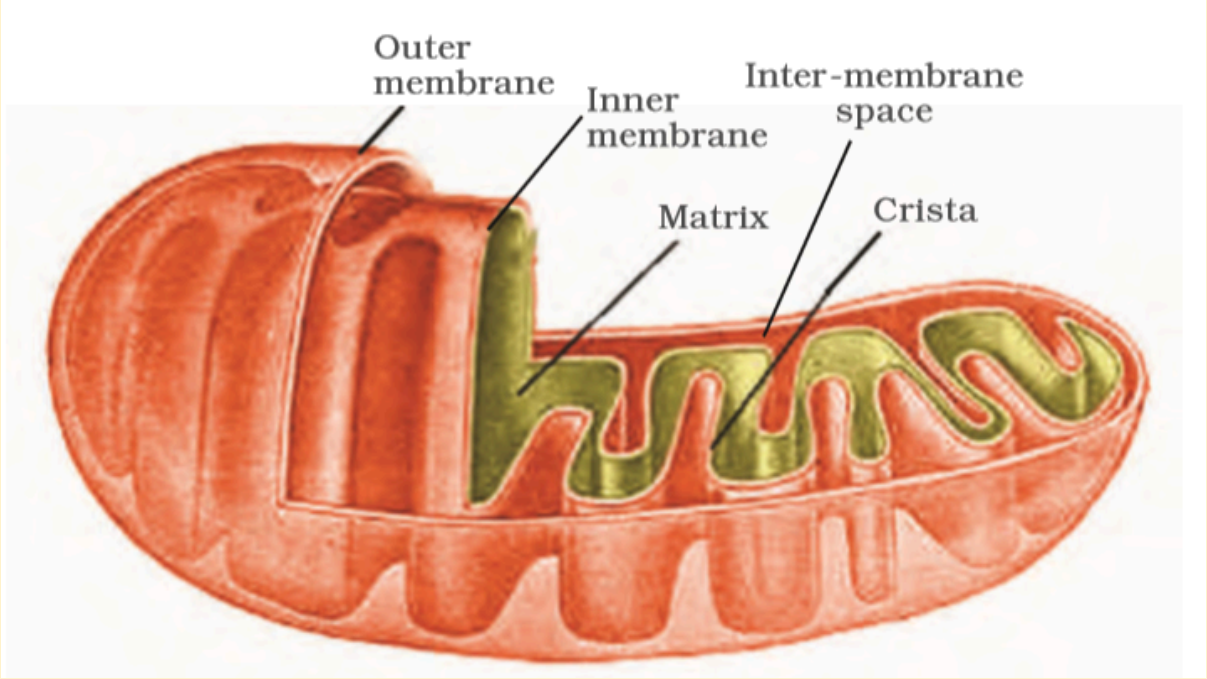
Lysosome :

- Lysosomes are a kind of waste disposal system of the cell. Lysosomes help to keep the cell clean by digesting any foreign material as well as worn out cell organelles.

- Foreign materials (bacteria or food as well as old organelles) entering in the cell is end up in the lysosomes. Lysosomes are able to do this because they contain powerful digestive enzymes capable of breaking down all organic material.

- During the disturbance in cellular metabolism (when the cell gets damaged), lysosomes may burst and the enzymes digest their own cell. Therefore, lysosomes are also known as the 'suicide bags' of a cell.
- Structurally, lysosomes are membrane-bound sacs filled with digestive enzymes which are made by RER.

Mitochondria :

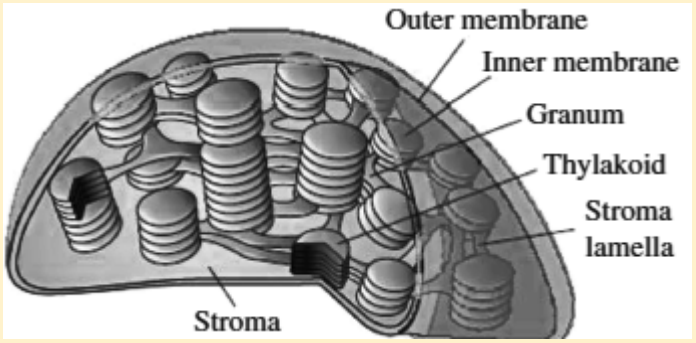


- Mitochondria are known as the powerhouses of the cell. The energy required for various chemical activities needed for life

is released by mitochondria in the form of ATP (Adenosine triphopshate) molecules.

- ATP is known as the energy currency of the cell. The body uses energy stored in ATP for making new chemical compounds and for mechanical work.
- Mitochondria have two membrane covering – the outer membrane is very porous while the inner membrane is deeply folded. These folds create a large surface area for ATP-generating chemical reactions.
- Mitochondria are semi-autonomous cell organelles because they have own DNA and ribosomes. Therefore, mitochondria are able to make some of their own proteins.

Plastid :



- Plastids are present only in plant cells. There are two types of plastids – chromoplasts (coloured plastids) and leucoplasts (white or colourless plastids).
- Plastids containing the pigment chlorophyll are known as chloroplasts. Chloroplasts are important for photosynthesis in plants. Chloroplasts also contain various yellow or orange pigments in addition to chlorophyll.
- Leucoplasts help in storage of starch, oils and protein granules.
- The internal organisation of the plastids consists of numerous membrane layers embedded in a material called the stroma.

- Plastids are similar to mitochondria in external structure. Plastids also have their own DNA and ribosomes.

Vacuole :

- Vacuoles are small sized in animal cells while plant cells have very large vacuoles. The vacuole of plant cells may occupy 50-90% of the cell volume.
- 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 single celled organisms like Amoeba, the food vacuole contains the food items that the Amoeba has consumed.
- In some unicellular organisms, specialised vacuoles also play important roles in expelling excess water and some wastes from the cell.

Important points :

- Camillo Golgi was born at Corteno near Brescia in 1843. He has got the Nobel prize in 1906 with Santiago Ramony Cajal for their work on the structure of the nervous system.