

# 5

# The Fundamental Unit of Life



*Stem cells have given hope to the increasing number and variety of patients who could benefit from transplants, as well as to provide cell replacement treatment to treat debilitating diseases including diabetes, Parkinson's, and Huntington's disease. The problem of stem cell research is politically fraught, causing biologists to engage in ethical discussions and generating exceptionally high levels of interest in this element of biology among the general public.*

## Topic Notes

- Introduction to Cell
- Types of Cell
- Physical Features of a Cell
- Structural Organisation of a Cell
- Cell Organelles and their Functions
- Cell Division

## TOPIC 1

# INTRODUCTION TO CELL

### Learning Objectives

- Students will learn about the discovery and history of the cell.
- Students will know about the different observations made by scientists.

### Learning Outcomes

- Students will be able to appreciate the efforts put up by various scientists to discover the cell.
- Students will be able to prepare a temporary mount with the help of onion peel.

### Real Life Application

You must have visited hospitals and witnessed a number of babies delivered everyday over there. Have you ever imagined how a baby is developed inside the mother's womb? You'll be amazed to know that a human baby is composed of trillions of cells which are formed after many successive cell divisions that increase them in number and size. At first, the cells divide to form tissues, then to form organs and in the same manner, they divide repeatedly until a complete organism is formed.



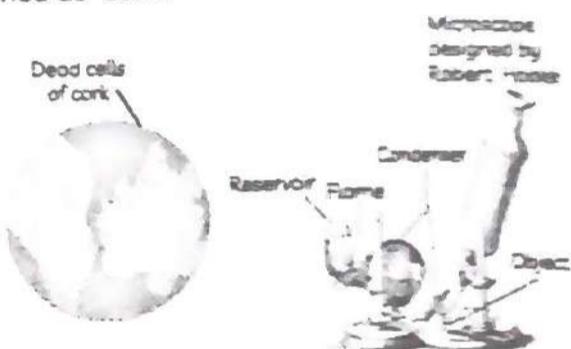
Although, the developmental patterns of the organisms differ from each other but every cell in an organism needs to divide during its embryonic development. This process is essential for cell function across different organisms. Let us learn more about cells.

In biology, a cell is a membrane-bound unit that contains the basic components of life and serves as the building block of all living organisms. A single cell, such as a bacterium or yeast can function as an independent organism. Cells develop specific roles. These cells work together with other specialised cells to form the structure of huge multicellular organisms like humans and other animals.

### Discovery of Cell

Cell was discovered by an English scientist, Robert Hooke in 1665 while observing a thin slice of cork under the microscope. He observed that cork has

a structure like a honeycomb with lots of compartments in it. These compartments were named as "cells".



Dead Cork Cells Seen Under a Microscope Resemble like a Honeycomb

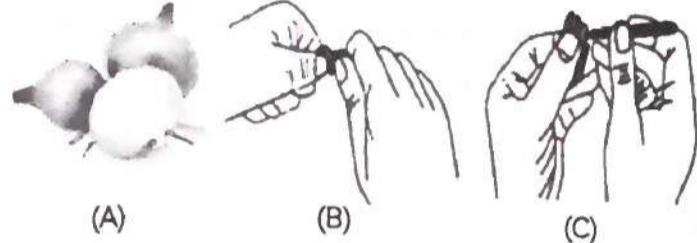
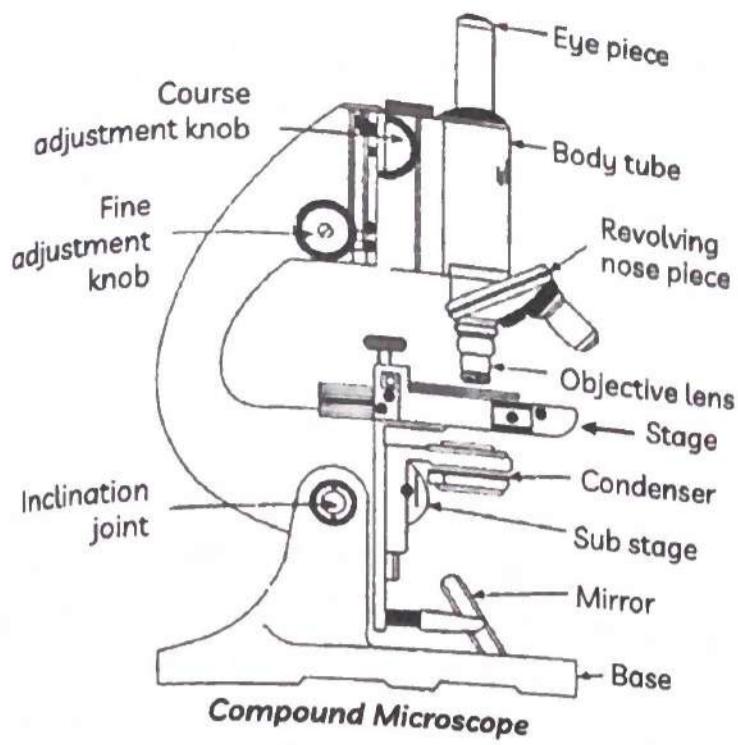
### Important

- In Latin, cell means little room.
- A microscope is an instrument that enables us to see objects which are invisible to the human eye. It has the ability to amplify the objects around it.
- Cork is a dead part of the bark of a tree.

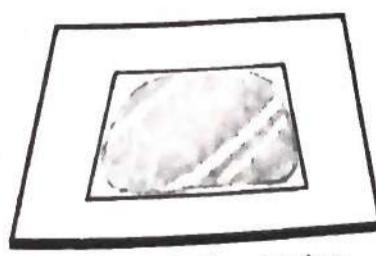
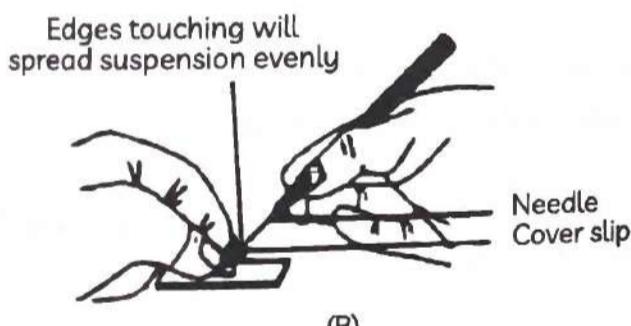
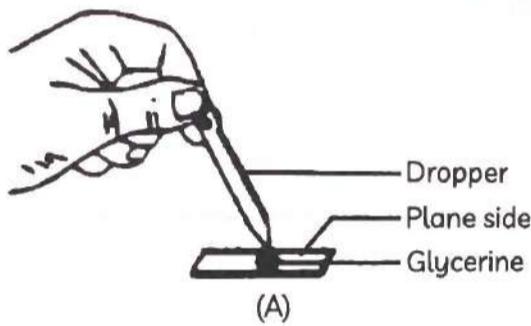
To understand the cell in a better manner, let's perform an activity:

- (1) Take a small piece of onion from onion bulb.
- (2) Peel out the outer skin (epidermis) from the concave side (inner side) of onion piece using forceps.
- (3) Transfer the peel immediately in a moist glass containing water. This prevents dehydration and folding of the peel.
- (4) Now add a small drop of water on a glass slide and transfer a small piece of peel from the moist glass onto it.
- (5) Apply a drop of Safranin solution on the onion peel to stain the peel uniformly.
- (6) Mount the peel with the help of a drop of glycerine to avoid dehydration further.
- (7) Put the coverslip on the mount using a needle carefully to avoid air bubbles.

Your temporary mount of onion peel is ready to be observed under microscope, first under low power followed by high power.



**Method of Taking Out Peel From Onion**

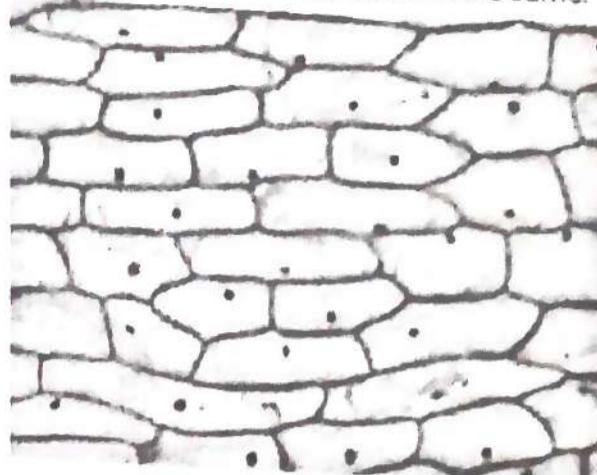


**Steps for Preparing a Temporary Mount**

As we look through the lens, the cells of an onion peel appear as prominent, linear and rectangular in shapes shown in the figure.

These cells come together to form a large structure resembling an onion bulb. It was discovered that onion bulbs of all sizes have identical tiny structures visible under a microscope as a result of this process.

Regardless of the size of the onion from which they came, the onion peel cells will all look the same.



**Cells of an Onion Peel**

The small structures that make up onion bulbs are known as cells, which serve as their basic building blocks. However, cells are not unique to onions—they are present in all living organisms around us.

#### **History of Cells**

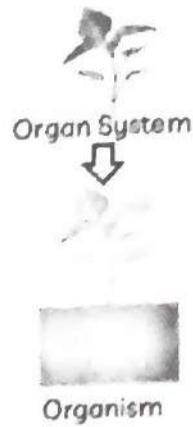
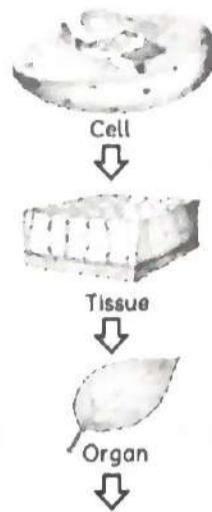
- (1) Leeuwenhoek observed free-living cells in pond water for the first time in 1674 with an improved microscope.
- (2) In 1831, Robert Hooke discovered an opaque area inside the cell called "nucleus".
- (3) In 1839, J. E Purkinje found the living fluid substance present inside the cell and termed it "protoplasm".
- (4) In 1838, M. J. Schleiden proposed that the plant consist of a cell and in 1839, T. Schwann said that all plants and animals are made up of cells. Together, they formulated the cell theory, asserting that the cell is the basic unit of life.
- (5) In 1855, Rudolf Virchow expanded this theory by stating that all cells arise from pre-existing cells.
- (6) The invention of the electron microscope in 1940 assisted in the understanding of the cell's complicated structure and organelles.

Based on various scientific observations, the following conclusions have been drawn:

- (1) The invention of magnifying lenses led to the discovery of the microscopic universe. In unicellular organisms, a single cell performs all functions, including nutrition, respiration, excretion, and reproduction. Example includes Amoeba, Chlamydomonas, Paramecium, and Bacteria. Virus is an exception.
- (2) Multicellular organisms consist of numerous cells, each specialised for different functions. They may appear as a single unit or as a cluster of cells.
- (3) In fungi, plants, and animals, multiple cells come together to form tissues. Every multicellular organism originates from a single cell.
- (4) All cells arise from pre-existing cells, and some species exhibit different types of cells with specialised functions.

### Level of Organisation

The level of organisation refers to the structural hierarchy in living organisms, from the simplest to the most complex forms. It describes how smaller units combine to form larger functional systems. Below hierarchy shows that the cell is the smallest unit of life.



Cells form the basic level of organisation. A group of similar cells with the common origin that works together to perform a specific task is called a tissue. Different tissues combine to form organs, which carry out physiological functions. Multiple organs and tissues that work together to perform specific functions form an organ system.

## TOPIC 2

### TYPES OF CELL

#### Learning Objectives

- Students will learn to classify the cells.
- Students will learn to categorise the different organisms into two types based on the number of cells.

#### Learning Outcomes

- Students will be able to classify the cells into two types.
- Students will be able to distinguish between prokaryotic cells and eukaryotic cells.
- Students will be able to understand two types of organisms along with their examples.

#### Real Life Application

You must have encountered someone suffering from pneumonia, especially during childhood, as it is a leading infectious cause of death in children worldwide.

Pneumonia primarily spreads via air-borne droplets released when an infected person coughs or sneezes. Additionally, it may spread through blood, particularly during or shortly after birth.

Look at the given picture that shows a child suffering from pneumonia.

Pneumonia is generally caused in humans by the bacteria *Mycoplasma pneumoniae* which is a type of bacteria. It is a single-celled prokaryotic microorganism that can cause deadly disease in human beings. These are found almost everywhere.

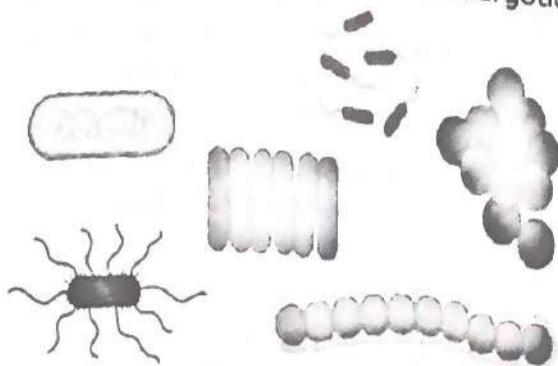
Unlike *Mycoplasma pneumoniae*, not all bacteria are harmful. There are many other useful microbes that help human beings in several ways. This highlights the diversity of cell types in nature. Cells can be broadly

classified into prokaryotic and eukaryotic cells based on their structure.



Students often get confused between prokaryotic and eukaryotic cells, especially when distinguishing which types of cells are found in multicellular versus unicellular organisms. The word prokaryote is derived from the Greek — it combines the word pro-

"Primitive" with karyon, "nucleus." This indicates that prokaryotic cells are more primitive and were the first type of cells to appear on Earth than eukaryotic cells.



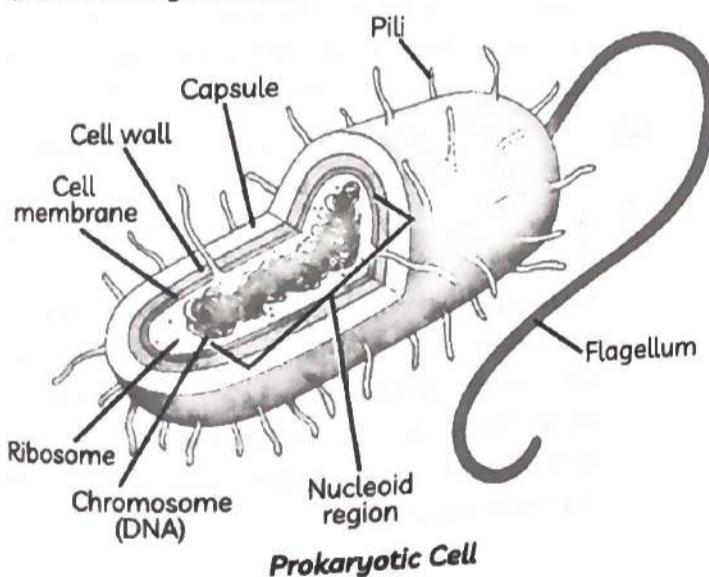
All living organisms are made up of cells. These tiny building blocks work together to create simple organisms like bacteria as well as more complex organisms, such as plants, humans and animals.

Cells are found in a variety of shapes and sizes, each suited to perform specific functions.

For example, a cell may be microscopic like Red Blood Cells (RBCs) or macroscopic like an ostrich egg.

## Types of Cells

**Prokaryotic Cell:** A cell containing nuclear material and cell organelles without a membrane are prokaryotic cells. The nuclear region, where the genetic material is located, is poorly defined and is called nucleoid. In prokaryotes, the genetic material isn't enclosed within a membrane-bound nucleus, unlike eukaryotic cells.

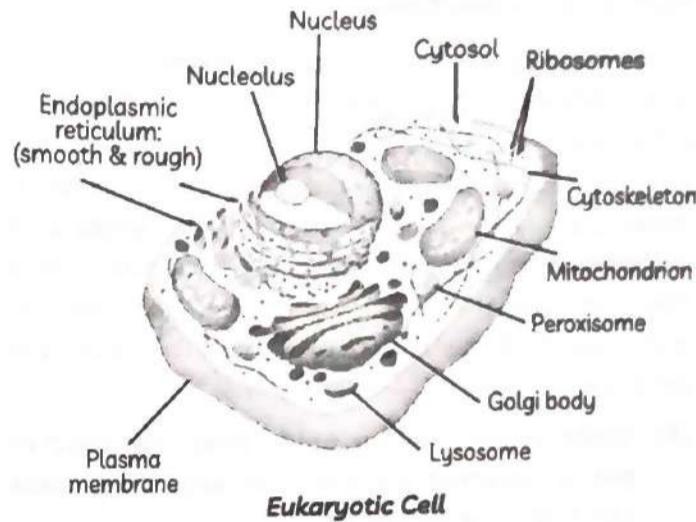


### Example 1. State differences between Prokaryotic cells and Eukaryotic cells.

| Ans. | S. No.                    | Characteristics  |
|------|---------------------------|--|
| (1)  | Nucleus                   | : Nucleus is absent.   |
| (2)  | Size in terms of diameter | : Size of the cell is generally small (1-10 $\mu\text{m}$ ). |
| (3)  | Arrangement of DNA        | : Circular   |
| (4)  | Chromosome                | : It contains a single chromosome.                           |

Example includes, bacteria, blue-green algae, archae-bacteria.

**Eukaryotic Cell:** A eukaryotic cell is one that has a membrane-bound nucleus as well as other membrane-bound compartments or sacs, known as organelles that perform specific functions. The word eukaryotic means "true kernel" or "true nucleus," referring to the fact that these cells have a membrane-bound nucleus. They have a diameter of 10-100  $\mu\text{m}$  and their DNA is present in a membrane-bound nucleus. Plants, mammals, fungi, and protists all have eukaryotic cells.



### Important

- Eukaryotic cells are found in the majority of unicellular and multicellular organisms.
- The term "organelle" refers to small organs present inside the cell.

## Types of Organisms

On the basis of the number of cells, organisms are of two types:

**Unicellular Organisms:** The organisms that are made up of a single cell and that single cell carries out all the functions necessary for life are named unicellular organisms. Example includes, Amoeba, Paramecium, bacteria, etc.

**Multicellular Organisms:** Multicellular organisms are organisms made up of a group of cells that work together in a coordinated manner, with various cells specialised to perform specific activities in the body. Example includes, Plants, humans, animals and so on.

(Understand)

| Prokaryotic Cell   | Eukaryotic Cell |
|--|-----------------|
| : Nucleus is present.  |                 |
| : Size of the cell is generally large (10-100 $\mu\text{m}$ ). |                 |
| : Linear   |                 |
| : It contains more than one chromosome.                        |                 |



|     |                 |  |  |
|-----|-----------------|--|--|
| (5) | Nucleolus       | Nucleolus is absent.                             | Nucleolus is present.  |
| (6) | Cell organelles | Membrane-bound cell organelles are absent.       | Membrane-bound cell organelles such as mitochondria, plastids, endoplasmic reticulum, Golgi apparatus, lysosomes, etc., are present. |
| (7) | Cell division   | Cell division takes place by fission or budding. | Cell division takes place by mitotic or meiotic cell division.   |
| (8) | Examples        | Bacteria, blue-green algae                       | Animal cells, plant cells, fungi   |

### Example 2. Case Based:

In the Biology practical class, the teacher assigned three samples—leaf peel, onion root tips, and onion peels—to three student groups for preparing temporary mounts and observing them under a microscope. The students prepared the slides and recorded their observations. The teacher instructed them to examine the cells from these different materials, such as leaf peels, onion root tips, and onion peels.

(A) While mounting the onion peel, the teacher put a coverslip on the peel kept on a slide carefully and gently to:

- (a) avoid oozing of glycerine
- (b) avoid the folding of peel
- (c) avoid the entry of air bubbles
- (d) make it look neat *(Understand)*

(B) Which of the following is found in cells of all samples?

- (a) Plasma membrane
- (b) Nucleus
- (c) Cytoplasm
- (d) All of these

*(Remember)*

(C) What is protoplasm made up of? *(Remember)*

(D) How are cells arranged in all these samples? *(Understand)*

(E) Assertion (A): All living organisms are composed of cells.

Reason (R): All living cells arise from the pre-existing cells.

(a) Both (A) and (R) are true, and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true. *(Understand)*

**Ans.** (A) (c) avoid the entry of air bubbles

**Explanation:** Coverslip should be placed on the slide carefully to avoid the entry of air bubbles between the cover slip and the slide, as this could interfere with the observation under the microscope.

(B) (d) All of these

**Explanation:** All cells have a plasma membrane, cytoplasm and nucleus irrespective of their location or origin.

(C) The protoplasm is made up of the cytoplasm and the nucleoplasm (the substance inside the nucleus). It is a jelly-like substance that holds the organelles and is responsible for the vital activities of the cell.

(D) Rectangular-shaped cells are arranged compactly similar to bricks in a wall.

(E) (b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).

**Explanation:** According to the cell theory proposed by Schleiden and Schwann, all living organisms are composed of cells. Virchow expanded the cell theory and stated that all the cells arise from pre-existing cells.

## TOPIC 3

### PHYSICAL FEATURES OF A CELL

#### Learning Objective

- Students will learn how to categorise organisms in terms of shape, size, volume and number.

#### Learning Outcome

- Students will be able to compare different organisms based on their shape, size, volume and number.



## Real Life Application

When you wake up in the morning or prepare for bed at night, you brush your teeth for which you use toothpaste to ensure a more attractive and durable smile. Have you ever thought how this toothpaste is clarified? Diatomaceous earth, a naturally occurring soft sedimentary rock, made from the fossilised remains of the tiny, aquatic unicellular microorganisms called diatoms, is one of the oldest and most effective materials used to clarify toothpaste. This substance is highly beneficial for remineralising your teeth.

But what does this mean? Our teeth contain minerals such as calcium, phosphorus, magnesium, etc., which we gradually lose over time. As we lose these minerals, our teeth become weaker. To keep them strong and prevent decay, it's important to replenish these minerals.



Diatomaceous earth is not only used in toothpaste but also plays a vital role in clarifying sugar and syrups, processing of oils, antibiotics, alcoholic and non-alcoholic beverages. They are also used as a filler in paper, paint, plastics, soaps and detergents, etc.

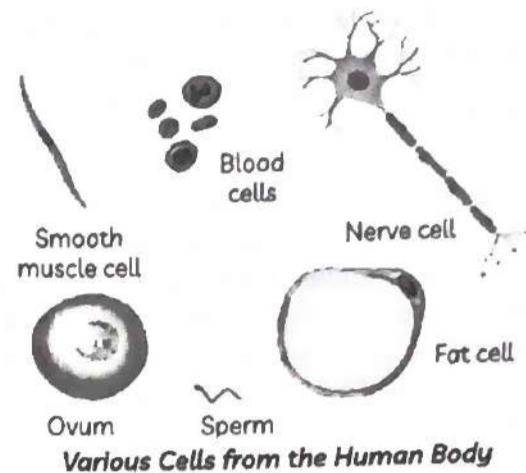
This is just one example of how unicellular organisms are utilised in our daily lives. Let us now learn the physical features of cell in this topic.

Each and every organism's cells are either unicellular or multicellular, and are categorised in terms of shape, size, volume and number.

## Shape and Size of the Cell

The shape and size of a cell are closely linked to the specific function it performs. Some cells, like those of the Amoeba, have the ability to change shape, while others maintain a fixed form.

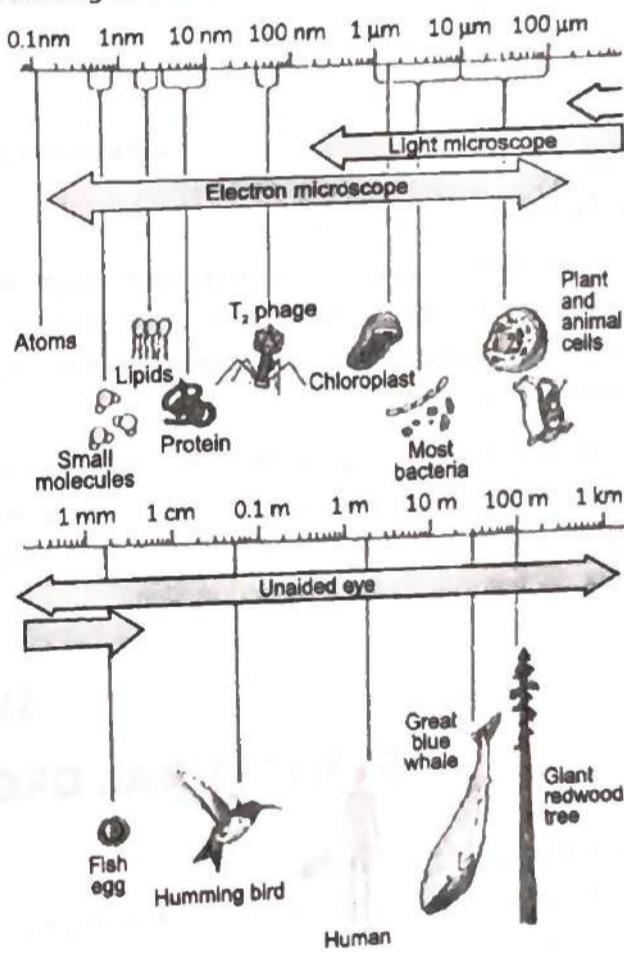
In the human body, cells vary in both structure and function. For example, nerve cells are long and elongated to help in transmission of electric signals from one part of the body to another while fat cells have an irregular shapes as they store varying amount of fats.



Various Cells from the Human Body

### Cell Size

The size of the cells varies between unicellular organism to multicellular organism. In living creatures, cell size can range from as small as a micrometre to several centimetres. Normally, cells are so tiny that they cannot be seen with the naked eye. However, some plant and animal cells are large enough to be seen without a microscope. For the majority of cells, magnification using a microscope is necessary to observe them.



Cell Size of Different Organisms

Smallest cell varies from 0.2 to 5  $\mu\text{m}$  found in bacteria to the largest cell measuring 18 cm which is an ostrich's egg. The size of a unicellular organism is larger than a typical cell of a multicellular organism. For example, *Amoeba proteus* is biggest among the unicellular organisms, having a length of 60 micrometers. The size of the typical cells of multicellular organisms ranges between 20 to 30 micrometers. The smallest cells are those of *Mycoplasma gallisepticum*, an organism

intermediate between virus and bacteria. The size is about 0.1 micrometer.

### Cell Shape

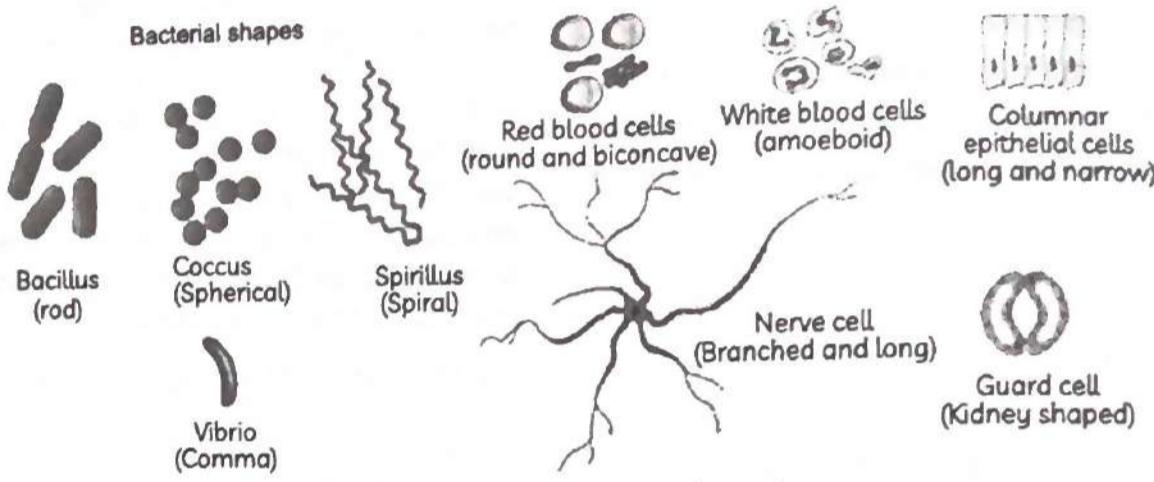
Shape of the cells varies in different organisms. It can be spherical, oval, elliptical, spindle-shaped, polygonal, isodiametric or flat like a plate. The distinct shape of cells enables them to perform unique functions. The cell's components are enclosed by a membrane that provides structure to both animal and plant cells. While some cells have a fixed shape, others can change shape.

For example, red blood cells (RBCs) are circular and biconcave, white blood cells (WBCs) are

amoeboid and can change shape, nerve cells are long, stretched, and branched, and columnar epithelial cells are long and thin. These are just a few examples of the diverse cell types found in humans.

Plant cells are typically square or rectangular in form. However, some specialised plant cells, like the guard cells of stomata, have unique shapes, such as kidney or dumbbell shapes.

Fungal cells have a wide variety of shapes. Single-celled fungi are typically spherical, while others may be tubular or form long chains of cells.



**Cell Shape Across Different Organisms**

### Cell Number

The number of cells vary from organism to organism. In multicellular organisms, the number of cells is indefinite but it is also fixed in certain species, such as nematodes.

Among multicellular organisms, some have billions of cells while others have trillions (like Humans). But every organism starts its life from a single cell which further divides into thousands and millions.

**Example 3. Shape and size vary from cell to cell according to their functions and composition. How will you justify the above statement? (Apply)**

**Ans.** The shape and size of cells differ depending on their functions and composition. For instance, a nerve cell is elongated and branched, designed for transmitting signals between the brain, spinal cord, and other organs. On the other hand, a muscle cell is small and spindle-shaped, specialised for facilitating movement.

## TOPIC 4

### STRUCTURAL ORGANISATION OF A CELL

#### Learning Objectives

- Students will understand the detailed structure of a eukaryotic cell.
- Students will learn to differentiate between diffusion and osmosis.
- Students will learn to outline the process of osmosis by using three types of solutions.
- Students will learn about the structure and functions of three main regions of the cell.

#### Learning Outcomes

- Students will be able to explain the detailed structure of a eukaryotic cell.
- Students will be able to compare the processes of diffusion and osmosis.
- Students will be able to elaborate the process of osmosis by taking various examples.
- Students will be able to explain the structure and functions of the three main regions of the cell.



## Real Life Application

Have you ever met a person with kidney failure? It is easy to understand how challenging life can be for them, as they need dialysis treatment for the rest of their lives unless they undergo a kidney transplant. Dialysis is a medical procedure that performs the functions of healthy kidneys when they can no longer meet the body's needs. It helps remove harmful substances and excess water from the body.

In dialysis treatment, the patient's blood flows across a semi-permeable membrane, with dialysis solution on the other side. This process works based on the principle of diffusion, osmosis and ultrafiltration. The dialysis fluid contains sugar, which helps to draw water out of the blood. Along with the water, the other harmful substances dissolved in blood are also filtered out.



Dialysis is a prime example of how the structure of a cell (the semi-permeable membrane) is applied in real-life medical treatments for kidney failure. In a cell, the cell membrane regulates the movement of substances in and out, much like the dialysis

membrane filters out waste and excess water while retaining essential components. Let us now study the structural organisation of a cell in detail.

There are three major functional regions of cells.

- (1) Cell membrane or plasma membrane
- (2) Nucleus
- (3) Cytoplasm

## Cell Membrane or Plasma Membrane

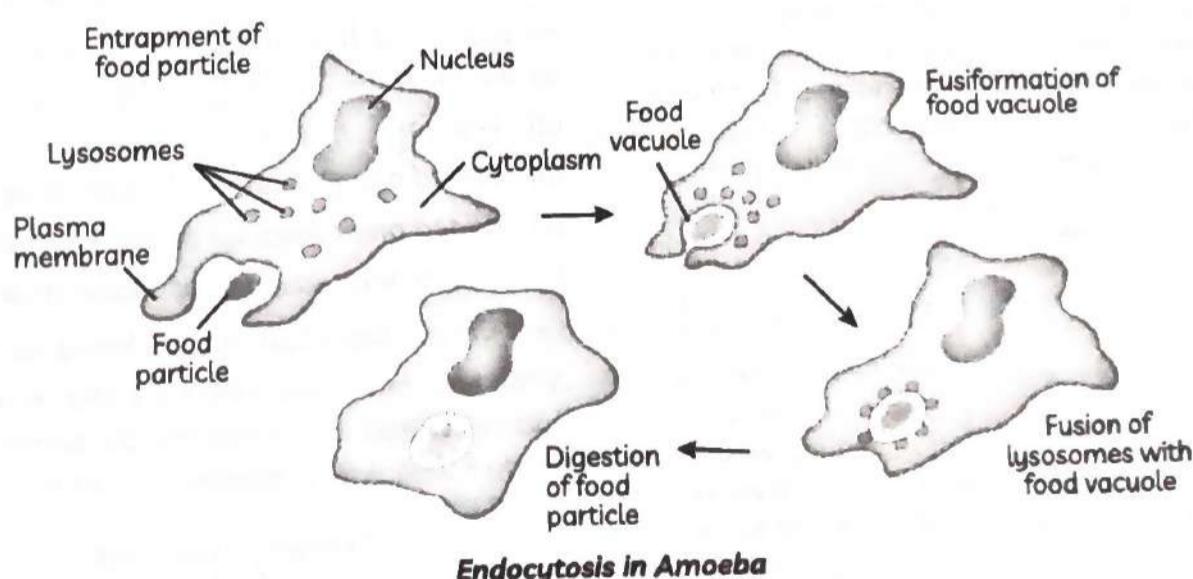
Plasma membrane also known as Cell membrane, is the outermost layer or covering which separates the contents of cells from the external environment.

- (1) It is a living component of the cell and is present both in plant and animal cells.
- (2) It is a delicate thin-walled layer that is elastic in nature.
- (3) It is made up of organic molecules proteins and lipids.

## Functions

- (1) It gives the cell its shape and provides mechanical support and protection to the cell's inner contents.
- (2) It regulates entry and exit of some materials. It also prohibits some materials from moving out of the cell. As a result, the cell membrane is called selectively permeable membrane.

The flexibility of the cell membrane also enables it to absorb food and other things from its surroundings. The term for such a process is endocytosis. For example, Amoeba.



In Amoeba, the cell membrane helps in the process of endocytosis, which involves absorbing food. For example, oxygen and carbon dioxide are two substances that move across the cell membrane. Carbon dioxide which is a cellular waste needs to be excreted out from the cell which accumulates in high concentration inside the cell. In an external environment, concentration of the CO<sub>2</sub> outside is low

as compared to that inside the cell. As soon as there is a difference in the concentration of CO<sub>2</sub> inside and outside a cell, CO<sub>2</sub> moves out of the cell, from a region of high concentration, to a region of low concentration outside the cell. Similarly, O<sub>2</sub> enters the cell, when the level or concentration of O<sub>2</sub> inside the cell decreases. This all happens by a process called diffusion. The law of diffusion also applies to water.



Water molecules flow across a selectively permeable membrane in the same way. The amount of material dissolved in water influences the transport of water across the plasma membrane. This is accomplished by a mechanism known as osmosis. Osmosis is the net diffusion of water over a selectively permeable membrane in the direction of a higher solute concentration. This movement helps balance the concentration of solutes inside and outside the cell.

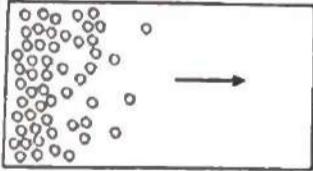
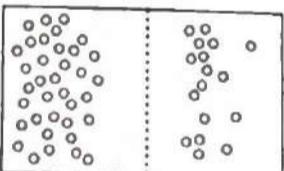
### Diffusion and Osmosis

**Diffusion:** It is defined as the movement of molecules from a region of high concentration to lower concentration and spread uniformly in a given region.

**Osmosis:** The process of movement of water molecules from a region of higher concentration to lower concentration through a semi-permeable membrane.

**Table: Difference between Diffusion and Osmosis**

| S.<br>No. | Diffusion   | Osmosis   |
|-----------|---|---|
| (1)       | The movement of molecules from a region of higher concentration to lower concentration without the involvement of any membrane. | The movement of molecules from region of higher concentration to lower concentration through semi-permeable membrane. |
| (2)       | It occurs in solids, liquids and gases.   | It occurs only in liquids.  |
| (3)       | It involves the movement of solvent molecules.  | It involves the movement of solute molecules.   |
| (4)       | The usage of a semi-permeable membrane is not required.   | When a semi-permeable membrane is penetrated, osmosis occurs.   |
| (5)       | Exchange of $\text{CO}_2$ and $\text{O}_2$ between cells and the external environment is an example of diffusion.               | Examples of osmosis include red blood cells swelling when placed in freshwater, and plant root hairs absorbing water. |

A solution is formed when a substance dissolves in another substance, typically in a smaller amount. For example, in a sugar-water solution, sugar is the solute and water is the solvent.



There are three types of Osmotic solutions:

**(1) Hypotonic Solution:** If the medium surrounding the cell has a higher water concentration than

the cell (the solution is highly diluted) the cell will gain water by process of osmosis. Such a dilute solution is called a hypotonic solution.

Water molecules move in both direction across the plasma membrane, but more water enters the cell than exits. As a result, the cell swells and expand in size. This process is known as endosmosis.

**(2) Hypertonic Solution:** If the medium surrounding the cell has a lower water concentration (the solution is less diluted or more concentrated) than the cell, the cell will lose water and shrink and this process is called exosmosis. Such a solution is called hypertonic solution.

**(3) Isotonic Solution:** If the medium has exactly the same water concentration as the cell, there will be no net movement of water across the cell membrane. Such a solution is known as an isotonic solution. Water passes through the cell membrane in both directions, but the amount entering equals the amount leaving, so there is no total water movement. The size of the cell will not change.

### Example 4. Case Based:

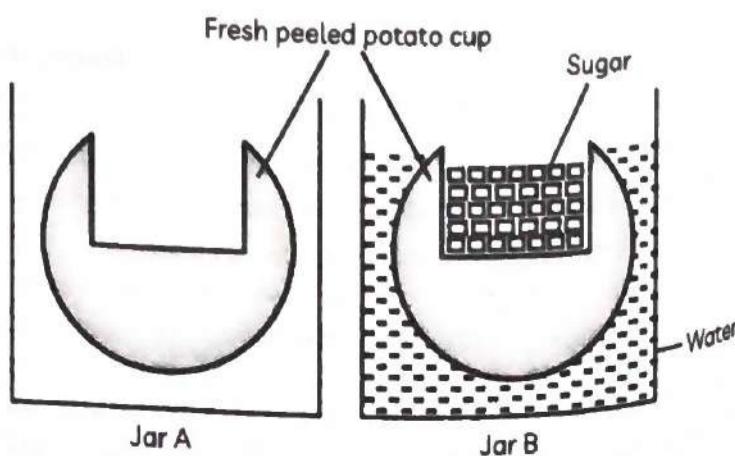
Raman studied the process of osmosis and diffusion in Biology class. He thought to carry out the following experiment:

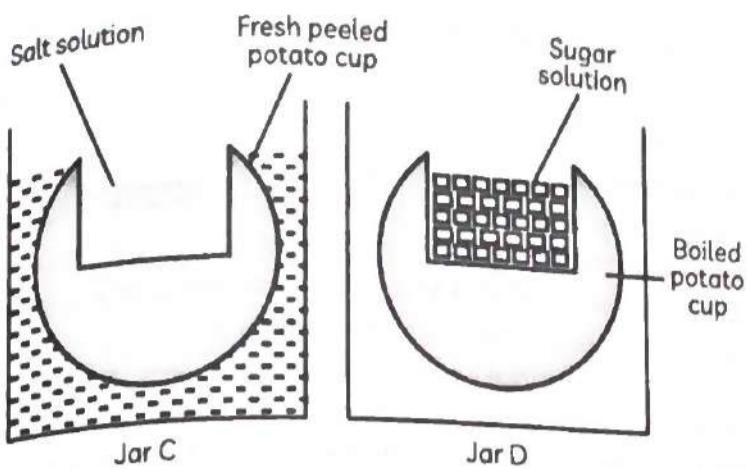
He took four peeled potatoes from the kitchen, halved and scooped each one out to make potato cups. One of these potato cups was made from a boiled potato. Now, he performed the following steps:

He placed each potato cup in a jar containing water as shown in the figure. Then, he

- kept jar A empty.
- added one teaspoon of sugar in jar B.
- added one teaspoon of salt in jar C.
- added one teaspoon of sugar in jar D.

He kept all these four jars undisturbed for two hours. After two hours, he observed the four potato cups and answered the following questions asked by his mother who was watching the entire process.





- (A) Describe why water collects in the hollowed-out areas of jars B and C. (Understand)
- (B) What is the purpose of Potato cup A in this experiment?
- It carry out the entire process.
  - It serves as the control of the experiment.
  - It acts as the semi-permeable membrane.
  - All of the above. (Apply)
- (C) Explain why water does not collect in hollowed-out areas of jar A and D. (Understand)
- (D) Osmosis is a special kind of:
- regulation
  - absorption
  - diffusion
  - adsorption (Remember)
- (E) Assertion (A): Selective permeability identifies the process of osmosis.  
Reason (R): It is the process of movement of water molecules from higher concentrated area to lower concentrated area.
- Both (A) and (R) are true, and (R) is the correct explanation of (A).
  - Both (A) and (R) are true, and (R) is not the correct explanation of (A).
  - (A) is true but (R) is false.
  - (A) is false but (R) is true. (Understand)

**Ans. (A)** Water collects in the hollowed-out areas of jars B and C due to the endosmosis process. A potato consists of numerous cells that have selectively permeable cell membranes. As the cups B and C are filled with sugar and salt, respectively, and their outer parts are in contact with the water, the concentration of water outside the cups is higher than inside. This difference in concentration causes the water to flow from the higher concentration outside the cups to the lower concentration inside the cups.

- (B) (b)** It serves as the control of the experiment.
- Explanation:** Potato A serves as the control of the experiment. It is essential for comparing the results as it demonstrates

that when the water concentration is the same on both sides, there is no movement of water.

- (C)** Since jar A does not contain hypertonic solution, so water does not collect in the hollowed out areas, as there is no concentration difference. Since the cells of the boiled potato in jar D are dead, osmosis does not occur.

- (D) (c) diffusion**

**Explanation:** Osmosis is a type of diffusion, specifically the diffusion of water molecules across a semi-permeable membrane from an area of lower solute concentration to an area of higher solute concentration. Absorption is a physical or chemical process in which the atom molecule or substance is soaked into something. It is an endothermic process.

Adsorption is a physical process when gas accumulates on the surface of a solid. It is an exothermic process.

- (E) (b)** Both (A) and (R) are true, and (R) is not the correct explanation of (A).

**Explanation:** Selective permeability refers to the ability of a membrane to allow certain molecules or ions to pass through while blocking others. This property is essential for the process of osmosis, where water molecules move across a selectively permeable membrane. Osmosis is the process where water moves across a selectively permeable membrane from an area of higher water potential to an area of lower water potential.

**Example 5.** How do substances like  $\text{CO}_2$  and water move in and out of the cell? Discuss. [NCERT]

**Ans.** Carbon dioxide moves in and out of the cell by the process of diffusion, which involves molecules moving across the cell membrane from a region of higher concentration to a region of lower concentration.

Water moves in and out of the cell via osmosis, which involves water molecules moving from a lower to a higher concentration of solutes via the cell membrane.

### Important

→ Water enters through the diffusion process.

### Cell Wall

- It is found in plant cells, fungi, bacteria, algae, etc
- In plant cells, it serves as an additional outer layer, which is rigid in nature. It lies outside the plasma membrane.



- (3) It is made of cellulose which provides structure and strength to the plant.
- (4) The cell wall is non-living, thick and easily permeable.

### Functions

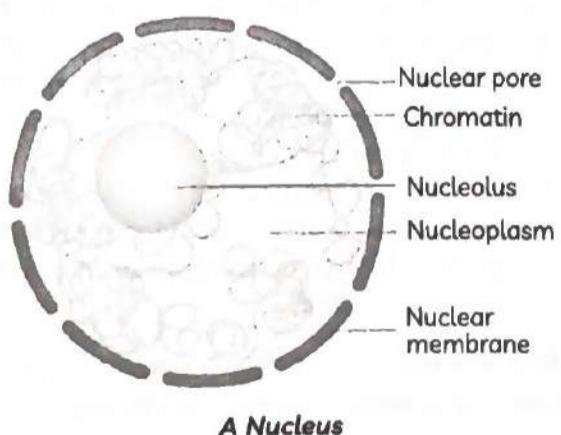
- (1) It protects the cell membrane.
- (2) It is primarily important for maintaining the cell's shape and size.
- (3) Plants, fungi, and bacteria can tolerate very dilute hypotonic external media without bursting because of the cell wall.
- (4) In such media, the cells are more likely to absorb water through osmosis. The cell expands, putting pressure on the cell wall and the wall exerts equal pressure against that swollen cell. This prevents the cell from drying out and becoming flaccid.
- (5) Due to cell wall, the cell can withstand much greater changes in the surrounding medium than the animal cell.

### Important

→ When a living plant cell loses water by osmosis, the contents of the cell shrink or contract away from the cell membrane and the cell becomes flaccid. This process is known as plasmolysis.

### Nucleus

- (1) It is spherical in shape and located at the centre of the cell.
- (2) It is surrounded by a double-layered membrane called a nuclear membrane. Nuclear membrane is porous in nature and allows the material to move in and out of the nucleus.
- (3) The nucleus contains a fluid called nucleoplasm.
- (4) It contains chromosomes, which appear as rod-shaped structures when the cell is preparing to divide. Chromosomes are made of protein and Deoxyribonucleic Acid (DNA).



- (5) Chromosomes store information for the inheritance of characters from parents to offspring in the form of DNA (Deoxyribonucleic Acid). DNA contains all structural and functional details of the living structure. A part of DNA

which contains information for inheritance of a particular character is called a gene. Genes act as hereditary carriers.

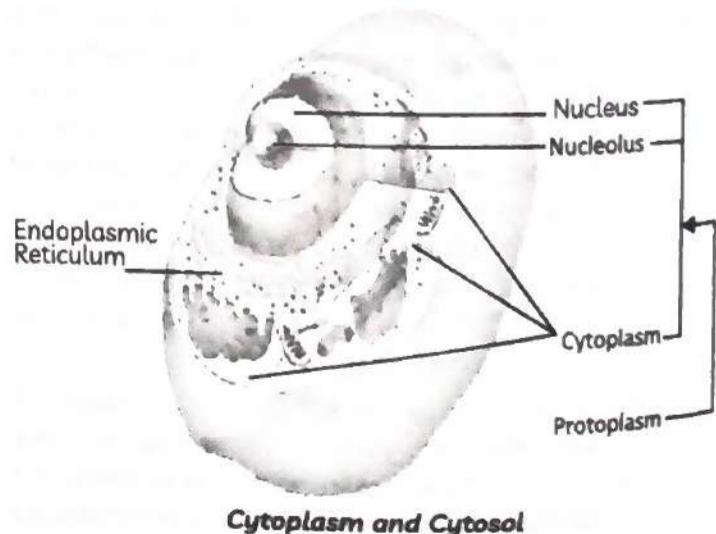
**Chromatin:** DNA exists as part of the chromatin material in cells that are not dividing. This chromatin material appears as an tangled mass of thread-like structures. When the cell prepares to divide, the chromatin organises into chromosomes. The nucleus plays a key role in protein synthesis and transmission of characters from one generation to the next which is necessary for cell reproduction. The nuclear membrane is absent in some organisms, leaving only nucleic acids (nucleoids) in the nuclear domain. For example, prokaryotic organisms like bacteria lack a nuclear membrane, while eukaryotic organisms possess a nuclear membrane surrounding the nucleus in their cells.

### Functions of a Nucleus

- (1) It regulates the metabolic activity of cellular components.
- (2) It controls the cell cycle and is responsible for processes such as cell division, protein synthesis and growth, etc.
- (3) It is a genetic storehouse. It is concerned with the transmission of hereditary characteristics from one generation to the next.

### Cytoplasm

- (1) Between the plasma membrane and the nuclear membrane, there is a jelly-like viscous, colourless semi-fluid substance called cytoplasm.
- (2) It is mainly made of salts, proteins and water. The liquid present in it is called cytosol. About 90% of the cytoplasm is made up of water, 7% proteins, 2% carbohydrates and lipids and 1% inorganic minerals, vitamins and other substances.
- (3) The cytoplasm contains several organelles that can perform distinct functions of the cell.



### **Functions**

- (1) It provides structure to the cell and houses various cell organelles, each performing specific functions. These organelles include the endoplasmic reticulum, ribosomes, Golgi apparatus, mitochondria, plastids, lysosomes and vacuoles.
- (2) It aids protein synthesis as well as other metabolic reactions such as glycolysis, fatty acid synthesis and nucleotide synthesis.

- (3) It allows the movement of chemicals such as hormones within the cell.
- (4) It plays a role in the breakdown of cellular waste.

### **Caution**

- Students usually confuse cytosol with cytoplasm, but the two are distinct substances.  
 → Cytosol is the fluid present inside the plasma membrane. It is composed of soluble ions, water, water-soluble proteins and molecules. Whereas, cytoplasm consists of water, cytosol and organelles.

## **TOPIC 5**

# **CELL ORGANELLES AND THEIR FUNCTIONS**

### **Learning Objectives**

- Students will learn about the structure and functions of cell organelles.
- Students will learn to distinguish animal cells from plant cells.
- Students will learn to draw plant cells and animal cells.

### **Learning Outcomes**

- Students will be able to explain the structure and functions of cell organelles.
- Students will be able to list the differences between animal cells and plant cells.
- Students will be able to draw well-labelled diagrams of animal cells and plant cells.

### **Real Life Application**

When a murder happens somewhere, CBI seals the area and names it as a crime scene. A wide variety of physical evidences can be collected at the crime scene for investigation. Then, DNA fingerprinting comes into play to identify the killer. The degree to which a suspect's DNA matches the DNA samples discovered at the crime scene can be used to assist and narrow down a list of possibilities, even though it doesn't really tell you who committed a crime but it is crucial for forensic science.

DNA fingerprinting is a technique to identify an individual from a sample of DNA. It is helpful in forensics because the match made between different crime scene profile and an individual profile identifies a possible suspect.



Such technology has revolutionised the criminal justice system over the past decades, increasing the possibility of certain criminal identification. This can reduce the likelihood of inadvertently locking up innocent people, which is important because it can also make it easier to identify the perpetrators.

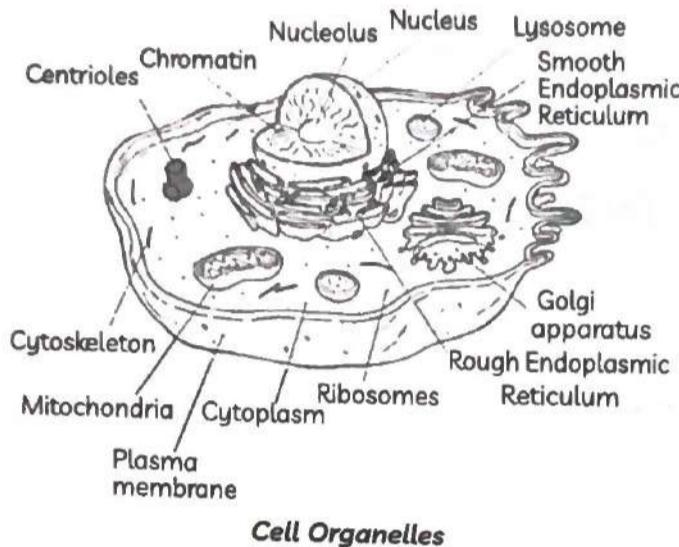
This represents an interesting real life application of DNA which is found inside the nucleus (a cell organelle). The nucleus, as the control center of the cell, stores genetic information in the form of DNA, which plays a critical role in inheritance and cellular functions. The DNA extracted from cells is analyzed for matching profiles in forensic investigations, demonstrating the pivotal role of the nucleus in preserving and transmitting genetic information. Similarly, other cell organelles like mitochondria (which have their own DNA) are involved in energy production, supporting the cell's overall functions. This emphasizes the connection between the functioning of cell organelles and their relevance in diverse applications like criminal justice. Let us now study various cell organelles in brief to understand their specific roles.

Large and complex cells, including cells from multicellular organisms, need a lot of chemical activities to support their complicated structure and function. To keep these activities of different kinds separate from each other, these cells have little structures called cell-organelles. Organelles are useful because they allow the cell's various functions to be separated.

The cytosol contains cell organelles, which are the cell's "small organs." They are the fine components of a cell, each with its own distinct shape, structure, and function.

The main cell organelles found in a cell are:

- |                           |                |
|---------------------------|----------------|
| (1) Endoplasmic reticulum | (2) Ribosome   |
| (3) Golgi bodies          | (4) Lysosomes  |
| (5) Mitochondria          | (6) Plastids   |
| (7) Vacuole               | (8) Centrosome |

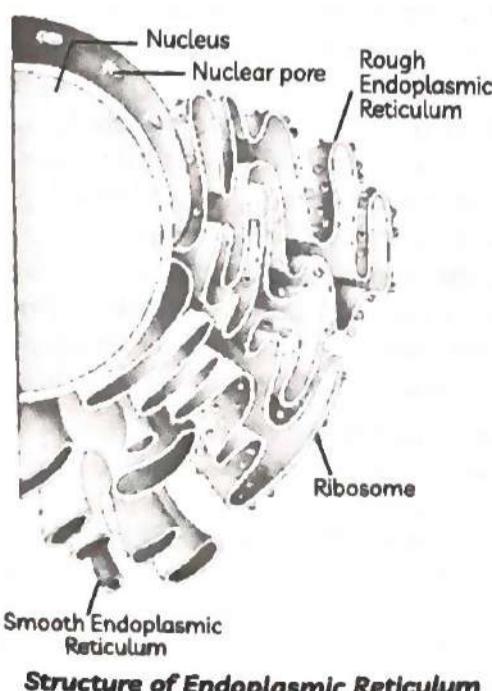


### Mnemonics

- Concept: Cell Organelles
- Mnemonic: N C VERMa Climed LarGe Rock
- Interpretation:

|    |   |                       |
|----|---|-----------------------|
| N  | — | Nucleus               |
| C  | — | Cytoplasm             |
| V  | — | Vacuole               |
| ER | — | Endoplasmic Reticulum |
| M  | — | Mitochondria          |
| C  | — | Cell membrane         |
| L  | — | Lysosome              |
| G  | — | Golgi bodies          |
| R  | — | Ribosomes             |

## Endoplasmic Reticulum (ER)



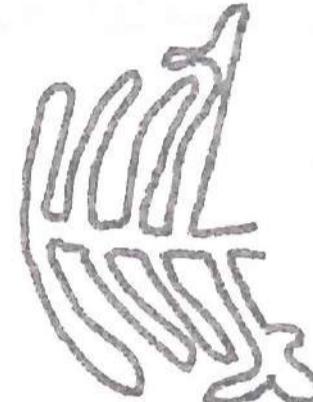
(1) The Endoplasmic Reticulum (ER) is a huge network of membrane-bound tubes and sheets. It has the appearance of lengthy tubules or circular or oblong sacs.

(2) It stretches all the way from the nuclear membrane to the plasma membrane.

(3) It is not found in prokaryotic cells or matured RBCs. Endoplasmic reticulum is divided into two types:

**Rough Endoplasmic Reticulum (RER):** Ribosomes are found on the surface of the RER and are used to synthesise proteins.

**Smooth Endoplasmic Reticulum (SER):** This organelle lacks ribosomes and is used to secrete lipids.



Smooth ER



Rough ER

### Functions

- (1) It forms cytoplasmic framework of the cell.
- (2) It facilitates the transport of various substances from the nuclear membrane to the plasma membrane and vice-versa.
- (3) ER's primary purpose is to transport materials (particularly proteins) between different parts of the cytoplasm or between the cytoplasm and the nucleus.
- (4) RER aids in transportation and synthesis of proteins which is done by ribosomes on its surface.
- (5) SER is involved in the synthesis and transport of lipids (fats), steroids and cholesterol.
- (6) Some of the proteins and lipids which are manufactured by SER and RER help in building cell membrane and this process is known as membrane biogenesis. Some other proteins and lipids function as enzymes and hormones.
- (7) Despite the fact that the ER appears different in different cells, it always creates a network system.
- (8) SER of the liver of vertebrates detoxify poisons and drugs out of the cell like DDT (insecticides), aspirin, petroleum products and pollutants.

### Ribosome

- (1) These are very small, dense, spherical bodies that occur freely in the matrix (cytosol) or are attached to the Rough Endoplasmic Reticulum (RER).

- (2) These are made up of proteins and Ribonucleic Acid (RNA).
- (3) Ribosomes are not bounded by a membrane and lacks lipids.
- (4) They are present in both prokaryotic and eukaryotic cells except in mammalian RBC.

#### Function

It plays an important role in the synthesis of protein.

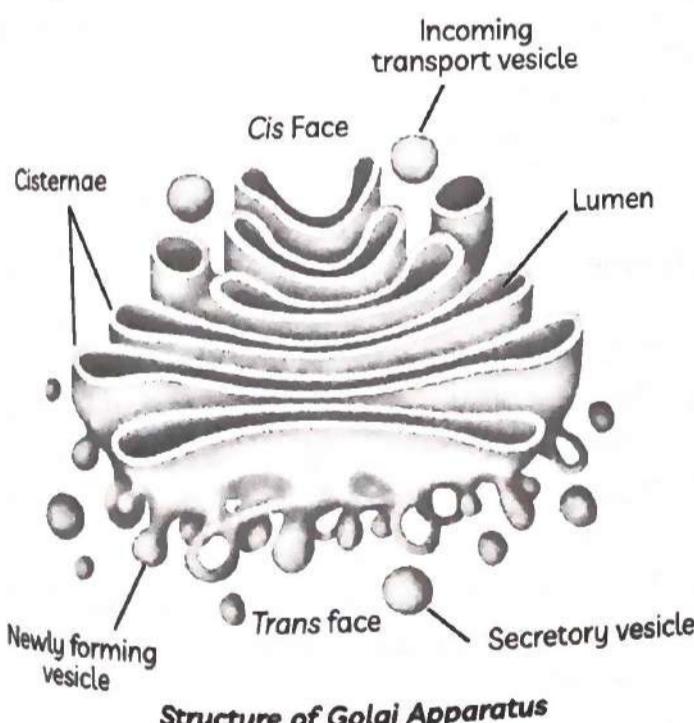
**Example 6. Where are the proteins synthesised inside the cell?** (Remember) [NCERT]

**Ans.** Ribosomes are the sites where protein synthesis takes place.

The ribosomes connected to the RER (Rough Endoplasmic Reticulum) generate proteins. Ribosomes are made in the cytoplasm, chloroplast and mitochondria. The RNA found in ribosomes serves an important function in protein synthesis.

## Golgi Apparatus (Golgi Body)

- (1) It was discovered by Camillo Golgi in 1898. It is called the post office of the cell.
- (2) It is found both in plant cells and animal cells.
- (3) It is not found in prokaryotic cells.
- (4) It consists of a set of membrane-bound, fluid-filled vesicles, vacuoles and flattened cisternae (closed sacs).



**Structure of Golgi Apparatus**

- (5) Cisternae are stacked in parallel rows, one on top of the other as shown in the above figure. These membranes are frequently connected to the membranes of the ER and so form part of a complex cellular membrane system.
- (6) In animal cells, it exists as a large network surrounding the nucleus, whereas in plant cells, it consists of many freely scattered Golgi apparatus components known as dictyosomes.

#### Functions

- (1) The Golgi apparatus transports materials synthesised by the ER to other regions of the cell.
- (2) Its responsibilities include storing, modifying, and packing items in vesicles.
- (3) It aids in the formation of the cell wall and plasma membrane.
- (4) It helps in the formation of lysosomes.
- (5) It helps in the formation of complex sugar.
- (6) During cell division, it is involved in the development of the cell plate.

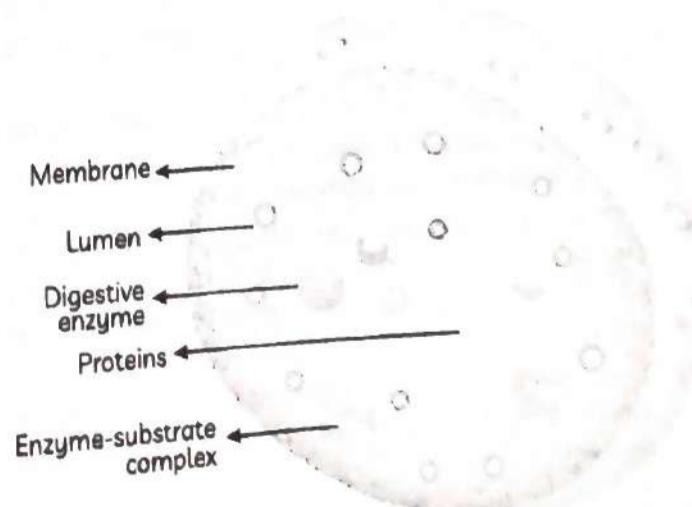
**Example 7. What would happen to the life of a cell if there was no Golgi apparatus?**

(Apply) [NCERT]

**Ans.** The Golgi apparatus is responsible for storing, packaging and dispatching chemicals produced by the endoplasmic reticulum. It carries material into and out of the cell and is also responsible for lysosome development. As a result, if there are no Golgi bodies, there will be no storage, packing, or transport of material and proteins in cells will float around aimlessly. In the absence of the Golgi apparatus, lysosomes will not form, and damaged membranes such as the cell wall and plasma membrane will not be repaired. Furthermore, acrosome production of sperm will not occur, preventing sperm from entering the egg. These are the conditions which will occur in absence of the Golgi apparatus.

## Lysosomes

- (1) It is mostly found in eukaryotic organisms.
- (2) It is present both in animal and plant cells.
- (3) Lysosomes are small, spherical, sac-like structures which contain several digestive enzymes enclosed in a membrane.



**Structure of a Lysosome**

- (4) Lysosomes' enzymes are made by Rough Endoplasmic Reticulum (RER).

### Functions

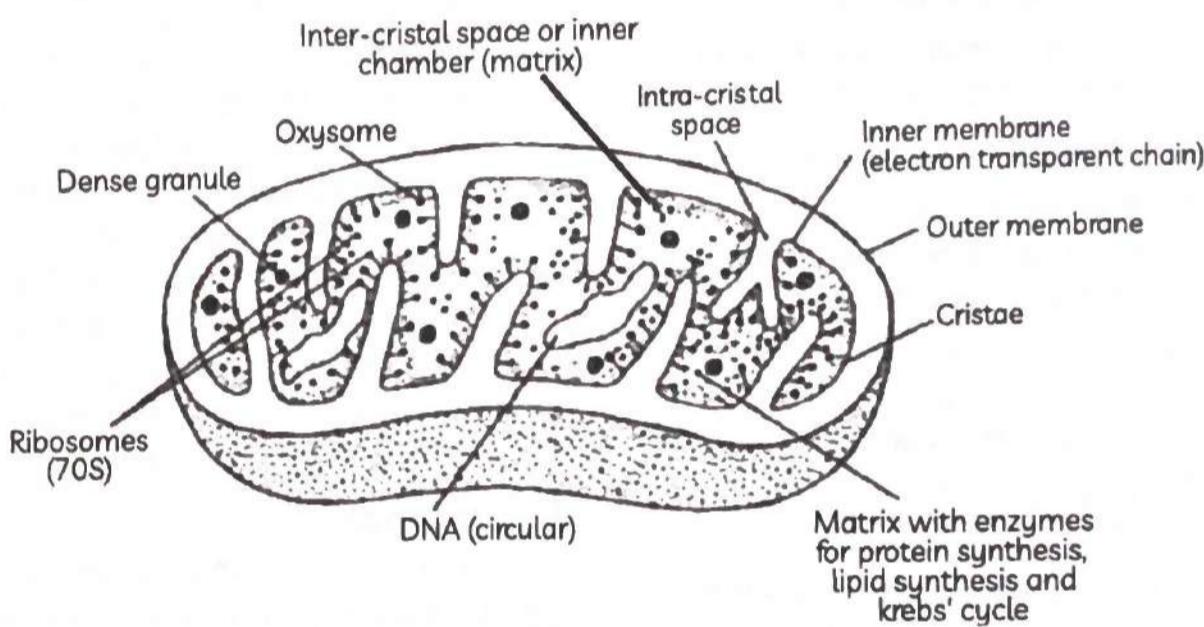
- (1) Lysosomes digest any foreign material and worn-out cell organelles which keep cells clean. Foreign materials entering the cells such as bacteria or food, as well as old organelles, end up in the lysosome, which breaks them up into small pieces. They can do this because they have powerful digestive enzymes that can break down any organic material.
- (2) By destroying foreign material, they protect the cells from bacterial infection.
- (3) As they digest poor working cells, they make way for new replacements. In this way, they remove cell debris and hence, are known as cellular housekeepers. They are a kind of garbage disposal system of the cell.
- (4) Lysosomes are called suicidal bags because during the breakdown of cell structure or when the cell gets damaged, lysosomes may burst and the enzymes digest their own cell. Therefore, lysosomes are also known as suicidal bags of the cell.

### Important

→ During starvation, the lysosome digests stored material in the cytoplasm, such as protein, lipids and glycogen and supplies the body with the energy it requires. This is known as autophagy.

### Mitochondria

- (1) They are known as the "powerhouse of the cell".
- (2) They are small rod-shaped organelles.
- (3) Mitochondria have double-layered membrane coverings. The inner membrane is deeply folded called cristae. Cristae increase the surface area for cellular respiration. The outer membrane is smooth and porous in nature.
- (4) They have their own ribosomes and DNA. Therefore, it is called Semi-Autonomous Organelle.
- (5) They are not found in bacteria or mammalian red blood cells.



Structure of Mitochondria

### Functions

- (1) They are the site of cellular respiration, and hence provide energy for vital functions of living cells.
- (2) Mitochondria release ATP (Adenosine Triphosphate) molecules, which provide energy for various chemical activities required for living.
- (3) 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.
- (4) They have their own DNA and protein due to which they are able to make some of their proteins.

- (2) They have their own DNA and ribosome.

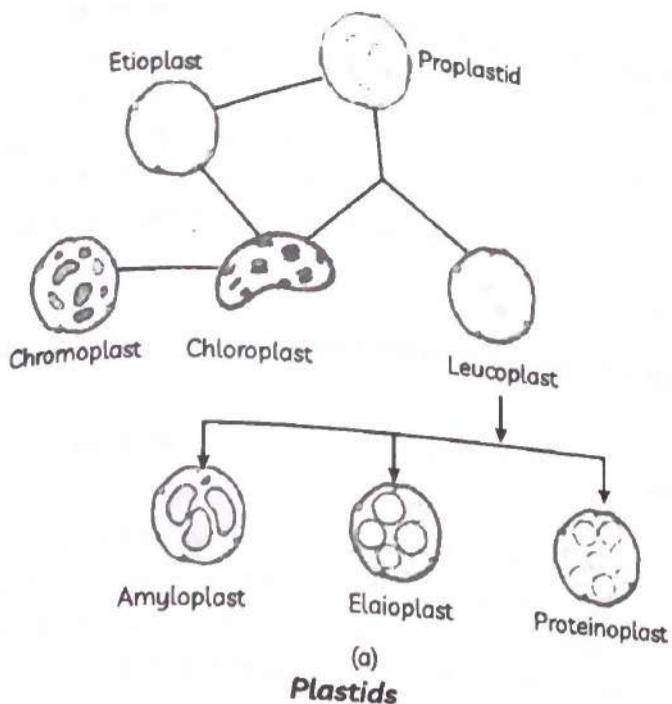
- (3) They are double membrane-bound organelles that are usually spherical or discoidal in shape.
- (4) Plastids are made up of a number of membrane layers contained within the stroma.
- (5) They have their own ribosomes and DNA. Therefore, they are called Semi-Autonomous Organelle.

### Important

→ Stroma is the colourless fluid surrounding the grana within the chloroplast.  
→ Grana are stacks of membrane-bounded, flattened discoid sacs called thylakoids containing the molecules of chlorophyll.

Plastids are of three types:

- (1) Chromoplast, (2) Chloroplasts, (3) Leucoplast



**Example 8.** Can you name the two organelles we have studied that contain their own genetic material? (Remember)

**Ans.** Mitochondria and chloroplast both have genetic material of their own. Both of these organelles are regarded as semi-autonomous organelles since they have their own DNA and ribosomes and are capable of synthesising the majority of their proteins.

### Related Theory

- Mitochondria are the cell's respiratory organs. They are known as the engine of the cell because they produce high energy ATP molecules. The energy in ATP is used by the cell.
- Plant cells contain plastids that have their own genome (DNA). They are capable of self-replicating (they possess the ability to divide).

### Chromoplast

- (1) They are coloured plastids containing orange and red colour.
- (2) They add colours to the flowers and fruits so that animals will get attracted and help in pollination and fruit dispersal.

### Leucoplast

- (1) They are plastids that are colourless.
- (2) Their shape is cylindrical or round.
- (3) Leucoplasts are the organelles that mainly store materials like starch, oils, lipids and protein granules.

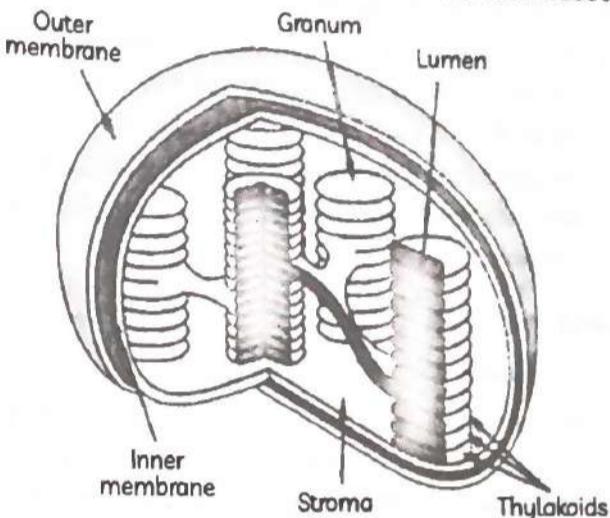
### Chloroplasts

- (1) They are green-coloured plastids.
- (2) They help in the photosynthesis of plants.
- (3) Chloroplasts are organelles with two membranes, a liquid stoma and stacked structures called lamellae. Grana are formed when lamellae are stacked on top of one another. Chlorophyll, a green pigment, is found in grana. This chlorophyll aids in the capture of solar energy and its conversion to food chemical energy.

- (4) Photosynthetic pigments called 'Chlorophyll', as well as lipids, carbohydrates, minerals, DNA, RNA, grana, thylakoids and stroma, are all found in chloroplasts.
- (5) The other main functions of chloroplasts are:
  - (i) Protein synthesis
  - (ii) Release oxygen
  - (iii) Storage of Starch

### Important

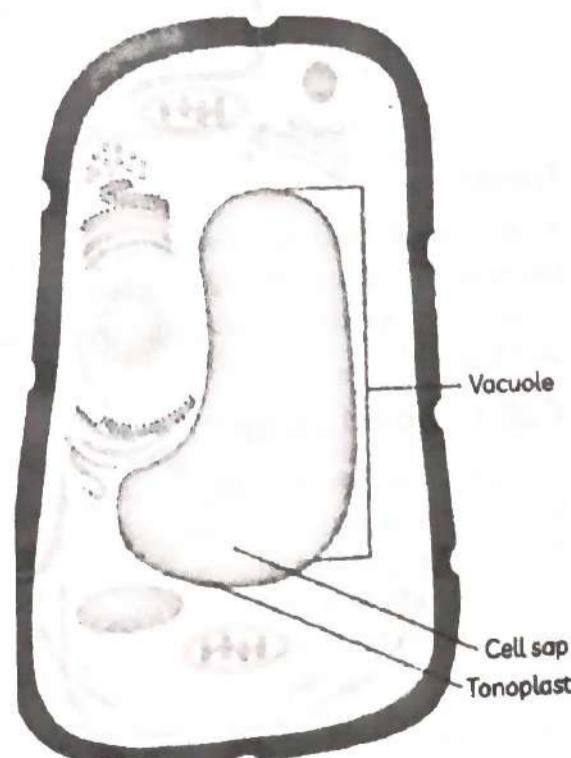
- During photosynthesis, the grana is the site of light reaction, while the stroma is the site of the dark reaction.



(b)  
Structure of a Chloroplast

### Vacuole

- (1) It is present both in plant and animal cells.
- (2) Plant cells have large vacuoles whereas in animal cells, it is smaller in size.
- (3) Vacuoles are membrane bound organelles and storage sacs for solid and liquid contents.



Structure of a Vacuole



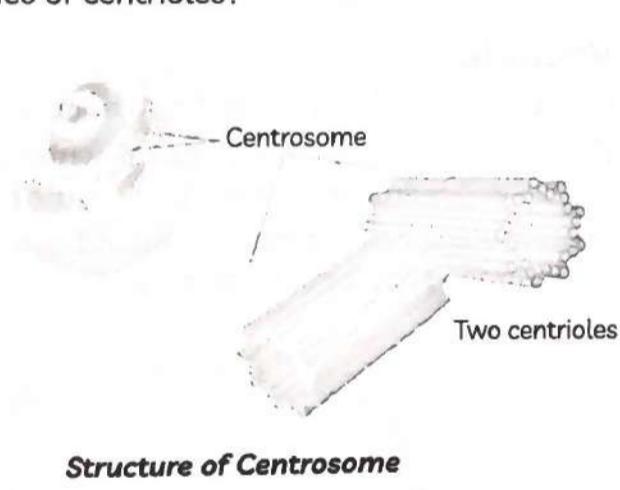
- (4) In mature plant cells, it covers 90% of space due to which other cell organelles and nucleus, are found near the cell membrane.
- (5) Cell sap, a fluid solution rich in carbohydrates, amino acids, proteins, minerals and metabolic wastes fills the vacuole.

### Functions

- (1) Specialised vacuoles help in the removal of excess water and certain wastes from the cell in some unicellular organisms.
- (2) It provides rigidity and turgidity to the plant cells.
- (3) It plays a role in osmoregulation, helping to maintain the balance of water and solutes within the cell.
- (4) In unicellular organisms like Amoeba, the food vacuole contains food particles engulfed by the organism.

### Centrosome

- (1) It is found only in animal cells.
- (2) It is made up of two granules called centrioles and is not bounded by any membrane. Microtubules make up centrioles, which are hollow and cylindrical structures.
- (3) In plant cells, the polar caps are formed by the activities of centrioles'.



### Function

It helps in cell division in animal cells. It organises the microtubules that form the spindle fibers, which are essential for separating chromosomes during mitosis and meiosis.

### Cell Organelles and Organs

Human body has a heart to pump blood, lungs to breathe, a stomach to digest food and so on. Different organs of the body are specialised to perform different functions. This separation of work among different organs of the body is called division of labour.

Similar type of division of labour is also found in a single cell. Each cell comprises of specialised

components called cell organelles. Each organelle performs specific function such as synthesis of new material, clearing up waste, reproduction, etc. A cell is able to live and perform all its functions because of these organelles. These cell organelles together make up the smallest structural and functional unit of life called the cell.

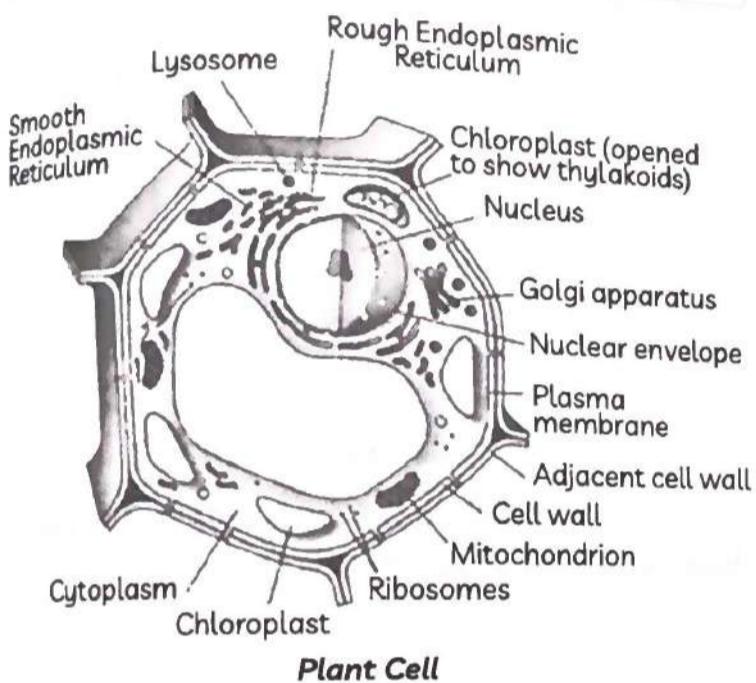
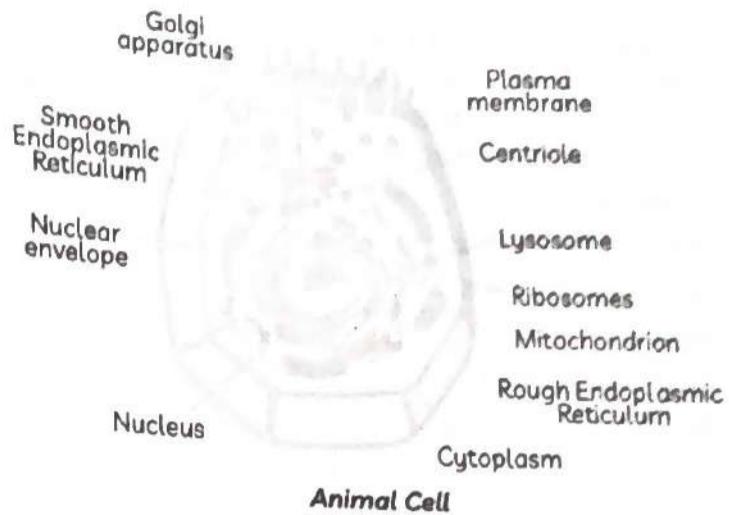
**Table: Difference between organelles and organs**

| S. No. | Organelles  | Organs  |
|--------|---|---|
| (1)    | It is described as a cell component that performs a specific and distinct function.                       | It is defined as a group of tissues that have the same origin and function. |
| (2)    | It is the part of the cell and found internally.  | They are found internal or external to the body                             |
| (3)    | It is found both in unicellular or multicellular organisms, i.e., they are found in all eukaryotic cells. | It is found only in multicellular organisms.                                |
| (4)    | Being small in size, they are microscopic in structure.   | Large in size or we can say, it has macroscopic structure.                  |
| (5)    | Mitochondria, Nucleus, Golgi apparatus are a few examples.  | Brain, Heart and Lungs are a few examples.                                  |

### Difference Between Animal Cells and Plant Cells

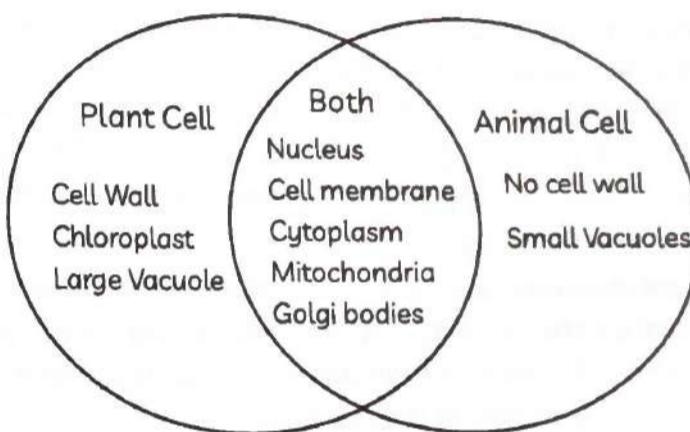
| S. No. | Animal Cells   | Plant Cells                               |
|--------|--|---|
| (1)    | Cell wall is absent.   | Cell wall is present.                     |
| (2)    | Round or irregular in shape.                                 | Rectangular or square in shape.           |
| (3)    | Animal cells are generally small in size.                    | Plant cells are larger than animal cells. |
| (4)    | Plastids are absent except in the case of protozoan Euglena. | Plastids are present.                     |

- (5) Golgi bodies are present.
- (6) Vacuoles are small and generally absent.
- (7) Mitochondria is present but fewer in number.
- (8) They have centrosomes and centrioles.
- Golgi bodies are present called dictyosome.
- Vacuoles are present and larger in size.
- Mitochondria is present in a large number.
- They lack centrosomes and centrioles.



**Example 9.** Create a venn diagram comparing the organelles found in plant and animal cells. (Create) [DIKSHA]

**Ans.**



## TOPIC 6 CELL DIVISION

### Learning Objectives

- Students will understand the different methods of cell division.
- Students will learn about the different stages of a cell cycle.

### Learning Outcomes

- Students will be able to explain three ways of cell division.
- Students will be able to know about the stages of Mitosis and Meiosis.

### Real Life Application

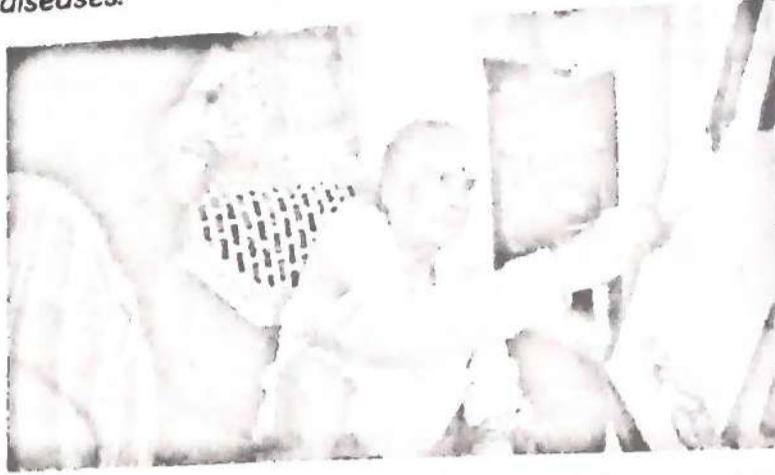
We all live with our parents and grandparents as a happy family. However, there are a few children whose parents or grandparents suffer from Alzheimer's disease. This condition leads to memory loss and eventually requires full-time care. In such cases, stem cells offer a promising solution.

Scientists create modified stem cells from easily accessible cells, such as skin cells. These cells are

extracted from human donors or laboratory cell lines. The DNA of the skin cell is then altered to resemble that of a stem cell. Once the stem cell is formed, scientists expose it to specific molecules, guiding its transformation into various types of cells, including heart, liver, or even brain cells.

This process is made possible due to cell division, particularly mitosis, which ensures the formation of identical cells for tissue repair and regeneration. Through controlled cell division, scientists can

generate specialised cells that replace damaged or lost cells in the body. Stem cells undergo repeated cycles of cell division to multiply and differentiate into specific cell types, helping in the treatment of various diseases.



This demonstrates a valuable real-life application of cell division, benefiting many patients. Now, let's explore the process of cell division in detail.

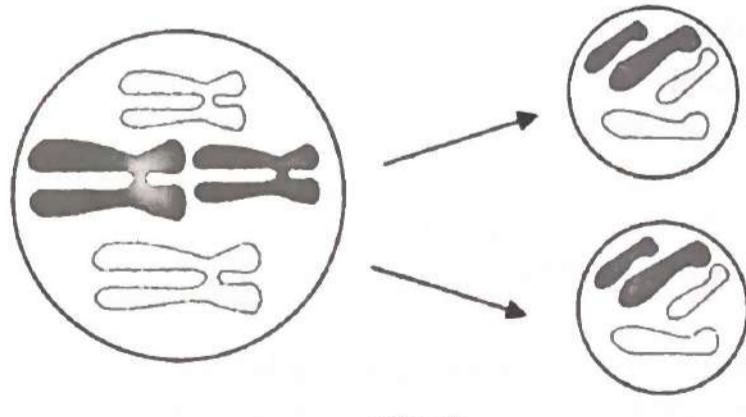
Cell division occurs for various reasons, including the replacement of old, dead, or injured cells. Living organisms grow not by increasing the size of their cells but by dividing cells to produce more and more cells. Every day, approximately two trillion cells divide in the human body.

In cell division, the original cell that undergoes division is called the 'parent' cell. The process by which a parent cell divides to form daughter cells and repeats the cycle is known as the cell cycle.

There are two main types of cell division: mitosis and meiosis. Each type of cell division has distinct characteristics and functions.

### Mitosis

The process of cell division by which most cells divide for growth is called mitosis.

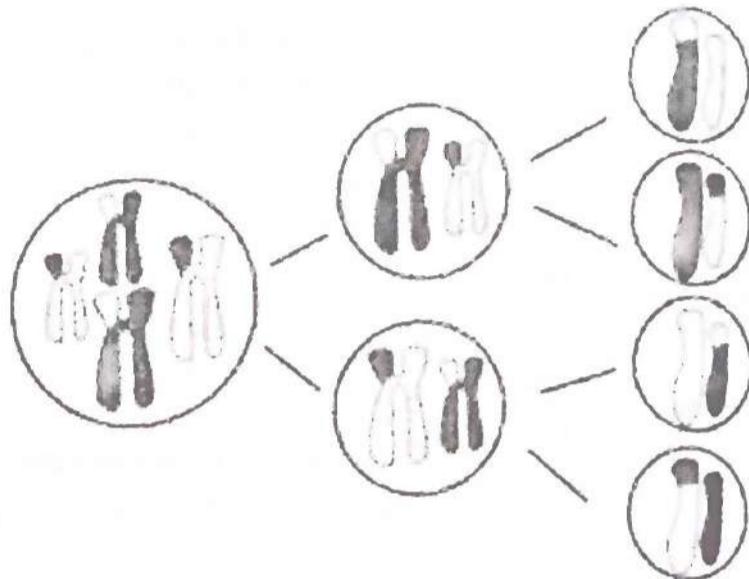


Mitosis

In this process, a cell called the mother cell divides to form two identical daughter cells as shown in the figure above. The daughter cells have the same number of chromosomes as the mother cell. In this type of cell division, the number of chromosomes remains unchanged in both the parent and the offspring cells. Each daughter cell retains the same chromosome number as the mother cell.

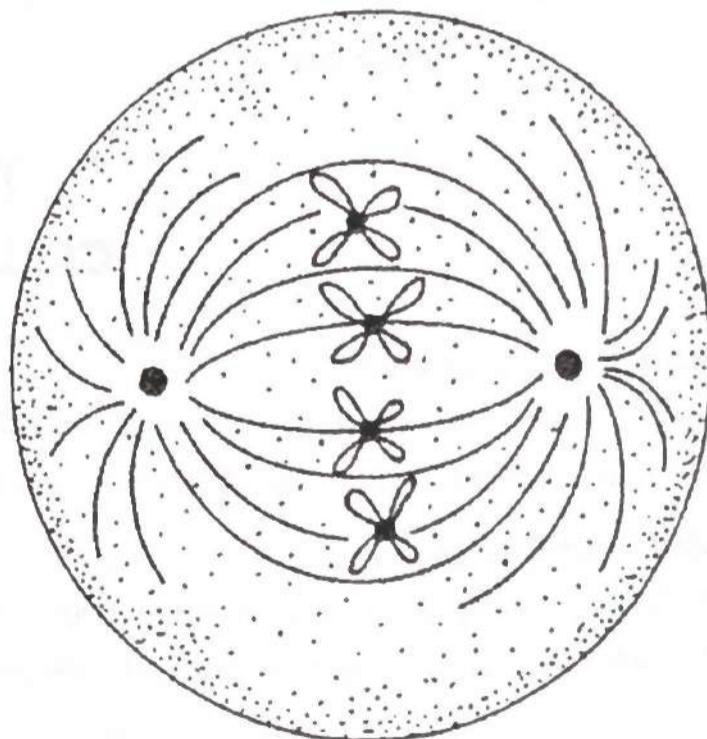
### Meiosis

Meiosis is the process of cell division by which specific cells of reproductive organs or tissues in animals and plants divide to form gametes. It involves two divisions in a succession. When a cell divides by meiosis, four new cells are produced instead of simply two as shown in the figure. The new cells only have half the number of chromosomes as the mother cells. Meiosis helps in the production of gametes—sex cells, sperm, and eggs.



Meiosis Division

**Example 10.** Cells grow by dividing. The picture shows one such growing cell ready to divide.



- (A) How many cells will be formed after the cell divides completely? (Remember)
- (B) How many chromosomes will each daughter cell receive? (Understand)

[CBSE Question Bank 2022]

**Ans.** (A) Two cells will be formed after the cell divides completely.

(B) Each daughter cell will receive the same number of chromosomes as the parent cell.

# OBJECTIVE Type Questions

[1 mark]

## Multiple Choice Questions

1. Ayan views a slide of onion root cells in a compound microscope under a low power objective. He wants to increase the magnification to see the slide better. His teacher tells him to centre the portion of the slide he wants to see in the field of view before he shifts to the high power objective. This is important because .....

- (a) Under high power, a smaller area of the slide is observed.
- (b) Under high power, a larger area of the slide is observed.
- (c) Under high power, the entire slide is magnified.
- (d) Under high power, focusing is not possible at all. [Delhi Gov. QB 2022]

**Ans.** (a) Under high power, a smaller area of the slide is observed.

**Explanation:** When switching from a low-power objective to a high-power objective in a compound microscope, the field of view decreases, meaning a smaller portion of the slide is visible. This is why centering the area of interest beforehand ensures that it remains within view under higher magnification.

2. If the cell is placed in a hypotonic solution, water will move ..... the cell, causing it to .....

- (a) into, swell
- (b) out of, shrink
- (c) in and out of the cell
- (d) none of the above [NCERT Exemplar]

**Ans.** (a) into, swell

**Explanation:** A hypotonic solution is one with a lower concentration of solutes. Water molecules move from the outside to the inside of the cell through the cell membrane. Endosmosis is the process through which a cell acquires water and swells up.

3. Double membrane is absent in:

- |                 |                  |
|-----------------|------------------|
| (a) chloroplast | (b) mitochondria |
| (c) nucleus     | (d) lysosome     |
- [NCERT Exemplar]

**Ans.** (d) lysosome

**Explanation:** Lysosomes do not have a double membrane. The nucleus, mitochondria and chloroplast are cellular organelles with double membranes.



### Related Theory

→ Lysosomes are single membrane-bound organelles containing digestive enzymes that breakdown excess or worn-out organelles, food particles, ingested viruses or bacteria, and macromolecules.

4. Which of the following are the main constituents of the cell wall?

- |               |             |
|---------------|-------------|
| (a) Cellulose | (b) Pectin  |
| (c) Starch    | (d) Protein |

[NCERT Exemplar]

**Ans.** (a) Cellulose

**Explanation:** The cell wall is a rigid and flexible structural layer surrounding the cell membrane in plants, algae, and most prokaryotes. It is absent in animal cells. The main components of the cell wall include cellulose, pectin, hemicellulose, and lignin. Cellulose, a key component of the plant cell wall, provides strength and structural support to stems, leaves, and branches. It is present in the inner layer of the cell wall as cellulose microfibrils (fiber-like strands), helping protect the internal structures of plant cells.



### Related Theory

→ Pectin is a polymer found in the cell walls of plants that aids in the elongation of primary cell wall and plant growth.

→ Lignin is the most important components of a plant's secondary cell wall

5. Find out the correct sentence.

- (a) Enzymes packed in lysosomes are made through RER (rough endoplasmic reticulum).

(b) Rough endoplasmic reticulum and smooth endoplasmic reticulum produce lipid and protein respectively.

(c) Endoplasmic reticulum is related with the destruction of plasma membrane.

(d) Nucleoid is present inside the nucleoplasm of eukaryotic nucleus.

[NCERT Exemplar]

**Ans.** (a) Enzymes packed in lysosomes are made through RER (rough endoplasmic reticulum).

**Explanation:** Lysosomal enzymes are made in the rough endoplasmic reticulum and travel to the Golgi.

The rough ER is involved in the manufacture and dispatch of certain proteins and is studded with millions of membrane-bound

ribosomes. Smooth ER is closely linked to lipid (fat) synthesis and metabolism, as well as the production of steroid hormones. It has a detoxifying effect as well.

The formation of the plasma membrane is linked to the endoplasmic reticulum. It synthesises proteins and lipids for membrane formation (with the help of ribosomes).



### Related Theory

- In a prokaryotic cell the nuclear material is not enclosed by a membrane and consists of a single chromosome, which is found freely in the cytoplasm.

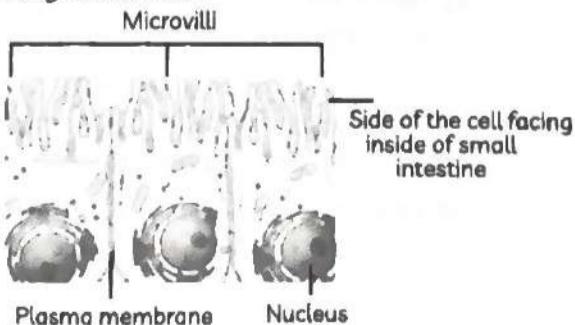
**6. Outer surfaces of some cells are folded into finger-like projections as shown in the given figure. Which of the following would be the function of such folded surfaces?**



- (a) To increase the energy production of the cell.
- (b) To increase the rate of cell division of the cell.
- (c) Increases the cell's ability to absorb nutrients.
- (d) To help in the movement of the cell more effectively.

**Ans. (c)** Enzymes packed in lysosomes are made through RER (rough endoplasmic reticulum).

**Explanation:** Microvilli (singular = microvillus) are finger-like projections on the plasma membrane of cells that specialise in absorption. The surface area of the plasma membrane is increased by these folding-like projections in the small intestine, which absorbs nutrients from digested food.



**Microvilli, appear on cell lining of the small intestine, increases the surface area available for absorption**

**7. Silver nitrate solution is used to study**

- (a) endoplasmic reticulum
- (b) Golgi apparatus
- (c) nucleus
- (d) mitochondria.

[NCERT Exemplar]

**Ans. (b) Golgi apparatus**

**Explanation:** Silver nitrate solution is used to study the Golgi apparatus, as it helps in visualizing the structure under a microscope, particularly due to the staining method known as the black reaction developed by Camillo Golgi.



### Related Theory

- Camillo Golgi, in 1898, developed a staining technique using a weak solution of silver nitrate, known as the black reaction. This method enabled him to stain individual nerve cells and other cell structures, making them visible under a microscope. While examining nerve cells in the brain of an owl, Golgi discovered the Golgi apparatus, an important organelle involved in processing and packaging proteins. Since then, silver nitrate solution has been widely used to stain and study the Golgi apparatus and other cellular structures.

**8. Living cells were discovered by:**

- (a) Robert Hooke    (b) Purkinje
- (c) Leeuwenhoek    (d) Robert Brown

[NCERT Exemplar]

**Ans. (c) Leeuwenhoek**

**Explanation:** Antonie van Leeuwenhoek was the first to discover living cells. With the improved microscope, he observed free-living cells of algae *Spirogyra* in the pond for the first time in 1674. He coined the term 'animalcules' to describe living cells. Bacteria is the name given to some minute 'animalcules.'

**9. Well-defined nucleus is NOT found in:**

- (a) animal cell    (b) plant cell
- (c) eukaryotic cell    (d) prokaryotic cell

[DIKSHA]

**Ans. (d) prokaryotic cell**

**Explanation:** A prokaryotic cell is a primitive cell that lacks a well-defined nucleus. Bacteria, Mycoplasma, cyanobacteria and blue-green algae are just a few examples of prokaryotes that lack a well-defined nucleus.



### Related Theory

- Eukaryotic organisms include diatoms, algae, and yeast, which have well-defined nuclei and cell membrane-bound organelles.

**10. Which of these properties qualifies Amoeba as eukaryotes?**

- (a) It is unicellular.
- (b) It needs food for energy.
- (c) It has a membrane bound nucleus.
- (d) It is surrounded by a plasma membrane.

[CBSE Question Bank 2024]



**Ans.** (c) It has a membrane bound nucleus.

**Explanation:** Amoeba qualifies as a eukaryote because it has a membrane-bound nucleus, which is a defining feature of eukaryotic cells. While Amoeba is unicellular and needs food for energy, these characteristics are not exclusive to eukaryotes. The presence of a membrane-bound nucleus sets eukaryotes apart from prokaryotes, which lack a membrane-bound nucleus.



### Related Theory

- Eukaryotes have a membrane-bound nucleus that houses their genetic material (DNA). In addition, eukaryotic cells contain various other membrane-bound organelles (e.g. mitochondria, endoplasmic reticulum).

**11. Which of these sentences are NOT a function of the Ribosome?**

- (I) It helps in the manufacture of protein molecules.
- (II) It helps in the manufacture of enzymes.
- (III) It helps in the manufacture of hormones.
- (IV) It helps in the manufacture of starch molecules.

**Options:**

- |                    |                    |
|--------------------|--------------------|
| (a) (I) and (II)   | (b) (II) and (III) |
| (c) (III) and (IV) | (d) (IV) and (I)   |

[NCERT Exemplar]

**Ans.** (c) (III) and (IV)

**Explanation:** As ribosomes are the site of protein synthesis and enzymes, they play an important role in protein synthesis. In addition, it produces amino acids, which polymerise to create proteins.

**12. Undefined nuclear region of Prokaryotes is known as:**

- |                  |               |
|------------------|---------------|
| (a) nucleus      | (b) nucleolus |
| (c) nucleic acid | (d) nucleoid  |

[NCERT Exemplar]

**Ans.** (d) nucleoid

**Explanation:** Nucleoid refers to the undefined nuclear region of prokaryotes. It lacks a defined structure due to the lack of a nuclear membrane, as seen in eukaryotic cells.

**13. Select the odd one out.**

- (a) The movement of water across a semi-permeable membrane is affected by the amount of substances dissolved in it.
- (b) Membranes are made of organic molecules like proteins and lipids.
- (c) Molecules soluble in organic solvents can easily pass through the membrane.
- (d) Plasma membranes contain chitin sugar in plants.

[NCERT Exemplar]

**Ans.** (d) Plasma membranes contain chitin sugar in plants.

**Explanation:** Plasma membranes are primarily composed of phospholipids and proteins in both plant and animal cells.

Chitin is found in the cell walls of fungi, not in the plasma membranes of plants. Plants have cellulose in their cell walls.

### Assertion-Reason (A-R)

**Q. no. 14 and 18 are Assertion – Reasoning based questions.**

These consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below:

- (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

**14. Assertion (A):** Raisins swell up in hypotonic solution and do not burst.

**Reason (R):** Cell wall exerts pressure on the swollen cell.

**Ans.** (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).

**Explanation:** In a hypotonic solution, the osmosis process allows cells to absorb water from the external medium.

The cells swell and develop pressure against the cell wall due to the high amount of water inside. The cell now exerts an equal amount of pressure on the swollen cell. Due to the presence of cell wall, cells may withstand very dilute external fluids without bursting.

**15. Assertion (A):** Mitochondria are semi-autonomous cell organelle.

**Reason (R):** Mitochondria have their own DNA and proteins.

[NCERT Exemplar]

**Ans.** (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).

**Explanation:** Mitochondria and chloroplasts have their own DNA and ribosomes, therefore called semi-autonomous cell organelles.

Mitochondria are organelles found within each cell. They generate energy in the form of a molecule called ATP (Adenosine Triphosphate), which is then used to fuel the cell's various functions.





### Related Theory

→ Mitochondria are organelles responsible for converting chemical energy into usable energy for our cells. This process is known as cellular respiration. It allows mitochondria to convert glucose and oxygen into ATP, which is a high-energy molecule. The energy currency of cells is Adenosine Triphosphate (ATP).

- 16. Assertion (A): Chromoplasts are green-coloured plastids.**

**Reason (R):** Chromoplasts provide colour to flowers and fruits that attract pollinators and disseminators.

**Ans.** (d) (A) is false but (R) is true.

**Explanation:** Chloroplast is green-coloured plastid which helps in the photosynthesis and manufactures of food for plants. The coloured plastids are called chromoplasts. The unique colour of flowers and fruits is due to chromoplasts. They contain yellow, orange, or red pigments except green. They play role in attracting insects and various pollinating agents and in fruit dissemination.

- 17. Assertion (A): The amount of material dissolved in water affects**

the passage of water across the plasma membrane.

**Reason (R):**

Water moves in and out of the cell by the process of osmosis.

**Ans.** (b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).

**Explanation:** The process by which water moves from a region of high concentration to low concentration across a semi-permeable membrane is called osmosis. The direction of movement of water depends on the concentration of the solute present in it.

- 18. Assertion (A): Chloroplasts contain only a green-coloured pigment called chlorophyll.**

**Reason (R):** Chloroplasts are important for photosynthesis in green plants.

**Ans.** (d) (A) is false but (R) is true.

**Explanation:** Chloroplasts contain chlorophyll, which is a green pigment, but they also contain other pigments, such as carotenoids, which are responsible for yellow, orange, and red colors in some plants. So, chloroplasts don't contain only chlorophyll.

## CASE BASED Questions (CBQs)

[ 4 marks ]

Read the following passages and answer the questions that follow:

**19. A dinner party was organised at Anu's home. She was helping her mother in arranging things. She had put boondi in curd to make 'Boondi raita' but as she was going to sprinkle salt on the salad, her mother stopped from doing so. She said it's too early to sprinkle salt on salad, and that it should only be done once all the guests had taken their seats.**

**(A) When salt is added to salad, what property of the salt is observable?**

**(B) Anu's father asked her the difference between diffusion and osmosis. What should be her reply?**

**(C) What happens when Anu sprinkled salt over the salad?**

**Ans.** (A) When salt is added to the salad, it creates a hypertonic solution. The salt causes water to move out of the cells in the salad through osmosis, as the concentration of water outside the cells is lower than inside the cells.

**(B) Anu replied, diffusion is the movement of particles from an area of high concentration to an area of low concentration until equilibrium is reached. In contrast, osmosis is a specific type of diffusion involving water molecules, where water moves across a semi-permeable membrane from an area of low solute concentration to an area of high solute concentration.**

**(C) When salt is sprinkled over salad, the solution becomes hypertonic, thus, the water present inside the salad flows out by the process of exosmosis.**

**20. Dr Parimal, a professor of Botany visited the Botanical Garden of Noida where many students had gathered for a tour. Students were very excited to explore the garden, which had a variety of plants with colorful flowers and different types of fruits. Some flowers were white, and the unripe fruits were green. The air was filled with pleasant fragrances from the flowers.**

**Lots of birds and insects were seen that were feeding on fruits and flowers, also helping in**

pollination and fruit dispersion. Students who were in the park recognised Dr. Parimal and out of curiosity asked the following questions.

- (A) Which process is responsible for the spread of the pleasant fragrance throughout the area?
- (a) Osmosis      (b) Reverse Osmosis  
(c) Diffusion      (d) Evaporation
- (B) Which plastid gives colour to flowers and fruits?
- (a) Chloroplast      (b) Chromoplast  
(c) Leucoplast      (d) Plasmolysis
- (C) Why were unripe fruits green in colour?
- (a) Due to the presence of chloroplast.  
(b) Due to the presence of chromoplast.  
(c) Due to the presence of leucoplast.  
(d) Due to the absence of chloroplast.
- (D) Choose the statement that shows the similarity between plastids and mitochondria.
- (a) Both are equal in size.  
(b) Both are semi-autonomous.  
(c) Both have identical shape.  
(d) Both are present in animal cell.

OR

- (D) Assertion (A): Chloroplast is the only plastid found in plants.

Reason (R): Plastids are responsible to provide colour to fruits and flowers.

- (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).  
(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).  
(c) (A) is true but (R) is false.  
(d) (A) is false but (R) is true.

Ans. (A) (c) Diffusion

**Explanation:** Diffusion is the process involved in the pleasant fragrance spread everywhere in the park. It is the process of moving substances from an area of higher concentration to an area of lower concentration until equilibrium is reached. This results in a uniform distribution of the substance throughout the surrounding space.

(B) (b) Chromoplast

**Explanation:** Chromoplast provides reddish, pink, purple, and brownish colour except green colour to the flowers and fruits that attract insects and birds.

(C) (a) Due to the presence of chloroplast

**Explanation:** Chloroplasts are present in the skin of unripe fruits, where they play a role in photosynthesis. As the fruits ripen, chloroplasts can transform into chromoplasts, which are responsible for the

red, yellow, orange, and other colors seen in ripe fruits. This color change is due to the presence of pigments like carotenoids in chromoplasts, which attract pollinators or help in seed dispersal.

- (D) (b) Both are semi-autonomous.

**Explanation:** Both plastids (like chloroplasts) and mitochondria have their own DNA and are capable of self-replication, making them semi-autonomous organelles.

OR

- (D) (d) (A) is false but (R) is true.

**Explanation:** There are three types of plastids found in plants namely chloroplast, chromoplast and leucoplast. Chromoplasts are responsible to provide colour to fruits and flowers.



#### Related Theory

→ Plastids and mitochondria have distinct differences. Plastids are found only in plant cells and perform various functions based on their type, such as photosynthesis in chloroplasts or color in chromoplasts. On the other hand, mitochondria are known as the cell's powerhouse. They generate energy for the cell by producing ATP (Adenosine Triphosphate), which is used in various chemical processes essential for life.

21. A membrane surrounds each cell, separating its contents from the outside world. To sustain their sophisticated structure and function, large and complex cells, such as those seen in multicellular animals, require a lot of chemical activity. These cells use membrane-bound tiny structures within themselves to keep different kinds of activities apart from one another. The cytoplasm is a jelly-like fluid that fills the space between the plasma membrane and the plasma membrane's outer layer, and it includes a variety of specialised cell organelles. Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Nucleus, Chloroplast, Mitochondria, and Plastids are some of the organelles found in cells. For the cell, each of these organelles has a distinct purpose. An electron microscope is required to see some of these organelles. They're significant since they play a key role in cell function.

- (A) Name any five cell organelles.  
(B) Name the jelly-like fluid substance present in cells.  
(C) What name is given to the functional segments of DNA? What is the function of these functional segments?

- Ans. (A) Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Ribosomes, Nucleus, Chloroplast, Mitochondria and Plastids.  
(B) Cytoplasm is a viscous liquid that fills each cell and is surrounded by the cell membrane.

Water, salts and proteins make up the majority of it. The cytoplasm of eukaryotic cells contains all of the materials inside the cell and outside the nucleus.

- (C) The functional segments of DNA are genes. The genes are functional units of heredity. They carry the hereditary information from one generation to the next. They also control the structure and metabolism of the body.

**22.** Anuja is explaining to her 10-year-old sister that Robert Hook discovered cells in 1665. Cell theory was created as a result of his observations. Two biologists, German zoologist Schleiden (1838) and British zoologist Schwann proposed the cell theory, which states that all plants and animals are made up of cells and the cell is the fundamental unit of life (1839). Virchow (1855) improved on the cell hypothesis by proposing that all cells originate from pre-existing cells. It was feasible to examine and understand the intricate structure of the cell and its various organelles after the invention of the electron microscope in 1940. All living organisms are made up of cells, which perform all of the functions necessary for the organism's survival, such as respiration, digesting, and excretion. A single cell in a unicellular creature performs all of these duties, whereas in multicellular organisms, distinct groups of cells perform different functions. Anuja does not have access to a microscope, thus she is unable to demonstrate the structure of a cell to her sister.

- (A) Who discovered the nucleus in the cell?  
 (B) Which of the following is the primary component of the cell wall?  
 (C) What is the significance of the term "selectively permeable membrane" in the context of cell membranes?

**Ans.** (A) Robert Brown discovered the nucleus in a cell in 1831.

- (B) The basic cell wall of green plants and many types of algae contains cellulose, which is an important structural component. It is a strong, fibrous and water-insoluble polysaccharide that plays an important function in maintaining the structural integrity of plant cell walls.  
 (C) Selectively permeable nature of the plasma membrane helps the cell by allowing only selective molecules to move in and out of the cell. Molecules that are not needed by the cell are restricted from entering or exiting through the plasma membrane.

**23.** Muskan is very fond of Chole bhature! One day she requested her mother to give her Chole bhature. So, her mother took some

gram (chole), washed them with water and left them soaked in water overnight. Muskan was very excited to see the soaked grams the next morning, so she went to see what had happened to the soaked grams. She was surprised to see them grow much bigger in size as compared to on previous night.

- (A) What actually happened to the grams soaked by Muskan's mother?  
 (a) They get shrink.

- (b) They get swell.  
 (c) They remain of the same size.  
 (d) Some get swell while others get shrink.

- (B) Which part of the gram seed will allow the water to enter the seeds?

- (a) Vacuole  
 (b) Cell wall  
 (c) Plasma membrane  
 (d) Cytoplasm

- (C) Which one of the following organelle is called storage sac of the cell?

- (a) Golgi apparatus (b) Vacuole  
 (b) Lysosome (d) Mitochondrion

- (D) Assertion (A): Water can move inward as well outward through plasma membrane depending on the concentration of solution in which the cell is placed.

**Reason (R):** Plasma membrane is a selectively permeable membrane.

- (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).  
 (b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).  
 (c) (A) is true but (R) is false.  
 (d) (A) is false but (R) is true.

**OR**

- (D) The largest cell organelles in the cell is/are:

- (a) Plastids (b) Golgi bodies  
 (c) Mitochondria (d) Chromosomes

**Ans.** (A) (b) They get swell.

**Explanation:** Gram seeds have a lower concentration as compared to the surrounding medium, they will absorb water by the process of endosmosis, due to which the gram seeds swell up and expands in size.

- (B) (c) Plasma membrane

**Explanation:** Water enters the seed through the plasma membrane, as it is selectively permeable, allowing only certain molecules like water to pass through.

- (C) (b) Vacuole

**Explanation:** The vacuole serves as the storage sac in plant cells, storing water, nutrients, and waste products.



- (D) (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).  
Explanation: Please see

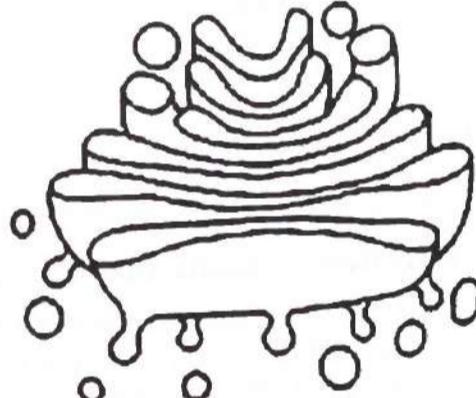
**Explanation:** Plasma membrane is a selectively permeable membrane that allows water to move inward as well as outward depending on the concentration of solution in which the cell has been placed.

**OR**

- (D) (a) Plastids

**Explanation:** Plastids are double membrane-bound organelles found in plant cells and algae. They are responsible for manufacturing and storage of food. Plastids are semi-autonomous organelles as they contain both their own ribosomes and DNA.

24. Camilo Golgi was the first to define the Golgi apparatus, which consists of a system of membrane-bound vesicles (flattened sacs) stacked almost parallel to each other called cisternae. These membranes are frequently coupled to the ER membranes, making up a complicated cellular membrane system. The Golgi apparatus packages and transports the material synthesised near the ER to numerous targets inside and beyond the cell. Storage, modification and packing of objects in vesicles are among its functions. Complex sugars can be produced from simple sugars in the Golgi apparatus in some instances. The development of lysosomes is also aided by the Golgi apparatus.



## **Golgi Apparatus**

- (A) What will happen if the organelle shown above is removed?

- (B) Name the cell organelle which has:



- (C) What is the importance of cell sap present in vacuoles of plant cell?

**Ans. (A)** The given figure shows Golgi apparatus. In the absence of the Golgi apparatus, lysosomes will not be formed and damaged membranes such as the cell wall and plasma membrane will not be repaired. Furthermore, the acrosome production of sperm will not occur, preventing sperm from entering the egg.

## Related Theory

- The Golgi apparatus is responsible for storing, packaging and dispatching chemicals produced by the endoplasmic reticulum. It carries material into and out of the cell and is also responsible for lysosome development. As a result, if there are no Golgi bodies, there will be no storage, packing, or transport of material and proteins and they will float around the cell aimlessly.

- (B) The cell organelle which has:

- (i) Cristae – Mitochondria
  - (ii) Cisternae – Golgi apparatus

- (C) Vacuoles of plant cells are full of cell sap.  
Importance of cell sap as follows:

- (1) They provide turgidity and rigidity of the cell
  - (2) They store substances like amino acids, sugars, various organic acids and some proteins which are important for the life of the plant cell

## **SHORT ANSWER Type-I Questions (SA-I)**

[ 2 marks ]

25. Damini's mother wanted to make mango pickles. She asked Damini to cut the tender mango into four pieces and smear it with common salt and keep it for some time. She did so and observed that after some time the mango pieces had started to lose water and they had shrunk in size. Name and explain the phenomenon observed by Damini.

[DIKSHA]

**Ans.** When salt is sprinkled over mango pieces, the solution becomes hypertonic, thus the water present inside the mango pieces flows out by the process of exosmosis.

## Related Theory

- Exosmosis is the mechanism through which water molecules flow out of the cell.

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

- Ans.** (1) The cell will lose its shape and size.  
(2) Since the boundary is lost, protoplasm of various cells will mix with each other.  
(3) Cell will not be able to regulate the exchange of materials with its surroundings.

**27. Name the fluid present in the plant cell vacuole. Why do plant cells possess large sized vacuole?**

**Ans.** The fluid present in the plant cell vacuole is called cell sap.

Plant cells possess a large vacuole for several important reasons. The vacuole stores water, nutrients, and waste products, which helps regulate the internal environment of the cell. It also plays a crucial role in maintaining turgor pressure, keeping the cell firm and providing structural support to the plant. Additionally, the vacuole helps maintain the water balance of the cell.



### Related Theory

→ Animal cells may also have vacuoles, but these are small and temporary.

**28. A person takes a concentrated solution of salt. After some time, he starts vomiting. What is the phenomenon responsible for such a situation? Explain. [NCERT Exemplar]**

**Ans.** When a person consumes a concentrated salt solution, the phenomenon of exosmosis occurs. In this case, the salt solution is hypertonic (it has a lower water concentration compared to the cells in the body). As a result, water moves out of the cells into the surrounding solution to balance the concentration, causing dehydration in the cells. This outward movement of water from the cells.

**29. How are chromatin, chromatid and chromosomes related to each other?**

[NCERT Exemplar]

**Ans.** The chromosomes are made up of chromatin, which is a thread-like structure. Chromatid refers to a copy of a duplicated chromosome that is connected to the other copy by a centromere.

**30. What is the significance of pores present on the nuclear membrane?** [DIKSHA]

**Ans.** The pores present on the nuclear membrane allow the transport of water-soluble molecules across the nuclear envelope. RNA and ribosomes move out of the nucleus, whereas carbohydrates, lipids and proteins move into the nucleus.

**31. In Biology practical class, the teacher asked Renuka and Sahil to keep the onion peel and RBC in two different beakers of hypotonic solution. Renuka noticed that the onion peel swelled while Sahil witnessed the RBCs burst rapidly. Why did this happen? Give reason by supporting the activity performed by both of them.**

**Ans.** Water moves into the cell when the surrounding medium is hypotonic. Both of them observed that cells of onion peel and RBC get enlarged and swell. Since RBCs lack a cell wall, they quickly absorb water and burst. In contrast, plant cells like the onion peel have a protective cell wall that prevents them from bursting. Hence,

- (1) Renuka observed the onion peel swelling while.
- (2) Sahil would observe the RBCs burst when kept in a hypotonic solution.

**32. Identify the cell organelles based on these common names given below.**

(A) Transporting channel of the cell

(B) Control room of the cell

Also, state the reason why are they called so.

**Ans.** (A) Endoplasmic reticulum is called transporting channel of the cell because it connects the cell membrane to the nuclear membrane. Since ER passes substances to various parts of the cell, it functions as an internal delivery system. The endoplasmic reticulum membrane transports secretory proteins, primarily glycoproteins.

(B) Nucleus is called the control room of the cell because it performs two main functions:

- (1) It contains hereditary information for structure, reproduction, development, metabolism and behaviour.
- (2) It directs the synthesis of proteins and enzymes which govern cellular activities.



### Related Theory

→ Nucleus is also known as the brain of the cell.

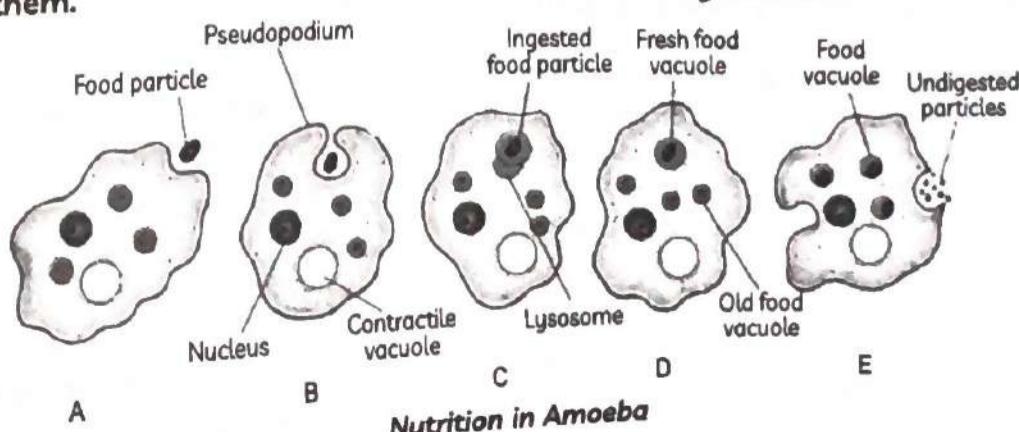
**33. How does Amoeba take its food?**

**Ans.** (1) Amoeba does not have any specific organ for taking food. The entire process is carried out by its flexible cell membrane.

(2) Amoeba draws out their pseudopodia when it senses food particles.

(3) Pseudopodia engulfs the entire food particle forming a food vacuole. This process is called endocytosis.

(4) Various digestive juices secreted in the vacuole break down the food particles which are then absorbed into the cytoplasm by diffusion.



### Related Theory

Amoeba gets rid of the undigested waste by removal from the surface by the process of exocytosis.

34. (A) Name the two organelles in a plant cell that contain their own genetic material and ribosomes.

(B) If you are provided with some vegetables to cook, you generally add salt into vegetables during the cooking process. After adding salt, vegetables release water. What mechanism is responsible for this?

[NCERT Exemplar]

**Ans.** (A) Mitochondria and plastids both have genetic material and ribosomes of their own. Mitochondrial DNA and plastid DNA both contain genes that create proteins required for mitochondria and plastid.

(B) Addition of salt creates a hypertonic solution with a high concentration of solute outside the vegetable cells. Thus, the water present inside the cells move out to balance the concentration, by the process of exosmosis.

35. If lysosomes are absent in a cell, then toxic waste materials accumulate in a cell. Why is it so? Mention any other function of lysosomes.

**Ans.** Lysosomes act as a waste disposal system of the cell as they digest any foreign material that enters the cell by the strong hydrolytic enzymes present in it. In their absence, waste will accumulate in the cell causing harmful effects on it. Lysosomes are also known as suicidal bags of the cell because, in cases of cellular disruption, they can damage the cell by releasing their enzymes.

36. The inner membrane of the mitochondria is folded into many finger-like projections.

Explain what would happen if the inner membrane was not folded?

[CBSE Question Bank 2022]

**Ans.** If the inner membrane of the mitochondria were not folded, it would drastically reduce the surface area available for cellular respiration. This would limit the number of enzymes and protein complexes involved in the production of ATP, the cell's energy currency. As a result, the mitochondria would be less efficient at generating energy, affecting the cell's overall function and leading to energy deficiencies.

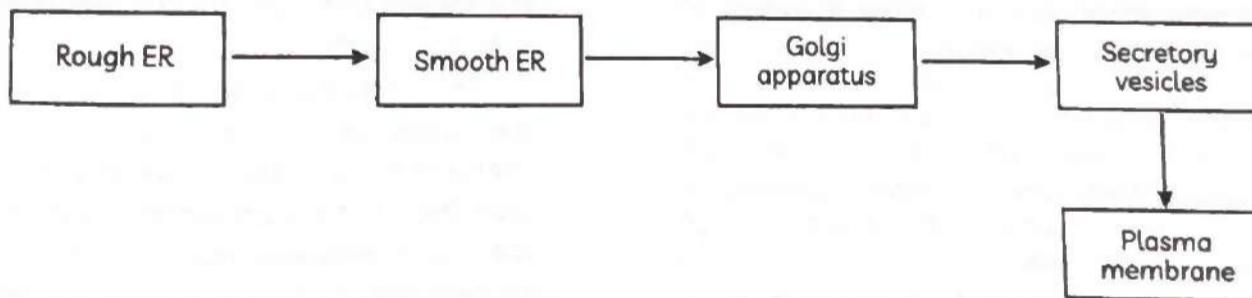
37. Why does the skin of your finger shrink when you wash clothes for a long time?

**Ans.** The skin of your finger shrinks when you wash clothes for a long time due to a process called exosmosis. When your skin is exposed to water, it acts as a hypertonic solution, while the water around it is hypotonic (lower concentration of solutes). Since the skin is semi-permeable, water moves out of the cells in your skin to balance the concentration of solutes. This loss of water causes the skin to shrink.

38. What is membrane biogenesis? How is the plasma membrane formed during this process?

[DIKSHA]

**Ans.** The process of plasma membrane formation is called membrane biogenesis. The proteins and lipids are first synthesised in the rough endoplasmic reticulum and the smooth endoplasmic reticulum, respectively. These are then transported to the Golgi complex for their modification. After modification, these are transported to the cell surface through vesicles which bud off from the Golgi complex to fuse with the cell membrane and form a part of the membrane.



## SHORT ANSWER Type-II Questions (SA-II)

[ 3 marks ]

39. Describe the microscopic structure of the cell. [DIKSHA]

**Ans.** Cell consists of three main parts:

(1) **Plasma membrane:** It is the outermost boundary of the cell that separates one cell from another. It also provides shape and size to the cell.

(2) **Cytoplasm:** It is a jelly-like substance that fills the space between the cell membrane and the nucleus. It holds the organelles in place and facilitates the movement of materials within the cell.

(3) **Nucleus:** The nucleus is surrounded by a double-layered nuclear membrane with pores. Inside, it contains the nucleolus and

chromatin (DNA). It is the main control centre of the cell as it directs all the activities happening in the cell.

#### 40. Why are cells called structural and basic units of life?

**Ans.** All living species are made up of cells, therefore it is referred to as the structural and functional unit of life. Cells are necessary for carrying out a variety of life-sustaining operations. They provide the necessary structure and are involved in the absorption of nutrients and their conversion into usable energy. In multicellular organisms, specialised cells carry out specific functions. These cells are also in charge of carrying out all metabolic and regulatory duties that are vital for the organism's survival. Hence, the cell is known as the structural and functional unit of life.

For example, RBC is a type of blood cell that is largely responsible for carrying oxygen and carbon dioxide.

#### 41. Give reasons:

- (A) Mitochondria is called as the 'Powerhouse of the cell'.
- (B) Vacuoles act as storage sacs inside a cell.
- (C) Why lysosomes are called suicidal bags of the cell?

**Ans.** (A) Mitochondria are referred to as the "Powerhouse of the cell" because they play a key role in the oxidation of food to release energy in the form of ATP.

These ATP molecules act as energy currency and are transported to various parts of the cell that need energy. This process is known as cellular respiration.

(B) Vacuoles act as storage sacs inside a cell because they are membrane-bound organelles that store a variety of substances, including water, nutrients, waste products, and other molecules. In plant cells, vacuoles also help maintain turgor pressure, which is crucial for cell rigidity. They can also store pigments in some plants, contributing to the color of flowers and fruits.

(C) Lysosomes are called "suicidal bags" of the cell because they contain strong hydrolytic enzymes that can digest cellular material, including worn-out cell parts and foreign substances. Under normal circumstances, these enzymes help break down waste and maintain cellular health. However, if the lysosome's membrane is damaged or the cell undergoes stress, the enzymes can leak out and digest the cell's own components, leading to cell death.

#### 42. Which kind of plastid is more common in:

- (A) roots of the plant?
- (B) leaves of the plant?
- (C) flowers and fruits? [NCERT Exemplar]

- Ans.** (A) Plant roots contain leucoplast, which are colourless plastids that serve as food storage.  
 (B) Plant leaves contain green chlorophyll which aids in photosynthesis.  
 (C) Multicoloured chromoplasts are found in flowers and fruits to attract pollinators.

#### 43. What is the difference between a bacterial cell and an onion peel cell?

|     | S.  | Bacterial Cell                                   | Onion Peel Cell |
|-----|---|--|-----------------|
| No. |   |  |                 |
| (1) | They are prokaryotic cells.                             | They are eukaryotic cells.                       |                 |
| (2) | They lack membrane-bound organelles.                    | They have membrane-bound organelles.             |                 |
| (3) | They lack a well-defined membrane-bound nucleus.        | They have a well-defined membrane-bound nucleus. |                 |
| (4) | Ribosomes are small in size.                            | Ribosomes are large in size.                     |                 |
| (5) | Most prokaryotes, including bacteria, have a cell wall. | Cell wall is present only in plants and fungi.   |                 |

(Any three)

#### 44. Distinguish between hypotonic solution, isotonic solution and hypertonic solution. [DIKSHA]

**Ans. Hypotonic Solution:** A solution is called hypotonic if it has a higher water concentration (or lower solute concentration) compared to the inside of the cell. When a cell is placed in a hypotonic solution, water moves into the cell by osmosis, causing the cell to swell and potentially burst.

**Isotonic solution:** An isotonic solution has the same water concentration (or solute concentration) as the inside of the cell. In this case, there is no net movement of water across the cell membrane, and the cell maintains its shape without gaining or losing water.

**Hypertonic Solution:** A solution is hypertonic if it has a lower water concentration (or higher solute concentration) than inside of the cell. When a cell is placed in a hypertonic solution, water moves out of the cell by osmosis, causing the cell to shrink and lose turgidity.

#### 45. What happens when:

- (A) a red blood cell is kept in a concentrated saline solution?
- (B) chloroplasts are removed from the plant cell?
- (C) Rheo leaves are first boiled in water and then dipped in sugar syrup?

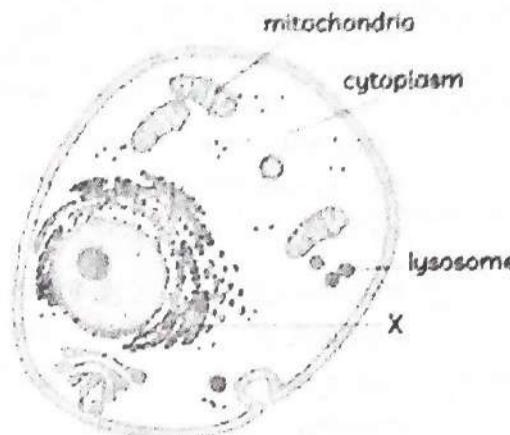


**Ans.** (A) When a red blood cell is immersed in a concentrated saline solution, exosmosis will take place causing the RBCs to shrink due to excessive water loss.

(B) Chloroplasts contain the pigment chlorophyll which is responsible for food preparation in plants by the process of photosynthesis. Without chloroplasts, plants would not be able to produce their own food through photosynthesis, which would make plant life impossible. Since plants form the base of the food chain, the absence of chloroplasts would disrupt life on Earth as we know it.

(C) The cells in the plasma membrane of *Rheo* leaves are killed by boiling in water. As a result, plasmolysis will not occur when sugar syrup is applied, since only living cells can absorb water through osmosis. Dead cells cannot take in water and thus cannot undergo plasmolysis.

46. The diagram shows an animal cell with some of its organelles. X is also a cell organelle.



(A) What does X represent in the diagram?

(B) Which cell organelle is called the powerhouse of the cell and why?

**Ans.** (A) X is endoplasmic reticulum.

(B) The mitochondrion is called the powerhouse of the cell because it is responsible for producing energy in the form of ATP (Adenosine Triphosphate) through cellular respiration. Mitochondria convert nutrients (like glucose) into energy, which is essential for various cellular activities, making them the main energy source for the cell.

## LONG ANSWER Type Questions (LA)

[ 5 marks ]

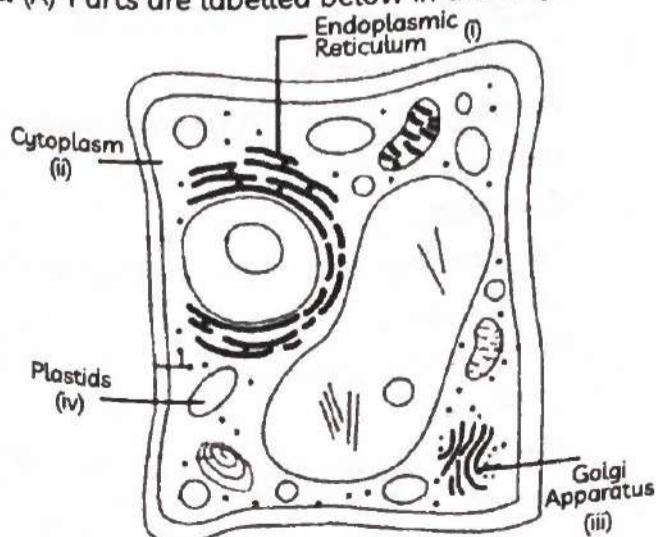
47. (A) Draw the structure of a plant cell and label the part which:

- (i) have cisternae-like structures for transport and synthesis.
- (ii) is a place where most biochemical reactions occur.
- (iii) packages and delivers the material synthesised in a cell.
- (iv) acts as a kitchen of the cell.

(B) Also, differentiate this cell from an animal cell based on:

- (i) Outer membranes
- (ii) Presence of centrioles

**Ans.** (A) Parts are labelled below in the diagram:



(B) (i) Plant cell has cell wall outside the cell membrane but the cell wall is absent in animal cell.

(ii) Centrioles are only found in animal cells not in plant cells.

48. Differentiate between rough and smooth endoplasmic reticulum. How is the endoplasmic reticulum important for membrane biogenesis? [NCERT Exemplar]

**Ans.** The endoplasmic reticulum is a complex network of tubular membranes found exclusively in the cytoplasm of eukaryotic cells. Endoplasmic reticulum is divided into two types.

- (1) Rough Endoplasmic Reticulum
- (2) Smooth Endoplasmic Reticulum

**Rough Endoplasmic Reticulum (RER)**

- (1) Ribosomes are connected to its membrane.

**Smooth Endoplasmic Reticulum (SER)**

- Ribosomes are not found on its membrane.



### Rough Endoplasmic Reticulum (RER)

(2) Cisternae and a few tubules make up this structure.

(3) It is involved in the production of enzymes and proteins.

### Smooth Endoplasmic Reticulum (SER)

Vesicles and tubules make up this structure.

Glycogen, lipids, and steroids are all synthesised by this enzyme.

### Rough Endoplasmic Reticulum (RER)

(4) Lysosome production is aided by this substance.

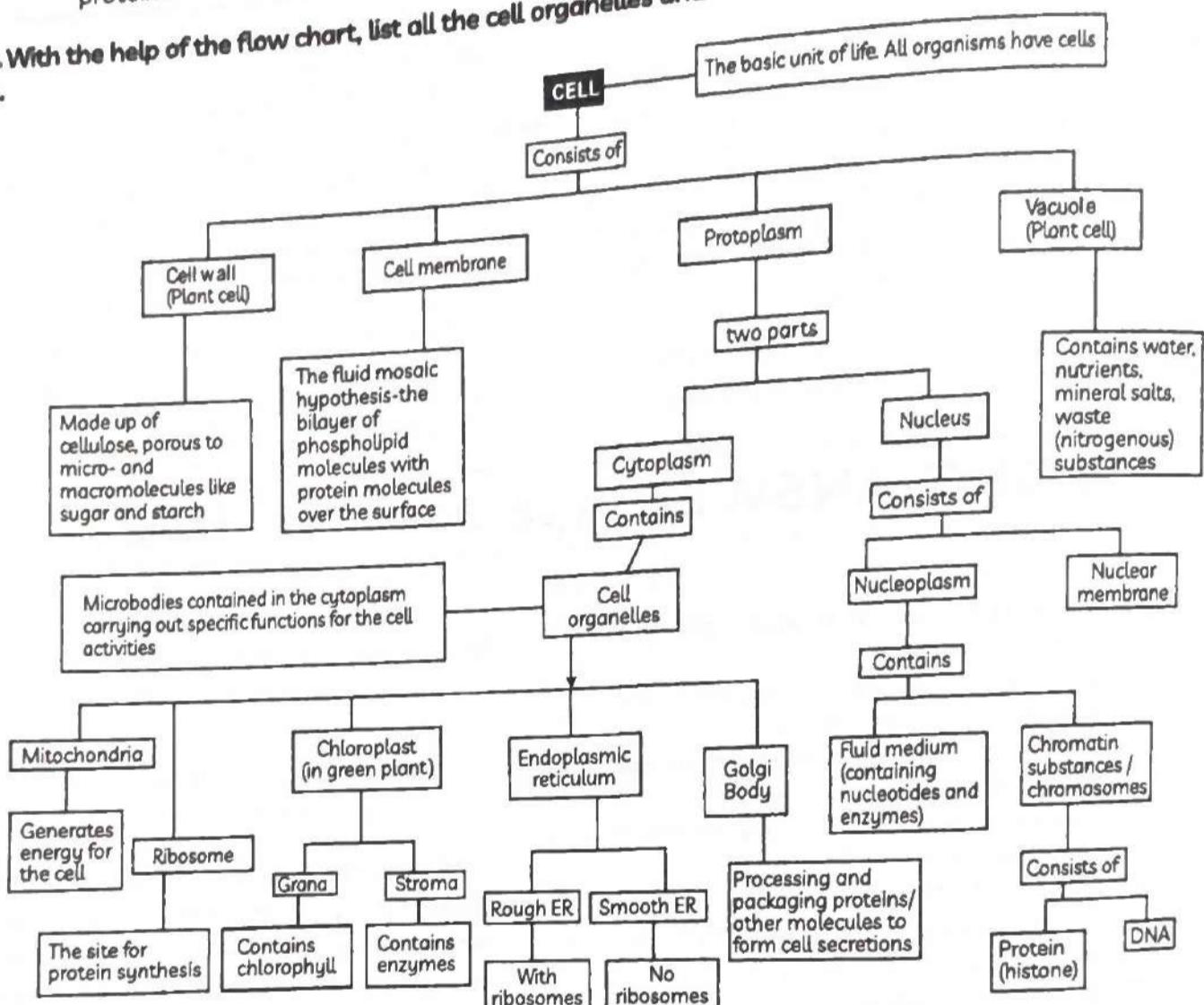
The endoplasmic reticulum is responsible for the formation of the membrane by synthesising lipids (smooth endoplasmic reticulum) and proteins (rough endoplasmic reticulum). As a result, they aid in membrane biogenesis.

### Smooth Endoplasmic Reticulum (SER)

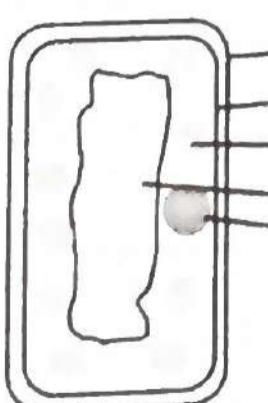
Spherosomes/Oleosomes are produced as a result.

49. With the help of the flow chart, list all the cell organelles and write one function of each of them. [DIKSHA]

Ans.



50. The figure shows a plant cell. Name the parts of the cell labelled A to E and describe their functions.



[British Council 2022]

Ans. A - Cell wall

Function: Provides rigidity to the cell

B - Cell membrane

Function: Helps in diffusion (movement of molecules from in/out) of cell

C - Chloroplast

Function: Traps light/ helps in photosynthesis

D - Vacuole

Function: Stores sap/food

E - Nucleus

Function: Stores DNA/control functions of the cell

# SELF ASSESSMENT

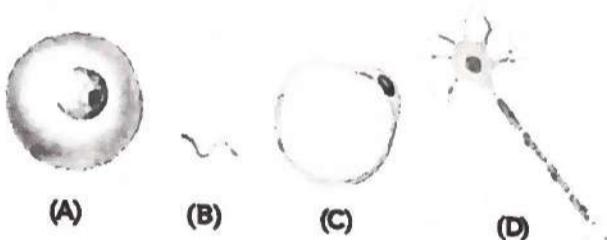
## Multiple Choice Questions

1. The table below describes some of the organelles visible in a cell under a microscope. Identify the type of organism to which the cell belongs.

| Cell Organelle | Description |
|----------------|-------------|
| Cell Wall      | Present     |
| Vacuole        | Large       |
| Centriole      | Not visible |
| Nucleus        | Present     |

(a) It is the cell of an animal.  
 (b) It is the cell of a plant.  
 (c) It is the cell of a bacterium.  
 (d) It is the cell of a virus.      (*Understand*)

2. Identify the largest cell from the given cells of human body.



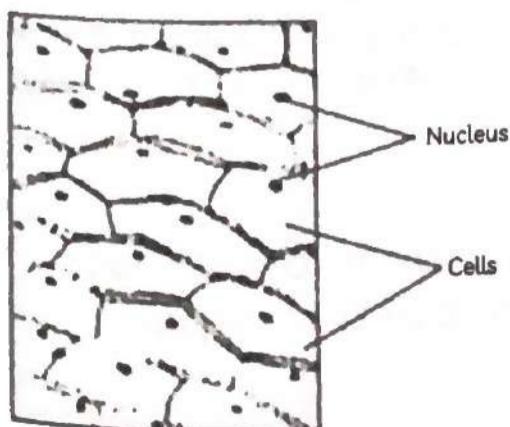
- (a) (A) and (B)      (b) Only (B)  
 (c) (C) and (D)      (d) Only (D)

3. Which of the following is the packaging and dispatching unit of the cell?

  - (a) Lysosomes
  - (b) Endoplasmic reticulum
  - (c) Golgi apparatus
  - (d) Mitochondria

(Understand) 1

4. Reena prepared a temporary mount of an onion peel and observed under a compound microscope. Her slide looked like as shown in figure drawn by her.



## Cells of an Onion Peel

Which of the following stain she had used to prepare the onion peel slide?  
(a) Iodine



### (Understand) 1

### **Assertion-Reason (A-R)**

Q. no. 5 to 6 are Assertion - Reasoning based questions.

These consist of two statements - Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below:

- (a) Both (A) and (R) are true, and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

5. Assertion (A): Central vacuole occupies 5-10% of plant cell volume

**Reason (R):** Central vacuole is a storage sac for solid or liquid content.

## (Analyse) 1

6. Assertion (A): Eukaryotic cells are larger than prokaryotic cells.

**Reason (R):** Organelles that are membrane-bound do not exist in prokaryotic cells. (Analuse) 1

## **Case Based Question**

7. Read the given source and answer the following questions.

A vacuole is a membrane-bound organelle along with other organelles in the cytoplasm of a cell. It is present in bacterial cells, plant cells, fungal cells and animal cells. The organelle does not have any specific shape or size.

**(A) Name:**

- (I) The fluid present in the vacuole.

(II) The unit membrane by which vacuole is surrounded. (Remember) 1

(B) (I) Mention the specific function of vacuole in the plant cell.

(II) How vacuole is useful in some unicellular organisms? (Understand) 1

(C) (I) Vacuoles are called storage sacs of the cell. Explain. (Understand)

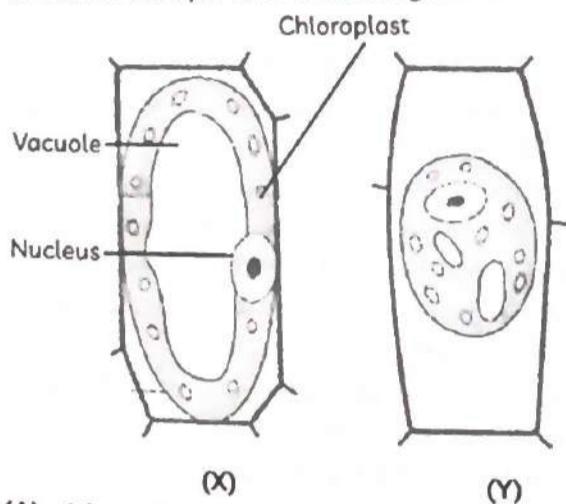
(II) Name some materials which a vacuole can store. (Remember)

OR

- (C) How does the structure and function of vacuoles differ in plant and animal cells? (Understand) 2

### Short Answer Type-I Questions

8. Mohit makes a slide of a leaf of Rhei and observes the cells under a microscope and draws the figure X. Then he puts the leaf in concentrated sugar solution, observes under the microscope and draws figure Y.



9. (A) Name:  
(i) One unicellular organism which has irregular shape.  
(ii) One cell which has an irregular shape. (Remember)  
(B) What name is given to the mechanism or phenomenon which helps fresh water organisms (e.g., Amoeba):  
(i) to continuously gain water in their bodies?  
(ii) to throw away excess water from their bodies? (Remember) 2

### Short Answer Type-II Questions

10. Study the given diagram carefully



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solutions of this paper

- (A) Identify the diagram and label part 'A'. (Understand)

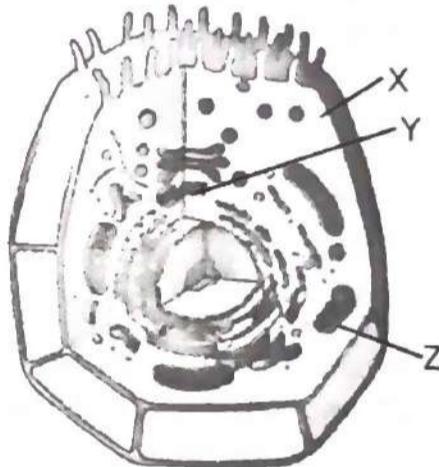
- (B) Name the term used for genetic material which lies in the cytoplasm and not covered by any envelope? (Remember)

- (C) Name the only cell organelle present in this cell which is not membrane-bound. How many chromosomes are present in this cell? (Understand) 3

11. Renu explained to her friend Mahak that there are both similarities and dissimilarities between plant cells and animal cells. Mahak was surprised to know that the two types of cells have some common features as well. Write down three similarities and three dissimilarities between plant cells and animal cells. (Analyse) 3

### Long Answer Type Question

12. (A) The teacher draws the following diagram on the smart board and asks her students to identify the diagram and label its parts.



- (i) The brain of the cell.  
(ii) The jelly like-substance that is present in the brain of the cell.  
(iii) The organelle which contains powerful digestive enzymes. (Apply)  
(iv) The organelle which takes part in storage, modification and packaging.  
(B) Why is 'X' called selectively permeable membrane? (Understand)  
(C) Identify the structure marked as 'Y'. (Apply)  
(D) Why is 'Z' called a strange organelle? Write its main function. (Understand) 5