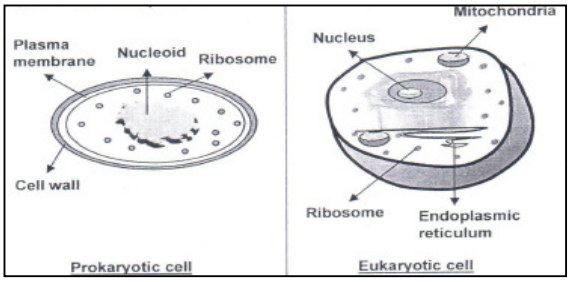
Difference between Prokaryotic and Eukaryotic Cells

All living organisms are made up of cells. And based on the kind of cells they are made up of, they are divided into two groups: 'prokaryotes' and 'eukaryotes'. Prokaryotes which include bacteria and blue green algae appeared about 3500 million years ago. All other organisms are eukaryotes and they probably from prokaryotes.



Feature	Prokaryotic Cell	Eukaryotic Cell
1. Size	Size generally small (1-10) μ m: 1 μ m = 10^{-6} m	Size generally large (5-100) μ m
2. Nuclear region	Lacks nuclear membrane and nuclear region.	Well defined & surrounded by a double layered nuclear membrane.
3. Chromosome	Single	More than one.
4. Cell Organelles	Membrane bound cell organelles absent.	Membrane bound cell organelles present. like mitochondria, plastids etc
5. Cell Division	Takes place by binary fission or budding	Takes place by mitotic or meiotic cell division.
6. Organisms	Found in bacteria, blue green algae etc	Found in fungi, plants and animals

Cell Organelle

Endoplasmic Reticulum (ER): The endoplasmic reticulum is a network of tube-like structures running through the cytoplasm. Some parts are connected to the nuclear membrane, while others are connected to the cell membrane. Endoplasmic reticulum is of two types: rough and smooth. If ribosomes are attached to it, the reticulum is rough, otherwise it is smooth.

Functions of Endoplasmic Reticulum

1. It increases the surface area of the cytoplasm for various metabolic activities of the cell.
2. It gives internal support to the colloidal matrix (cytoplasm).
3. It is associated with the synthesis, storage and transport of metabolic products.
4. It helps in the formation of the cell plate and nuclear membrane during cell division.
5. Rough endoplasmic reticulum (RER) is associated with the synthesis of proteins.
6. Smooth endoplasmic reticulum (SER) secretes lipids which along with proteins constitute cell membrane by a process called membrane biogenesis.
7. SER plays a crucial role in detoxifying many poisons and drugs.

Ribosomes: Ribosomes are extremely small, round bodies found either in the free state in the cytoplasm or attached to the surface of the ER. They are composed of ribonucleoprotein (ribonucleic acid and protein).

Functions of Ribosomes

1. The main function of ribosome's is to act as a platform or work place for the synthesis of proteins.

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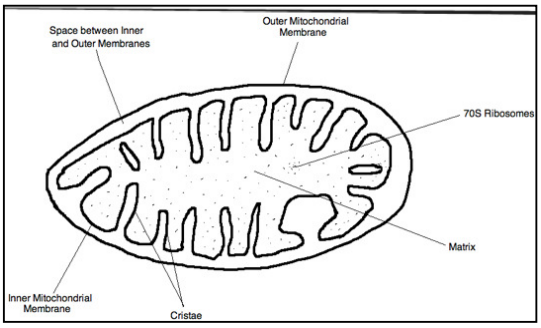
Mitochondria : Mitochondria are small, rod-shaped organelles found in large numbers. Each mitochondrion is bounded by two membranes- outer and inner. The outer membrane is smooth and the inner membrane is pushed inwards at intervals forming crests called cristae. The cristae lie in a ground substance called matrix. Mitochondria possess enzymes necessary for the oxidation of carbohydrates.



This process releases energy in the form of ATP. This is why mitochondria are known as the powerhouse of the cell. Mitochondria have their own DNA and ribosomes. They can synthesize their own proteins and thus they are semiautonomous organelles.

Functions of Mitochondria

1. Mitochondria provide energy for the vital activities of living cells.

Golgi body : Golgi body was first discovered by Camillo Golgi. Golgi bodies complex are formed by stacks of flattened (saucer-shaped) membranes or flattened sacs called cisternae. There are some conspicuous vacuoles and clusters of very small vesicles (bladder-like structures) near the cisternae. Golgi bodies are usually called dictyosomes in plants.

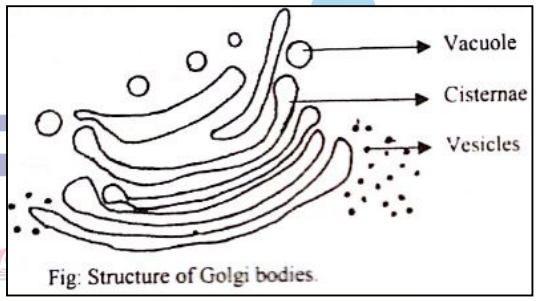


Fig: Structure of Golgi bodies.

Functions of Golgi Body

1. They store, modify, package and condense the proteins synthesized in the ribosomes.

2. They form the cell plate during cell division.

3. They set aside digestive enzymes in tiny membrane-bound vesicles which become lysosomes.

4. They add sugars to some proteins and synthesize some polysaccharides for the cell membrane.

Plastids Plastids are double-membraned organelles which are found only in plant cells. They are usually spherical or discoidal in shape, and their average size is 4 to 6 p.m. a plastid shows two distinct regions-grana and stroma. Grana are stacks of membrane-bound, flattened, discoid sacs containing chlorophyll molecules. These molecules are responsible for the production of food by the process of photosynthesis. They are, therefore, called the kitchen of the cell. The homogenous matrix in which grana are embedded is known as stroma. Like mitochondria, plastids also contain their own DNA and ribosome's.

Plastids are of three types:

Leucoplasts are colourless plastids. They store food ion the starch, protein and lipids.

1. **Chloroplasts** are green plastids which contain chlorophyll. Green leaves have chloroplasts.
2. **Chromoplasts** are variously coloured plastids in flowers and fruit.

Functions of Plastids

1. By trapping solar energy, green plastids manufacture food through photosynthesis.

2. Chromoplasts provide colour to various flowering parts.
3. Leucoplasts help in the storage of protein, starch and lipid (oil).

Lysosomes : These saclike, small, spherical, single membrane-bound vesicles contain enzymes. These enzymes are synthesized in the RER, which are brought to the Golgi complex. Lysosomes are formed by the Golgi complex. They occur in animal cells and in the meristematic cells of a few plants.

Functions

1. They help in breaking down (digesting) large molecules of the cell.
2. They work in defence against bacteria and viruses.
3. During starvation, lysosomes act on the or on cellular organelles and digest them. This results in cell death. Hence lysosomes are called suicide bags or demolition squads.

Centrioles: The centrosome is a distinct region of the cytoplasm close to the nucleus of animal cells. It usually has two central granules called Centrioles. The Centrioles are hollow, cylindrical structures made of microtubules arranged in a specific manner. They are arranged at right angles to each other.

Function of Centrioles

1. At the time of cell division, Centrioles move to the poles and form spindle fibres which help in the movement of chromatids (daughter chromosomes) in the daughter cells.
2. They help in the formation of cilia and flagella.

Cytoskeleton : The cytoskeleton is formed by microtubules and microfilaments.

A. Microtubules are hollow tubules made up of protein units called tubulin. They from Centrioles, flagella and cilia.

B. Microfilaments are thinner filaments. They are solid rods, built from a protein called actin.

Function of Cytoskeleton: The cytoskeleton gives structural support to the cell, and helps in cell motility (cell movement, e.g., amoeboid movement).

Vacuoles

Vacuoles may be small or larger. These organelles are filled with liquid or sap and are membrane-bound. In animal cell, vacuoles are smaller in size and lesser in number than in plan t cells. In some plant cells, only one large vacuoles is present. The major portion of a plant cell is occupied (can contract) or non-contractile. When the pressure of the contractile vacuole increases, it contracts and releases its contents. In unicellular organisms like Amoeba, food particles are present inside food vacuoles.

Functions of Vacuoles

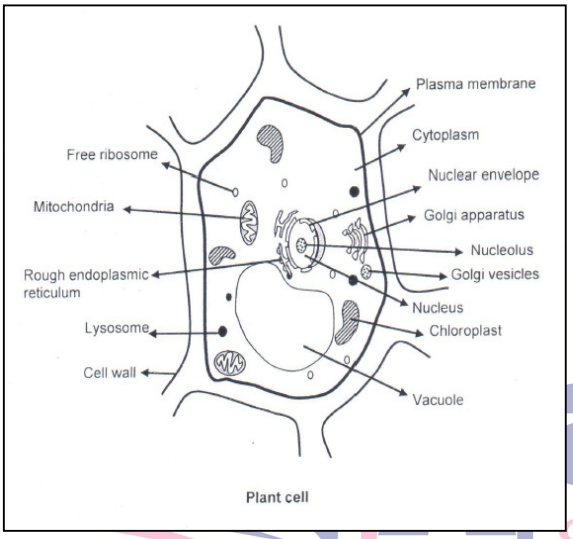
1. In animals, vacuoles are often associated with the maintenance of water balance.
2. They work in osmoregulastion, i.e., the maintenance of internal pressure.
3. They store various substances including waste products.

Plant and Animal Cells

The basic organization of plant and animal cells is same, though there are some differences:

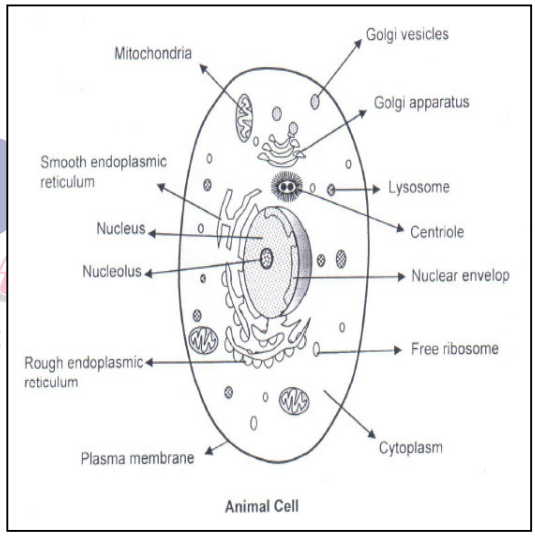
S No.	Plant Cell	Animal Cell
1	They are usually larger than animal cells	They are generally small in size.
2	The plasma membrane of a plant cell	Cell wall is absent.

	is surrounded by a rigid cell wall made up of cellulose.	
3	Plastids (leucoplasts, chloroplasts, chromoplasts) are present in plant cell	Plastids are absent.
4	Vacuoles are present in abundance. They are larger in size.	Vacuoles are less in number and smaller in size.
5	They have many small simpler units of Golgi complex called dictyosomes.	They have a single highly elaborate Golgi complex.
6	Centrioles are absent.	Centrioles are present.
7	They have a regular shape.	They are usually irregular in shape.



Plant cell

Movement Of Substances Across The Cell Membrane



Animal Cell

Diffusion : Diffusion is the process of mixing up of different substances due to the random motion of their component atoms, molecules and ions. Diffusion takes place in solids, liquids and gases. Gases can mix up perfectly with each other and become uniform. In liquids, diffusion is slower than in gases. In solids, diffusion occurs very slowly at normal temperatures.

Transport of substances by diffusion

- When gases like carbon dioxide and oxygen accumulate inside the cell, their concentration is greater inside compared to the external environment. Due to this difference in concentrations, their net movement is to the outside by diffuse, i.e., from their region of higher concentration to lower concentration.
- Similarly, when the concentration is greater outside, O_2 and CO_2 move inside the cell from the external environment following the principle of diffusion. In unicellular organisms, transport of gases by diffusion occurs all over the cell membrane, e.g., Chlamydomonas, Paramecium, Amoeba, etc. In multicellular organisms like Hydra and sponges, transport of oxygen and nutrients also takes place through diffusion.

Osmosis : Diffusion of water across a semipermeable membrane is called Osmosis. The movement of water in living beings depends on osmosis. The movement of water molecules across the cell membrane is affected by the amount of solute dissolved in it. Here also the water molecules are free to pass across the membrane in both directions. But the net movement of water molecules takes place from the dilute solution to the concentrated one.

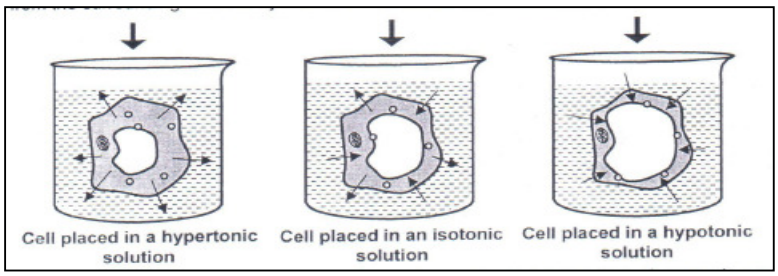
Transport of water between cells and their environment

What will happen to an animal cell or a plant cell placed in a sugar or salt solution in water? Osmosis will take place and the movement of water molecules will depend on the concentration of the surrounding solution.

1. In a hypotonic (dilute) solution, the cell will gain water by osmosis. This is because there is a higher water concentration outside the cell. The cell sap, or cytoplasm, has less water molecules than the outer solution. Water molecules pass in both directions across the cell membrane. But more water enters the cell than goes out of it. So the net movement of water is into the cell, due to which the cell increases in volume, or swell up. This is called endosmosis.

2. When the cell is placed in an placed in an isotonic solution, which has exactly the same water concentration as the cell, there will be no net movement of water molecules across the cell membrane. Although water passes the cell membrane in both directions, the amount coming in is the same as the amount going out. So there is no net movement of water and the cell remains the same size.

3. When the cell is immersed in a hypertonic (very concentrated) solution, water will diffuse out of the cell by osmosis. This is because there is a low concentration of water outside the cell. Although water molecules pass the cell membrane in both directions, more water goes out of the cell than enters it. As a result, the cell will shrink. This process is called exosmosis. If exosmosis continues in a plant cell, the cytoplasm would appear shrunken. This is called plasmolysis and cell is said to be plasmolysed.



Demonstration of osmosis in an egg

1. Take a beaker containing dilute Hydrochloric acid. Put an egg inside the beaker.
2. The hard shell of the egg, which is made up of calcium carbonate, gets dissolved. The egg is now enclosed by a thin outer semi - permeable membrane.
3. Put this deshelled egg in pure water. After a few minutes the egg swells up. The swelling is due to the movement of water into the egg by osmosis from the external environment.

Demonstration of osmosis in raisins: Put some dried raisins in a bowl. Partially fill it with water. After 10 minutes you will observe that the raisins swell up. This is

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due to endosmosis. Now put the swollen raisins in a concentrated salt solution. The raisins shrink as they lose water due to exosmosis.

Significance of Osmosis and Diffusion

- Diffusion and Osmosis play an important role in living world. Diffusion helps in exchange of gases between cells and their environment. Single celled organisms that live in freshwater habitats gain water by osmosis. The tendency of water to pass into aquatic organisms by osmosis has to be countered to expel the excess.
- Plants absorb water through their roots from the soil by osmosis. It is carried upwards by xylem tubes to leaves, flowers and other parts.
- The food synthesized in leaves is distributed to different parts through phloem tissues following the principle of osmosis.
- In plants, cell to cell diffusion of water is controlled by osmosis. Osmosis regulates the opening and closing of stomata in leaves. They are surrounded by guard cells.

Significance of Cell Membrane

- The net movement of substances is from high concentration to lower concentration. There is no expenditure of cellular energy.
- Cell membrane is selectively permeable and flexible. This is because it is made up of organic molecules called lipids and proteins. The transport of some substances is against the concentration gradient. This requires cellular energy. Organic molecules like glucose and inorganic ions like sodium and potassium are transported in this way.

Exercise

1. What is endocytosis?
2. What is a cell wall? Is it living, dead or non living? Give its important functions.
3. What is plasmolysis? Is the similar phenomena observed in animal cells also? Why or why not? Give an experimental demonstration for plasmolysis.
4. How can you demonstrate experimentally that osmosis occurs in living cells only and not in dead cells?
5. What are chromosomes? Where are they present? Give their significance and composition.
6. What is chromatin? Compare and contrast chromatin from chromosome
7. What is observed in an onion peel under a microscope? What additional information is obtained on adding a drop of iodine solution over it
8. What is the reason for adding excess sugar to jams and jellies?
9. What is ER? What are the two types of ER? Give the functions of each.
10. What is membrane biogenesis? How does ER help in membrane biogenesis?

Worksheet

1. Give the location and the main function of ribosomes?
2. What are the components of Golgi apparatus? Give the function of each component.
3. What makes mitochondria semi-autonomous in nature?
4. Why are large number of mitochondria present at the base of cilia and flagella?
5. Draw a well labeled diagram of a prokaryotic cell.
6. Name the smallest and the largest known cells.
7. Which cell organelle helps to detoxify poisons and rigs from liver cells?
8. What are the functions of Vacuoles? What is its role in amoeba?

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