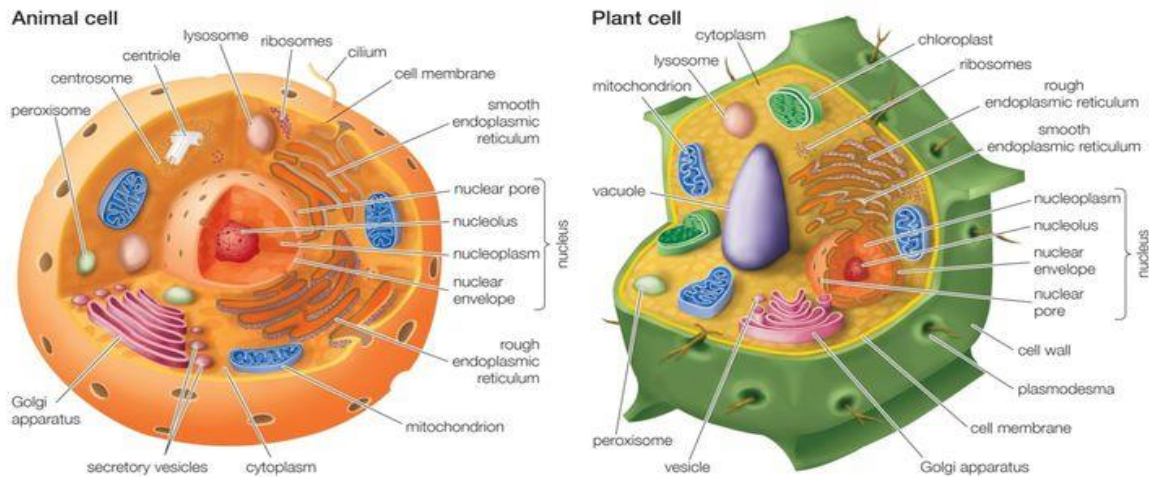


Cells / Cell Structure

Introduction



In this project we will study about cells and its structure. A cell is a tiny mass of protoplasm which is limited by a membrane and capable of performing all Functions of life. A typical cell is formed of three parts:

- (i) Plasma membrane or cell membrane
- (ii) Nucleus
- (iii) Cytoplasm.

It is called structural unit because the structure of human being is decided by the living cells present inside him and it is called functional unit because the functioning of organism is also dependent on these cells.

Discovery of the Cell

In 1665, Robert Hooke - an English scientist, saw cells for the first time in a thin slice of cork resembled the structure of honey comb like structures and he named this as a cell.

Discovery of Living Cells :

A Van Leeuwenhoek in 1674, studied the living cells as bacteria, protozoa, RBCs etc. for first time with the help of his improved microscope.

Shape & Size of Cells

The size and shape of cells vary considerably but all of these are ultimately determined by the specific function of the cell. Cells can be polygonal, spherical, elliptical, spindle shaped, cuboidal.

Some cells can change their shape like, white blood cells while most of the plant cells and animal cells have almost fixed shapes. Human RBCs are biconcave disc shaped, nerve cells are elongated thread like. In a multi-cellular organisms the shape of a cell depends mainly on its functional adaptations and partly on the surface tension, viscosity of the protoplasm, mechanical action between adjoining cells and rigidity of the cell membrane.

Plasma Membrane or Cell Membrane :

Each cell is bound by an extremely delicate, thin, elastic membrane, called plasma membrane. It encloses nucleus and cytoplasm of the cell, which constitutes the 'protoplasm' and it is a selectively permeable membrane. It is a living membrane and it is made up of lipids and proteins.

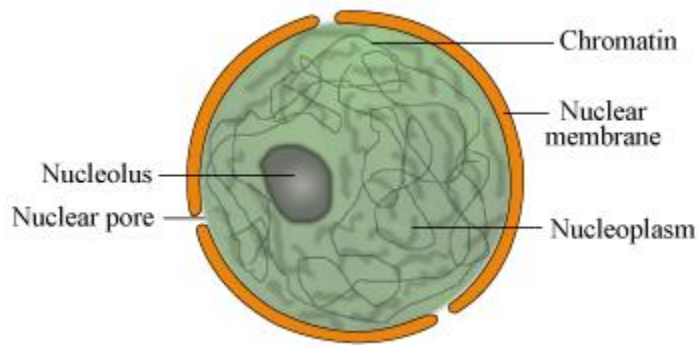
Functions :

The following Functions are performed by plasma membrane:

- It gives definite shape to the cell.
- It provides mechanical barrier for the protection of the internal contents on the cell.
- It is selectively permeable membrane.

The plasma is a vehicle for the transport of the body's important fuels such as glucose and basic fats. Other substances that are carried in the plasma include iron, which is essential for the formation of the oxygen carrying pigment hemoglobin, and a number of important hormones such as thyroid hormone. Plasma therefore consists of a water solution of minerals, foods and small amounts of essential compound such as hormones plus one other essential component-the protein that makes up a major part of it.

Nucleus:



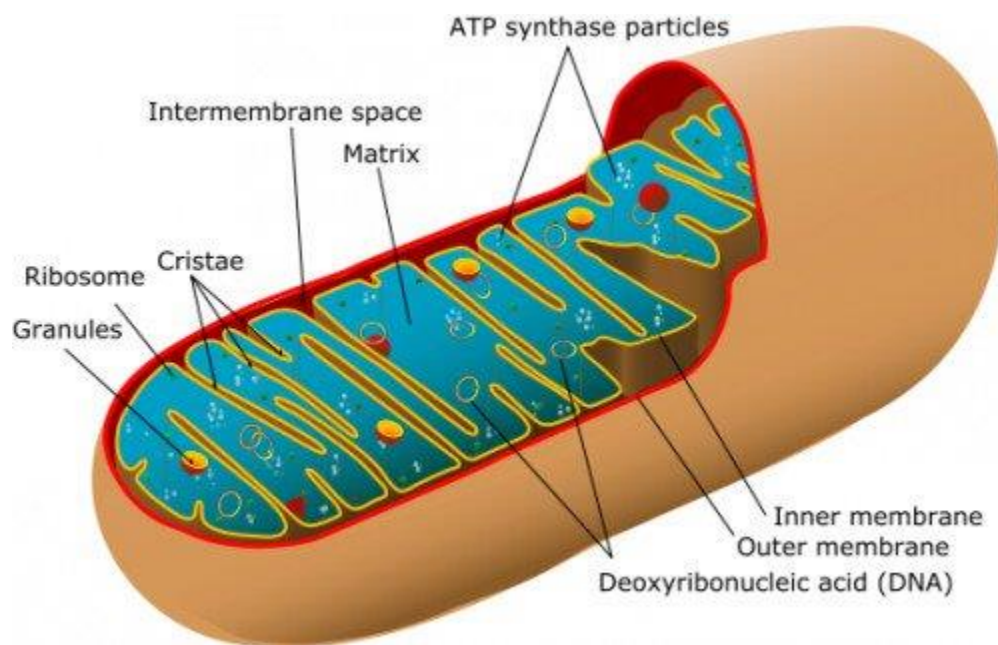
Nucleus is the largest cell structure. It is bounded by two membranes. It is a specialized protoplasmic body denser than the surrounding cytoplasm. It is oval or spherical in shape. It is the controlling Centre of all cell activities.

Cytoplasm:

The protoplasmic mass of the cell excluding nucleus is called as cytoplasm. When the cell is young, the cytoplasm completely fills the space in between nucleus and plasma membrane. As it increases in size, a number of small cavities appear in the cytoplasm called as vacuoles.

Cytoplasm is a viscous, homogeneous and colloidal liquid that contains various molecules such as water, amino acids, carbohydrates, lipids proteins, etc. It is also containing various organelles. These organelles may be bounded by a membrane. These organisms are the actual sites for various metabolic Functions of the cells. A cell has to perform several vital Functions of the body. These activities of the cell are performed by different cell organelles. These cell organelles are mostly enclosed by membranes. The different cell organelles are:

(a) Mitochondria :



Mitochondria (singular mitochondrion) are organelles found in the cytoplasm of all eukaryotic cells. Mammalian RBCs are devoid of mitochondria. They are commonly known as 'power house of the cell' because they contain enzymes necessary for the total oxidation of food and for release of high amount of energy in the form of ATP (Adenosine triphosphate) molecules.

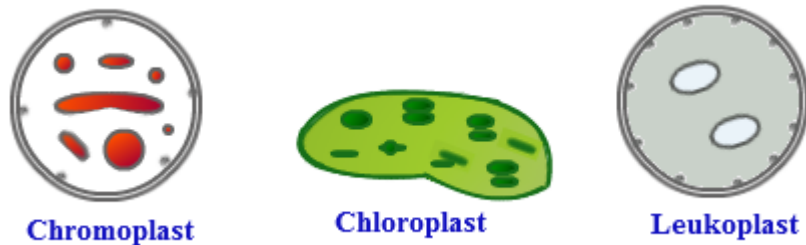
Mitochondria are rod shaped or filamentous organelles. Each mitochondrion is bounded by two membranes. The outer membrane is smooth whereas the inner membrane is folded inwards to form cristae. Cristae increases the surface area for metabolic reactions to take place. The inner membrane encloses a matrix, which contains

enzyme, which are required for the release of energy.

Function:

Mitochondria provide energy for vital activities of living cells, like synthesis of chemical compounds, their transport, and for mechanical work.

(b) Plastids:



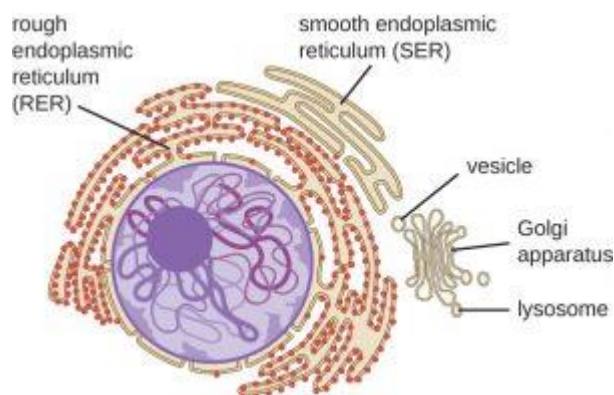
Plastids are the largest cell organelle found only in plant cells. On basis of pigments present in plastids, plastids are of following three types:

(i) Chromoplasts: Chromoplasts are variously coloured like red, orange, yellow, etc., except green. They are mostly present in flowers and fruits.

(ii) Leucoplasts: Leucoplasts are colorless plastids. They store the food of the plant body in the form starch, protein and fats. They are mostly present in the storage cells of roots and underground stems.

(iii) Chloroplasts: Chloroplasts are green coloured plastids because of the presence of chlorophyll. They occur abundantly in green leaves and also in green parts of the shoot. They trap the solar energy which is used for manufacturing food. So, they are the site of photosynthesis.

(c) Endoplasmic Reticulum:



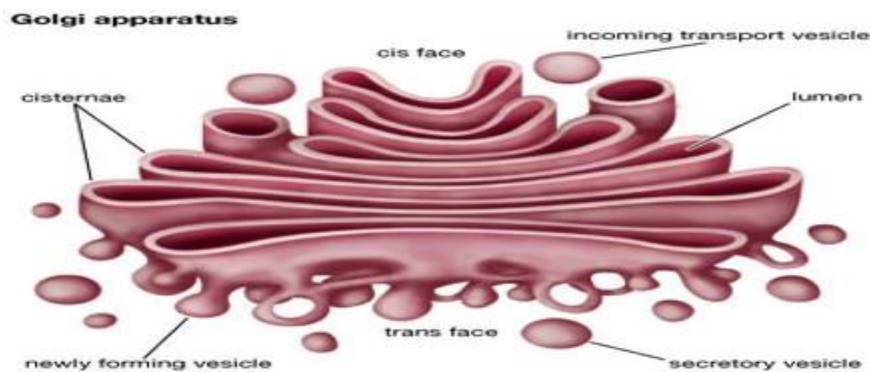
Endoplasmic reticulum (E.R.) is a complex network of membrane-bounded tubules. It is continuous between nuclear membrane and plasma membrane. It is present in all the cells except prokaryotes and mammalian erythrocytes (R.B.C.) Depending upon the presence or absence of ribosomes on the surface of E.R., there are two types of E.R. in cells. These are:

- Rough E.R. is characterized by the presence of ribosomes on its surface.
- Smooth E.R. is devoid of ribosomes on its surface.

Functions:

- Rough E.R. is the site of protein synthesis.
- Smooth E.R. helps in lipid synthesis.
- E.R. helps in intracellular and intercellular transport of substances.
- It gives internal support to the cytoplasm.

(d) Golgi Bodies:

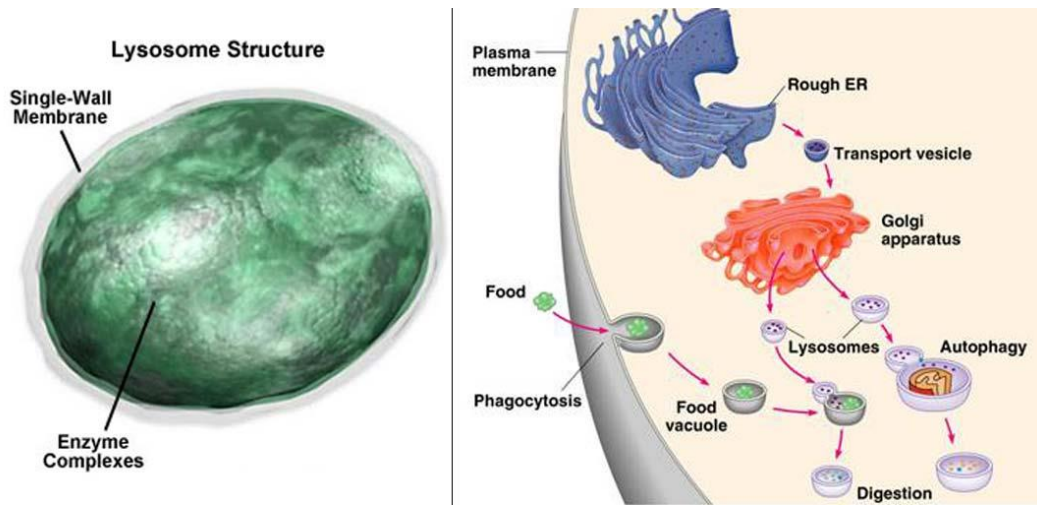


Golgi bodies, also known as Golgi apparatus or Golgi complex is composed of membrane bound, fluid filled vesicles, vacuoles and stack of many flattened closed sacs (cisternae). The plant cells contain many freely distributed subunits (cisternae) of Golgi apparatus, called dictyosomes. It is present in all the eukaryotes except mammalian R.B.C. Golgi apparatus is the secretory organelle of the cell.

Functions :

They help in the formation of cell plate during cell division.

(e) Lysosomes :



Lysosomes are small, spherical bodies bounded by a single membrane. These bodies contain hydrolytic enzymes (digestive enzymes). These enzymes are released when the lysosome's membrane bursts, permitting it to digest cellular structures and to act as 'suicidal bags' in causing cell death.

Functions :

They help in the destruction of foreign particles (bacteria and viruses). So, they provide protection to the body.

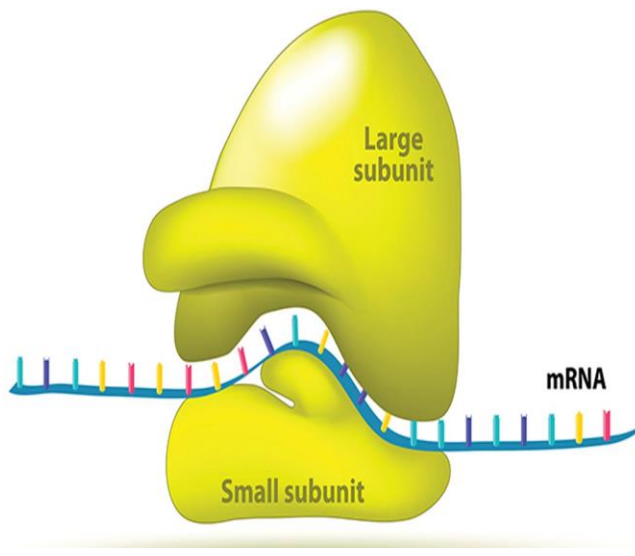
They help in intercellular and intracellular digestion of food particles.

(f) Peroxisomes : Peroxisomes are small spherical bodies bounded by a single membrane. They are found in both plant and animal cells. They are mostly found in kidney and liver cells. They contain powerful oxidative enzymes for peroxide biosynthesis.

Functions :

- They help in carrying out oxidative reactions, which include removal of toxic substances.
- They take part in lipid metabolism in animals.

g) Ribosomes :



Ribosomes are extremely small, round bodies found either in free state in the cytoplasm or attached to the surface of E.R. They are composed of ribonucleic acid (RNA) and proteins. They are not bounded by membrane. So, they are present in both prokaryotes as well as in eukaryotes. But, they are absent in mammalian R.B.C.s

Functions:

- Ribosomes are the site of protein synthesis in the cell.

(h) Centrosome: It is found in animal cells only. It is not found in higher plants. It occurs close to the nucleus and has usually two small granules, called centrioles, which are embedded in a cytoplasmic body, called centrosome. In plant cells, the polar caps perform the function of cell division.

Functions:

- During cell division centrioles migrate to the poles of animal cells and are involved in the formation of the spindle.

(i) **Cilia and Flagella:** Cilia and flagella are hair-like, thin, microscopic structures found on the outer surface of the cell. Basically, both have a similar structure but cilia are small sized and more numerous, while flagella are long, whip-like and fewer (usually one or two in a cell) in number.

Function:

• Both cilia and flagella are locomotory organelles of the cell.

(j) **Vacuoles:** Vacuoles are filled with liquid or sap and are membrane bound. In plant cells, vacuoles are larger in size but lesser in number as compared to animal cells.

Major portion (90%) of a plant cell is occupied by vacuoles. Vacuole is centrally located in plant cells, so the nucleus and other organelles in plant cells are pushed near the boundary wall.

Functions:

• In animal cells, vacuoles are involved in the maintenance of water balance. It provides turgidity and rigidity to plant cells.

• Vacuoles are helpful in separation of a variety of substances present in the cell sap from the cytoplasm. In plant cells, cell sap contains sugar, amino acids, proteins, minerals and metabolic wastes.

Difference between Plant Cells and Animal Cells:

Plant Cells	Animal Cells
1. Cell wall is present.	1. Cell wall is absent.
2. Plastids are present.	2. Plastids are absent.
3. Centrosomes and centrioles are absent instead two small clear areas called polar caps are present.	3. Centrosomes with one or two centrioles are present.
4. Vacuoles are larger in size and less in numerous.	4. Vacuoles are smaller in size and more number.
5. Nucleus lies on one side in the peripheral cytoplasm.	5. Nucleus usually lies in the centre.
6. Plant cells cannot change their shape.	6. Animal cells can change their shape.

7. Contain several subunits of Golgi apparatus called dictyosomes.	7. Prominent and highly complex Golgi bodies present near nucleus.
8. Usually larger in size.	8. Comparatively smaller in size.

Table: Sizes of Small Cells

Cells	Minimum (in micron)	Maximum (in micron)
Mycoplasma	0.1	0.5
Human R.B.C.	7	20
Human Liver Cell	20	30

Graphical Presentation of Mycoplasma, Human RBC and Human Liver Cell

Table: Sizes of Big Cells

Cells	Size (in micron)
Acetabularia	100000
Ostrich egg	180000
Nerve Cell	1000000