

CELL: THE FUNDAMENTAL UNIT OF LIFE

Cell: Cell is called the fundamental unit of life.

A cell is capable of independent existence and can carry out all the functions which are necessary for a living being. A cell carries out nutrition, respiration, excretion, transportation and reproduction; the way an individual organism does. Unicellular organisms are capable of independent existence which shows a cell's capability to exist independently. Due to this, a cell is called the fundamental and structural unit of life. All living beings are composed of the basic unit of life, i.e. cell.

CELL THEORY (Schleiden, Schwann and Virchow):

- All living organisms are composed of one or more cells.
- The cell is the basic unit of structure, function, and organization in all organisms.
- All cells come from preexisting, living cells.

STRUCTURE OF CELL

Shape and Size of Cells:- Cells come in all shapes and sizes. While most of the cells are spherical in shape, cells of various other shapes are also found. Most of the cells are microscopic in size, i.e. it is impossible to see them with naked eyes. Some cells are fairly large, e.g. a neuron in human body can be as long as 1 meter. The egg of an ostrich is the largest known cell of a living animal and an average egg is 15 cm long and 13 cm wide.

A cell is enclosed in a membranous casing and is filled with a liquid substance which is called the cytoplasm. There are many cell organelles in a typical cell. Some of the main structures of a cell are as follows:

Cell wall: Cell wall is made of cellulose. It is somewhat hard but permeable to most of the substances. Cell wall is available in plant cells and in cells of bacteria and fungi.

Plasma membrane: Plasma membrane is a semi-permeable membrane. It is composed of bilayer of lipid and protein.

Functions of Plasma Membrane: Plasma membrane provides a container to the cytoplasm. It facilitates passage of various substances in and out of the cell.

Nucleus: Nucleus is covered by double membrane; called nuclear membrane. The fluid which is inside the nucleus is called nucleoplasm. Nucleus contains chromosomes which are important for the functioning of a cell. Chromosomes contain genes which are the carriers of genetic information. Nucleus plays an important role during cell division. Nucleus controls all the functions of the cell.

Prokaryotes and Eukaryotes:- Based on the level of organization of nuclear material, a cell can be categorized as prokaryote or eukaryote. In some organisms, the true nucleus is absent. This means that the DNA and RNA are not bound by a membrane. Bacteria are examples of prokaryotes. When genetic materials are bound by a membrane, it is termed as true nucleus. In this case, the cell is called eukaryotic. Organisms other than bacteria are eukaryotes. Eukaryotes are considered as more advanced than prokaryotes.

Mitochondria: Mitochondrion is a capsule-like structure. It is a double membrane structure. Its inner membrane is projected into numerous finger-like structures; called cristae. Mitochondria are the sites of cellular respiration. After cellular respiration, energy is stored in the form of ATP (Adenosine triphosphate); in mitochondria. Mitochondria have their own DNA and ribosomes and hence mitochondria can produce their own protein.

Functions of Mitochondria:- Cellular respiration; due to this, mitochondria are also known as the 'powerhouse of the cell'.

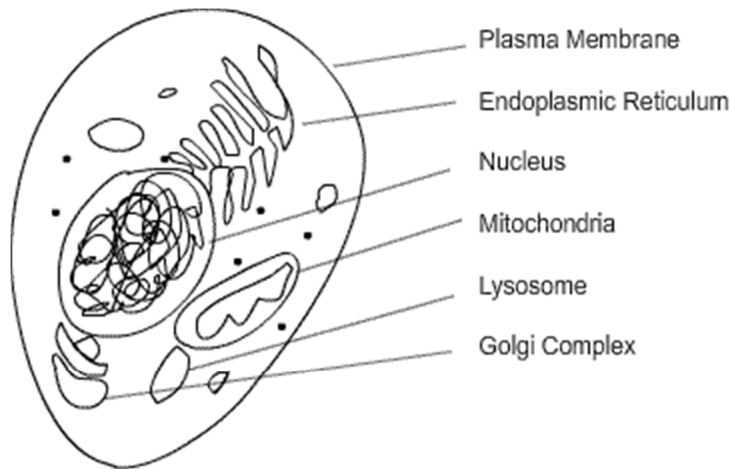


Fig: A typical animal cell

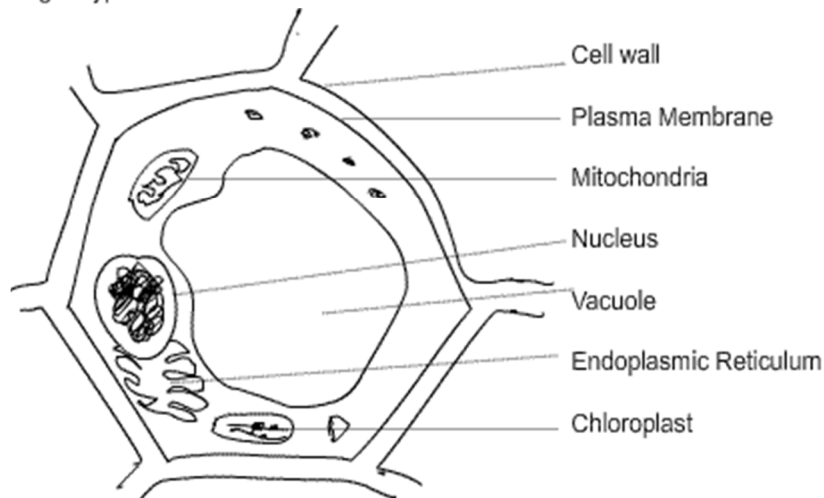


Fig: A typical plant cell

Endoplasmic Reticulum: Endoplasmic reticulum is a mesh-like structure which is composed of numerous tubes. It extends from the plasma membrane to the nuclear membrane. There are two kinds of endoplasmic reticulum, viz. smooth ER and rough ER. Rough ER has ribosomes on its surface which give it the rough appearance.

Function of ER: It serves as the transport channel in the cell. Substances are transported from cell membrane to cytoplasm and to nucleus and vice-versa. ER also serves the role of packaging many substances in the cell.

Golgi Complex: Golgi Complex was discovered by Camillo Golgi. It is composed of many sac-like structures which are stacked one above another.

Functions of Golgi Complex: Golgi complex is responsible for packaging of various substances in the cell.

Lysosome: Lysosome are small sac-like structures and they are derived from Golgi complex. Lysosome contains digestive enzymes.

Functions of lysosome: The enzymes in the lysosome digest foreign particles and thus destroy them. Sometimes, the lysosome may burst open and its content ends up digesting the contents of the cell. The cell gets killed in the process. Due to this, lysosome is also called the 'suicide bag of the cell'.

Ribosome: These are tiny dot like structures interspersed in the cytoplasm and also on the surface of Rough ER. Ribosome is responsible for protein synthesis.

Plastids: These are somewhat similar to mitochondria; in appearance. Plastids are found in plant cells. They are of two types, chromoplast and leucoplast. Colourful plastids are called chromoplast and colourless plastids are called leucoplast. Chloroplast is green in colour and is found in green parts of plants. Plastids too have their own DNA and ribosome.

Functions of Plastids: Leucoplasts are responsible for storing food; such as carbohydrates, protein and lipid. Chromoplasts impart various colours to the plant parts. A leaf of a plant is green in colour because of chloroplast. Chloroplast is the site of photosynthesis.

Vacuoles: These are fluid filled chambers and are often seen in many cells. Vacuoles are very large in plant cells. A plant cell usually has single but large vacuole. Such a vacuole fills almost the entire space inside the cell. Vacuoles are much smaller and very few in animal cells.

Plant Cell Vs Animal Cell

Plant cell	Animal cell
Cell wall present	Cell wall absent
Plastids present	Plastids absent
Vacuole is usually very large and single	Vacuoles are much smaller and may be absent

HISTORY OF DISCOVERY OF CELLS

- Robert Hooke was the first to discover cell (1665).
- Leeuwenhoek was the first to discover free living cells in pond water (1674).
- Robert Brown discovered the nucleus (1831).

- Purkinje coined the term 'protoplasm (1839).
- Schleiden (1838) and Schwann (1839) proposed the Cell Theory. Virchow (1855) made further addition to the cell theory.
- The discovery of electron microscope (1940) made it possible to study the structures of cell organelles.

Solution of NCERT Exercise

In text questions:

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1. Who discovered cells and how?

Answer: It was Robert Hooke who discovered cells. He observed the cells in thin slices of cork. They appeared like small compartments when viewed through the microscope.

2. Why is the cell called structural and functional unit of life?

Answer: A cell is capable of carrying out all the life functions; such as nutrition, excretion, respiration, etc. Hence a cell is called the functional unit of life. Additionally, the cell is the smallest unit of life and all the living beings are made up of cells. Hence a cell is called the structural unit of life.

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1. How do substances like CO₂ and water move in and out of the cell? Discuss.

Answer: Substances move in and out of the cell because of diffusion. Diffusion is the random movement of particles in order to attain concentration equilibrium. The movement of water through a semi-permeable membrane is called osmosis. It is important to note that plasma membrane is a semi-permeable membrane. Water always moves from high water concentration to low water concentration.

2. Why is the plasma membrane called a selectively permeable membrane?

Answer: Plasma membrane allows passage to some selected substances. Hence it is called a selectively permeable or semi-permeable membrane.

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1. Can you name the two organelles we have studied that contain their own genetic material?

Answer: Mitochondria and Chloroplast contain their own genetic material.

2. If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?

Answer: Various parts of a cell are responsible for various functions. They work in tandem to continue life in the cell. In case, the organization of a cell is destroyed due to some physical or chemical influence, the cell will die.

3. Why are lysosomes known as suicide bags?

Answer: Lysosomes contain digestive enzymes. In case of a rupture in lysosome, the enzymes are released in the cytoplasm and end up digesting the contents of the cell. This results in cell death. Due to this, lysosome is also known as suicide bags of cells.

4. Where are proteins synthesized inside the cell?

Answer: Proteins are synthesized in ribosome.

Exercise Questions

1. Make a comparison and write down ways in which plant cells are different from animal cells.

Answer:

Plant cell	Animal cell
Cell wall present	Cell wall absent
Plastids present	Plastids absent
Vacuole is usually very large and single	Vacuoles are much smaller and may be absent

2. How is a prokaryotic cell different from a eukaryotic cell?

Answer:

Prokaryotic cell	Eukaryotic cell
Size: generally small (1 – 10 μ) 1 μ (micron) = 10 ⁻⁶ m	Size: generally large (5 – 100 μ)
Nuclear region is now defined and nuclear membrane is absent	Nuclear region is well defined and surrounded by a nuclear membrane.
Single chromosome	More than one chromosome
Membrane bound cell organelles absent	Membrane bound cell organelles present

3. What would happen if the plasma membrane ruptures or breaks down?

Answer: Plasma membrane provides a container for the cell organelles and cytoplasm. Moreover, plasma membrane also protects the contents of a cell from external environment. In case the plasma membrane ruptures or breaks down, the cell contents would be exposed to the external environment. This would prove lethal for the cell and the cell would cease to exist.

4. What would happen to the life of a cell if there was no Golgi apparatus?

Answer: Golgi apparatus plays the important role of packaging various substances for further use or for storage. If there was no Golgi apparatus, various substances would not be in a position to be transformed in proper forms for further use. Certain substances; like protein and lipid are important for the formation of plasma membrane and hence absence of Golgi apparatus will hamper the formation of new cells during cell division.

5. Which organelle is known as the powerhouse of the cell? Why?

Answer: Mitochondrion is known as the powerhouse of the cell. The reason for this is the fact that cellular respiration takes place in mitochondria and the energy released after that gets stored in mitochondria; in the form of ATP. These ATP molecules are utilized on an SOS basis.

6. Where do the lipids and proteins constituting the cell membrane get synthesised?

Answer: Lipids are synthesized in the endoplasmic reticulum. Protein is synthesized in ribosomes which are usually present on the rough ER.

7. How does an Amoeba obtain its food?

Answer: Amoeba obtains its food through a process called phagocytosis. The cell membrane of amoeba is projected into numerous finger-like outgrowths; called pseudopodia. Amoeba surrounds a food particle by pseudopodia and makes a food vacuole; after engulfing the food.

8. What is osmosis?

Answer: The movement of water from high concentration to low concentration through a semi-permeable membrane is called osmosis.