



# Foundation

## COURSE

in

# Biology

Class

# 9

with **CASE STUDY**  
**Approach** for NEET/  
 Olympiad

1911+

FIB, T/F, Study  
 MTF & Subjective Qs

A/R

6th Edition

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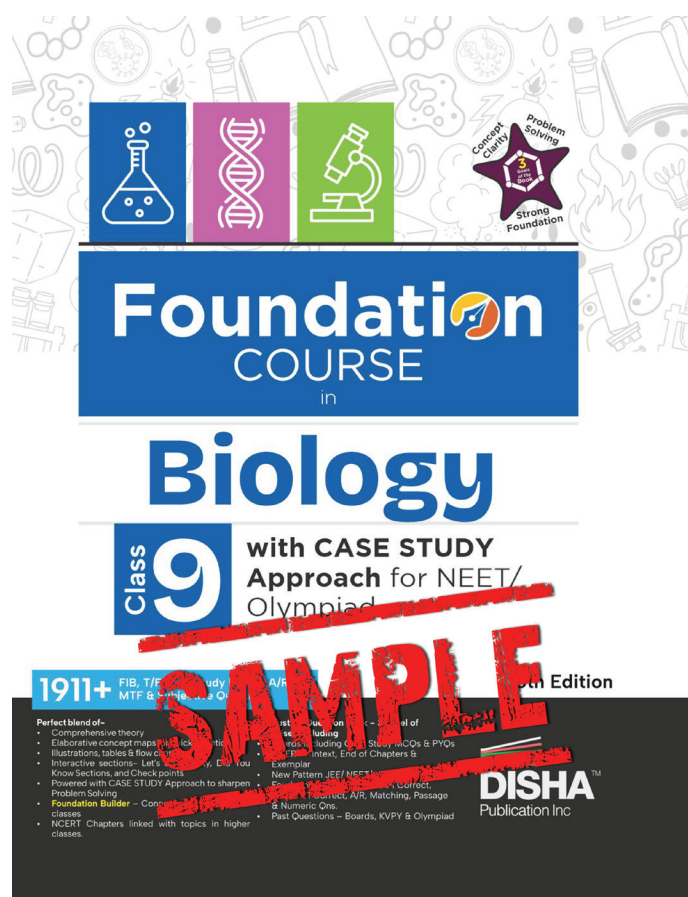
**Case Study :** Types of Osmotic Solution

**Exercise 1 :** Master Board

**Exercise 2 :** NCERT Questions

**Exercise 3 :** Foundation Builder

This sample book is prepared from the book "Foundation Course in Biology Class 9 with Case Study Approach for NEET/ Olympiad - 6th Edition".



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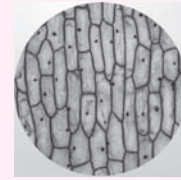
# Chapter 1

# The Fundamental Unit of Life



## Learning Objectives

- What are Living Organisms Made Up of?
- What is a Cell Made Up of? What is the Structural Organisation of a Cell?
- Cell Division



## Exam Mirror

- ☯ Plasma Membrane or Cell Membrane
- ☯ Nucleus
- ☯ Cell Organelles
- ☯ Prokaryotic Cell



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## Critical Concepts

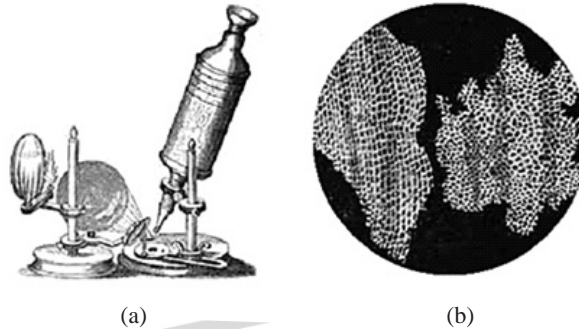
- ✦ Osmosis
- ✦ Plasmolysis
- ✦ Endoplasmic Reticulum
- ✦ Vacuoles



## INTRODUCTION

The term “cell” is derived from a Latin word *cella* which means ‘little room’ or ‘hollow space’. The cell was first discovered named by an English scientist **Robert Hooke** in 1665. He was one of the earliest scientists, who saw cells for the first time in a thin slice of cork (dead cells of oak bark) with his microscope. He observed and described these cells as “Honey comb” like structures. He named and revolutionised the study of life on earth.

What Hooke observed as boxes or cells in the cork were actually dead cells. Cells of living organisms could be observed only after discovery of improved microscopes.



**Robert Hooke used an early microscope (a) to see cell in thin slices of cork.**

**His drawings of what he saw (b) indicate that he had clearly observed the remains of cork cell (300x)**

Hooke recorded all his drawings and observations into *Micrographia*.

Soon after Robert Hooke discovered cells in cork, Anton van Leeuwenhoek in Holland made other important discoveries using a microscope.

In 1674, **Van Leeuwenhoek**, a Dutch Scientist, studied living cells in the pond water for the first time with the help of an improved Microscope, which he himself had made. Though he was the first one to observe “cells”, but he did not use the term “cell”.

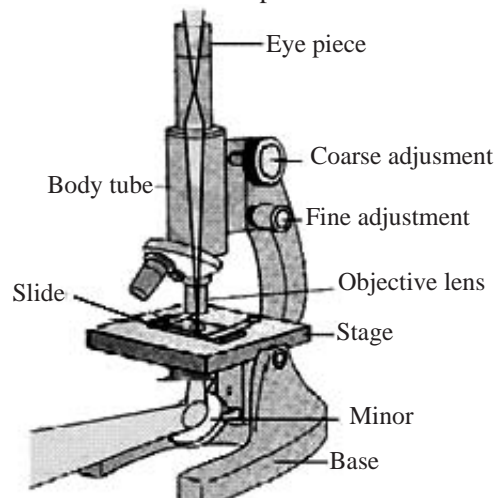
Leeuwenhoek was the father of microbiology.

## WHAT ARE LIVING ORGANISMS MADE UP OF?

Living organisms are made up of living cells. Cells (discovered by Robert Hooke in 1665) are called the structural and functional unit of life because all the living organisms are made up of cells and all the functions that take place inside the organisms are performed by cells.

Cells are microscopic entities which are not visible to naked eyes. Invention of microscope was a milestone towards learning the intricate details of the internal arrangement of the cell.

Leeuwenhoek prepared a light microscope (with single biconvex lens) which is comparable to today’s compound microscope. However, the compound microscope is much advanced in comparison to the microscope of Robert Hooke and Leeuwenhoek.



**Compound Microscope**



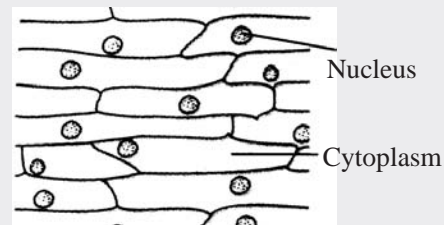
### Let's Do Activity

**Aim:-** Perform an experiment to study plant and animal cells with the help of microscope.

**Requirement:-** Plant cells (Onion skin mount)

**Procedure:-**

- ☞ Take an onion piece and peel the delicate transparent tissue from its inner surface using forcep.
- ☞ Place this tissue, unwrinkled in a small drop of water on a glass slide.
- ☞ Then add a small drop of safranin stain to the tissue and cover it with a cover slip. While placing the coverslip ensure that there is no air bubbles under the coverslip.
- ☞ Now observe the slide under a microscope.

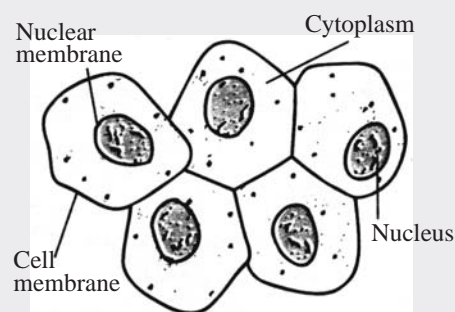


**Observation:-** You will see several small rectangular shaped cells. The boundary of each cell is covered by a cell membrane which in turn is covered by another thick covering called the cell wall. In the centre of cell, there is a dense round body called the nucleus. In between the nucleus and the cell membrane, there is a jelly like substance called cytoplasm.

**Requirement:-** Animal cells (Cheek cells)

**Procedure:-**

- ☞ Take a clean glass slide and place a drop of water on it.
- ☞ Gently scrap the inside of your cheek with the blunt end of a clean toothpick.
- ☞ Then stir the material on the toothpick in the drop of water on the slide.
- ☞ Add a small drop of methylene blue stain on the slide.
- ☞ Now carefully place a coverslip over the slide and observe the slide under microscope.



**Observation:-** You can see large number of irregular shaped cells with a thin cell membrane. Cell wall is absent in animal cells. In the centre of cell, nucleus is present. It is stained dark blue.



### CONNECTING TOPIC

#### Cell theory

In 1838, two biologists, J.M Schleiden and T.Schwann proposed the “Cell theory”. According to them, the cell is the structural and functional unit of all living beings.

In 1838, Matthias Jakob Schleiden, a German botanist was the first to assert that cells are the building blocks of all plants.

In 1839, another German physiologist, Theodor Schwann stated that cells are the fundamental units of animals. Their discoveries led to the formulation of the cell theory.

In 1855, Rudolf Virchow, a German pathologist proposed that all cells arise from pre-existing cells. He stated this in Latin as “Omnis cellula-e- cellula”.

Cells theory, therefore, states that

- i. All living organisms are composed of one or more cells.
- ii. The cell is the basic and fundamental unit of life.
- iii. All cells arises from pre-existing cells.

### Let's Connect

- Which of the following depicts the fundamental features of cell theory?
  - All cells share similar chemistry and physiology.
  - All living organisms are composed of cells and their products.
  - Each cell is made up of a small mass of protoplasm containing a nucleus inside and a plasma membrane with or without a cell wall outside.
  - Activities of an organism are the sum total of activities and interaction of its constituent cells.
 Correct option regarding the statement is
  - Only (i) is correct.
  - (ii) and (iii) are correct.
  - (ii), (iii) and (iv) are correct.
  - All are correct.
- Which of the following organism does not follow 'Cell Theory'?
  - Bacteria
  - Virus
  - Fungi
  - Plants

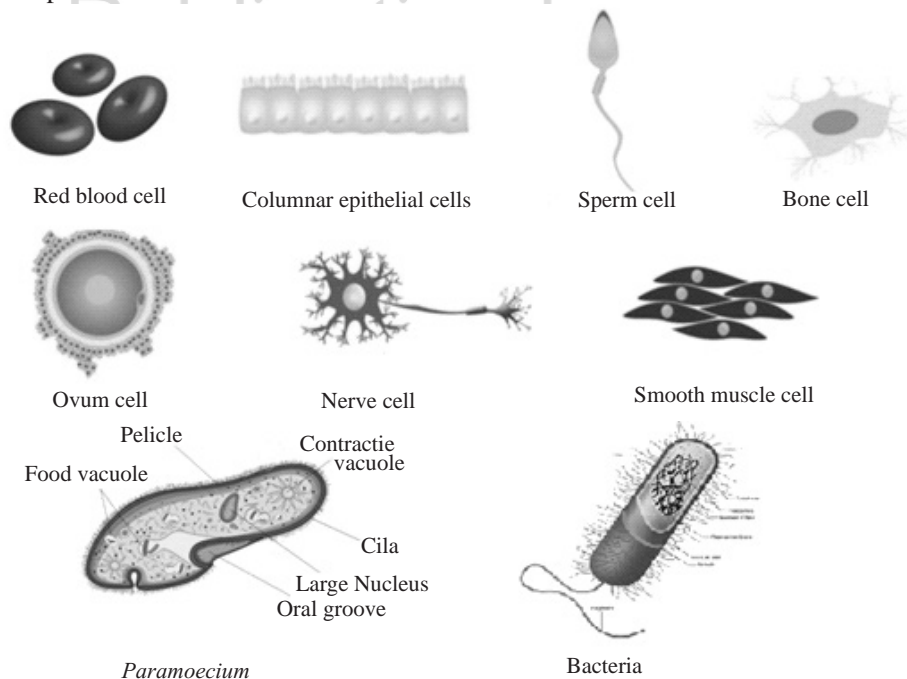
#### Solutions:

- (d) Fundamental features of cell theory are:
  - All living organisms are composed of cells and their products.
  - Each cell is made up of a small mass of protoplasm containing a nucleus inside and a plasma membrane with or without a cell wall outside.
  - All cells are basically alike in their chemistry and physiology.
  - Activities of an organisms are the sum total of activities and interactions of its constituent cells.
- (b) Virus

### Cell Shape, Size and Number

Cells are the lowest level of organisation in every life form. Living organisms are made up of different types of cells of different shapes and sizes. Their organs also vary in shape, size and number of cells. They may not be very big, but their shapes can be different from each other. However, all these cells have common abilities, such as obtaining and using food energy, responding to the external environment, and reproducing.

Now, if we look at the cells from different parts of human body, they too don't look alike in shape and size. Instead, the cells are different in shapes and size.



Different shapes of animal cells



From the above figures we can conclude that plant cells are different from animal cells. Plant cells in a root are different to those in the stem or in the leaf. Animal cells, including cells in our bodies are all sorts of different shapes and sizes. It means cells vary in number, shape and size in different organisms and also in different parts of same organism.

### Cell Size

The size of the cell ranges between broad limits. Some cells are extremely small and can be seen only when magnified and is visible only with a microscope since, they are only a few micrometres in diameter.

### Cell Shape

The shape of the cells is more variable than their size. The shape of the cell may be spherical, oval, elliptical, spindle shaped, polygonal or flat-plate like. The shape of the cell is determined by the specific function of the cell.

Some of the cells like Amoeba and white blood cells can change their shape while most of the plant cells and animal cells have almost fixed shapes.

### Cell Volume

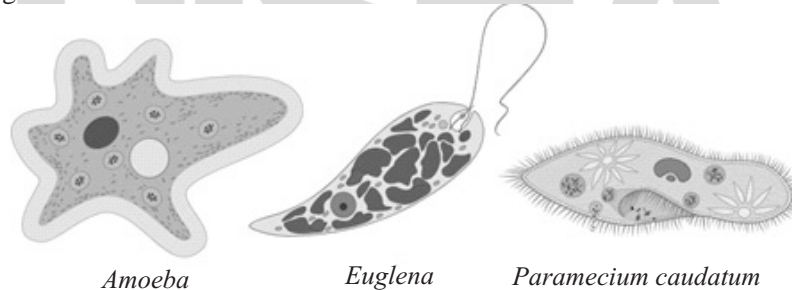
The volume of a cell is constant for a particular cell type. It is independent of the size of the organism. For example, the kidney or pancreatic cells are about the same size as in dog or cat. The difference in total mass of the organism or organ depends on the number, not on the volume of the cells.

### Cell Number

The number of cells varies in all living organisms. Based on the number of cells, the organisms are divided into two types- unicellular (single celled) organisms and multi cellular (multicelled) organisms.

#### Unicellular organisms (Single-celled organisms):

The organisms made up of single cells are called unicellular organisms. *Amoeba*, *Euglena*, *Paramecium*, bacteria etc are examples of unicellular organisms.



Examples of unicellular organisms

#### Multi-cellular organisms (Multi-celled organisms):

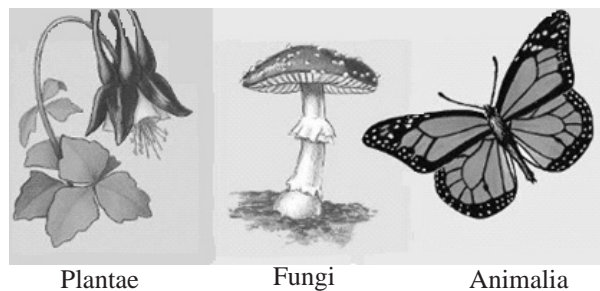
The organisms made up of a multi number of cells are called **multi-cellular organisms**. Plantae, fungi and animalia are example of multi-cellular organisms. All the cells of many cellular organisms have a similar basic structure and similar basic life activities.

**DID YOU KNOW?**

- The smallest cell is a mycoplasma cell *mycoplasma gallisepticum*, which is about 0.1 micron in diameter.
- The largest cells are represented by eggs of Ostrich, which is about 170-135 mm.
- In case of human body, spermatozoa are the smallest cell and ovum is the largest cell. Nerve cell is the longest cell with an axon of 1m length.

**DID YOU KNOW?**

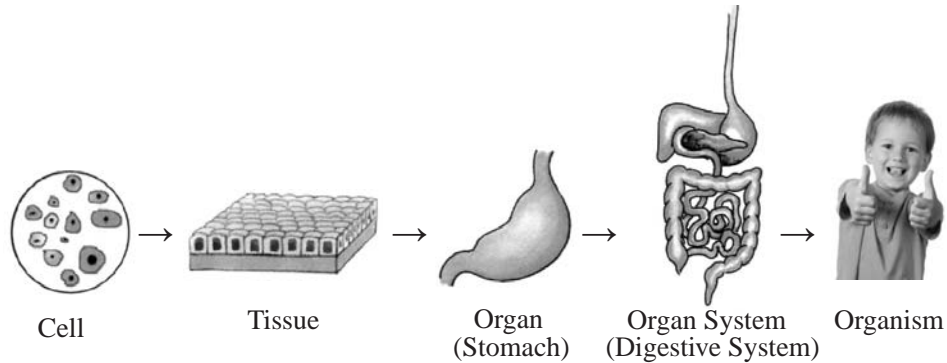
All the cells of a multi-cellular organism develop from single cell called zygote.



Examples of multicellular organisms

The increasing order of complexity in multicellular organisms is:

**Cell → Tissue → Organ → Organ System → Organism**



### Levels of organisation

**Table: Difference between unicellular and multi-cellular organisms.**

Sl.No	Unicellular organisms	Multi-cellular organisms
1.	The organisms made up of single cells, are called unicellular organisms.	The organisms made up of large number of cells are called multi-cellular organisms.
2.	Division of labour. A single cell performs all the activities of the organism.	Division of labour is present. Cells are specialised to perform different functions.
3.	The life span of these organism is short.	The life span of multi-cellular organism is long.
4.	Examples include <i>Amoeba</i> , <i>Paramecium</i> , bacteria etc.	Examples include Fungi, Plants, and Animals.

### Types of Cells

There are two types of cells *i.e.*, prokaryotic (bacteria) and eukaryotic such as animal, plant, fungi and protista (unicellular organisms).

#### Prokaryotic cells

Prokaryotes have no nucleus – the DNA is in the cytoplasm, and it can form small circular strands of DNA called **plasmids**. Prokaryotic cells are found in single-celled organisms, such as bacteria. Organisms with prokaryotic cells are called **prokaryotes**.

They were the first type of organisms to evolve and are still the most common organisms today.

#### Eukaryotic cells

Eukaryotic cells have their DNA enclosed in a nucleus. Eukaryotic cells are usually larger than prokaryotic cells, and they are found mainly in multicellular organisms. Organisms with eukaryotic cells are called eukaryotes, and they range from kingdom protista to animalia.



#### Illustration 1 :

**How does cell increase its number?**

**Solution :**

Cell increase its number by cell division where cell divides into two new cells.



#### Illustration 2 :

**Eukaryotic cell can be differentiated from prokaryotic cell in having**

(a) Ribosome

(b) Cell wall

(c) Nucleus

(d) All of these

**Solution : (c)**

Nucleus



**CHECK POINT-1**

1. Which organisms does not have a fixed shape?  
 (a) Amoeba                      (b) Yeast                      (c) Bacteria                      (d) All of these
2. Who discovered cell for the first time through cork slice?  
 (a) Anton Von Leeuwehoek                      (b) Robert Hooke  
 (c) Robert Brown                      (d) Aristotle

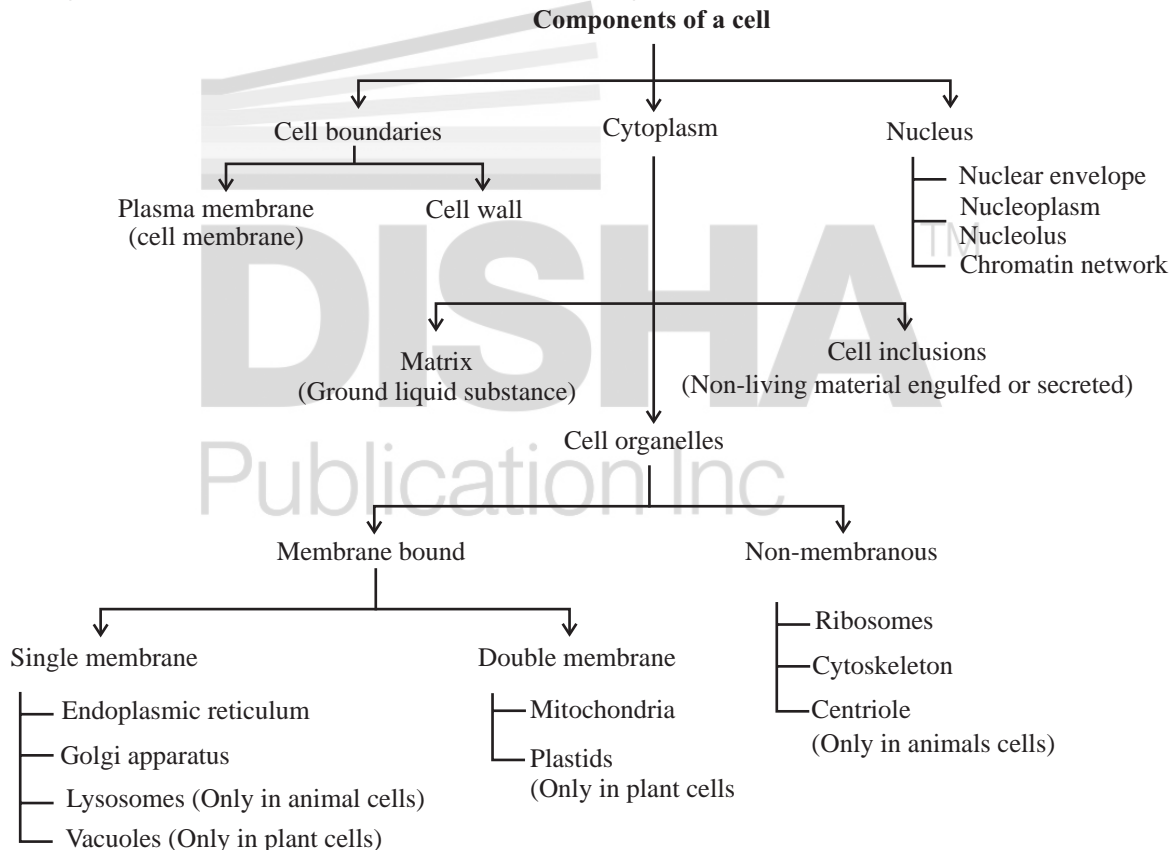
**Solutions:**

1. (a)                      2. (b)

**WHAT IS CELL MADE UP OF? / WHAT IS THE STRUCTURAL ORGANISATION OF A CELL?**

Although the living cells show wide variations in the parameters such as size, shape and structural features, a typical cells shows some common characteristics features. A typical cell, either a plant cell or an animal cell, is formed of three basic parts: plasma membrane or cell membrane, nucleus and cytoplasm.

Plant cell, fungi and some bacteria contain an additional covering called cell wall.



**Concept Map: Components of a cell**

The main cell components of the cell are plasma membrane (or cell membrane), cell wall, nucleus, cytoplasm and cell organelles.

**Plasma Membrane/Cell Membrane**

Plasma membrane is the outermost, extremely delicate elastic membranous covering of each cell. It separates the cytoplasm of the cell from its environment. Plasma membrane is a living, selectively permeable membrane, which allows some selected materials to move in and out of the cell, and prevents the entry and exit of the other substances.

The plasma membrane is made up of a bilayer of lipids and proteins. Small carbohydrates are attached at places to outer surface of lipids and proteins.

### Functions of plasma membrane:

- (i) It also plays a role in anchoring the cytoskeleton (networks of filaments and tubules) that extends throughout a cells through the cytoplasm to provide shape to the cell and in attaching to the extracellular matrix and other cells to help group cell together to form tissues. The member also maintains the cell potential.
- (ii) It functions as a mechanical barrier between external and internal environment of the cells.
- (iii) It regulates the movement of molecules in and out of cell.
- (iv) The flexibility of membrane helps the cell to engulf food and other substances from its external environment by endocytosis.

For example : *Amoeba* obtains its food by endocytosis. Endocytosis is the ingestion of material by the cells through plasma membrane.

### DID YOU KNOW?

Cell membrane regulates the movement of substance in and out of cell. If the cell membrane fails to function, then the cell dies.



### Transport across the membrane:

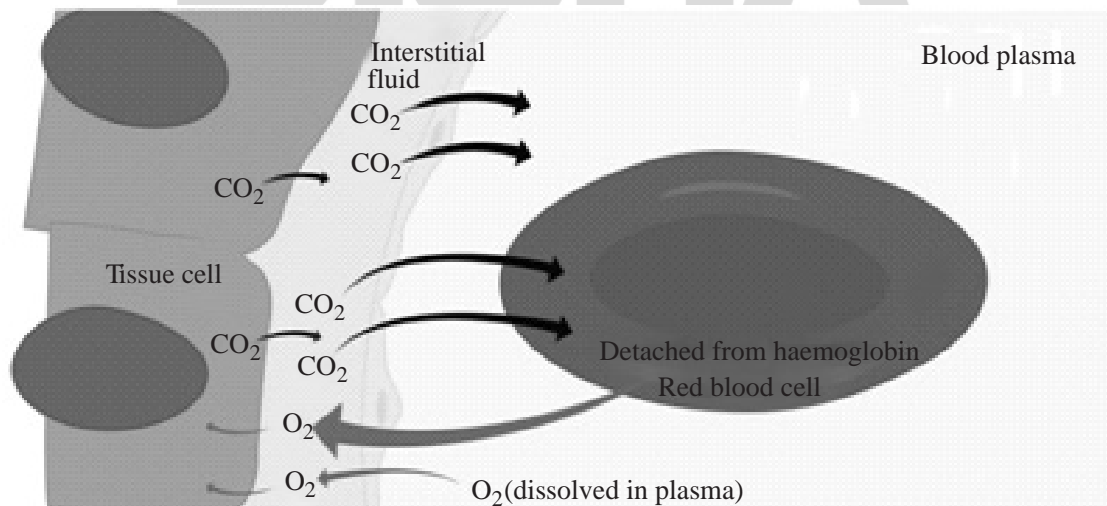
#### Passive transport:

The transport of substances across the plasma membrane without expenditure of energy is known as passive transport. It is of two types: **diffusion and osmosis**.

- (i) **Diffusion** : The process of movement of substance from the region of higher concentration to the region of lower concentration, so as to spread the substance uniformly in the given space is known as diffusion. This process does not require energy.

For example: Transport of  $\text{CO}_2$  and  $\text{O}_2$  across the membrane. The gases like  $\text{CO}_2$  and  $\text{O}_2$  move across the membrane through diffusion. The process of respiration produces carbon dioxide inside the cell. As the concentration of  $\text{CO}_2$  increases inside the cell as compared to the outside,  $\text{CO}_2$  diffuses out of the cell into external medium.

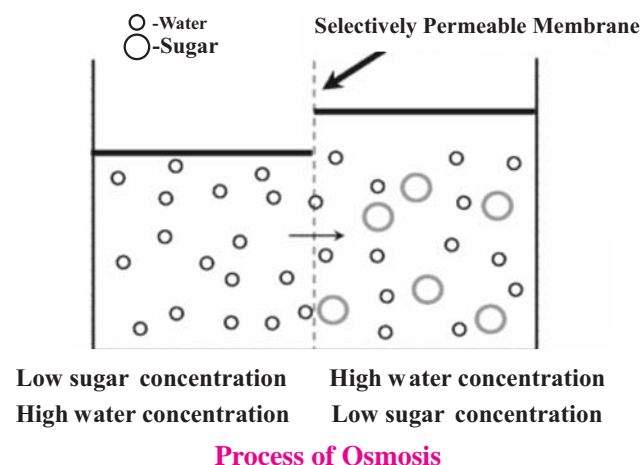
Similarly, the concentration of oxygen is always higher in the external medium (atmosphere) as compared to the inner side of the cell. Therefore, oxygen diffuses from outside to the inside of cell.



**Process of diffusion: Oxygen diffuses out of the capillary and into cells, whereas carbon dioxide diffuses out of cells and into the capillary.**

- (ii) **Osmosis** : It is defined as the diffusion of water (solvent) from region of higher concentration to region of lower concentration across the semi-permeable membrane. This kind of movement is along the concentration gradient. There is no expenditure of energy.

For example : Movement of water across selectively permeable membrane.



### Types of Osmosis

Osmosis is of two types: endosmosis and exosmosis.

**Endosmosis** – When a substance is placed in a hypotonic solution, the solvent molecules move inside the cell and the cell becomes turgid or de-plasmolysed. This is known as endosmosis.

**Exosmosis** – When a substance is placed in a hypertonic solution, the solvent molecules move outside the cell and the cell becomes flaccid or plasmolysed. This is known as exosmosis.



### Let's Do Activity

**Aim:-** To study the process of endosmosis and exosmosis.

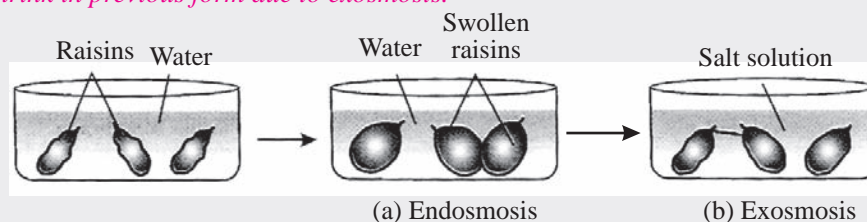
**Requirement:-** Dry raisins, plain water, salt or sugar solution.

**Procedure:-**

- Take few dry raisins in a petri dish having plain water (a hypotonic solution). Leave it for 30 minutes and record your observation.
- Now place the swollen raisins in concentrated sugar or salt solution (a hypertonic solution) and leave it for 30 minutes. Record your observation.

**Observation:-**

- You would observe that raisins swell up due to endosmosis.
- The raisins shrink in previous form due to exosmosis.



### Types of osmotic solutions

There are three types of osmotic solutions. These are hypotonic solution, hypertonic solution and also isotonic solutions. They are used to compare the osmolarity of a cell to the osmolarity of the extra cellular fluid around it.

- Hypotonic solution:** If the extracellular fluid has lower osmolarity than the fluid inside the cell, it's said to be hypotonic—hypo means less than—to the cell, and the net flow of water will be into the cell.
- Hypertonic solution:** If the extracellular fluid has a higher osmolarity than the cell's cytoplasm, it's said to be hypertonic—hyper means greater than—to the cell, and water will move out of the cell to the region of higher solute concentration.
- Isotonic solution:** In an isotonic solution—iso means the same—the extracellular fluid has the same osmolarity as the cell, and there will be no net movement of water into or out of the cell.

Table : Difference between Diffusion and Osmosis

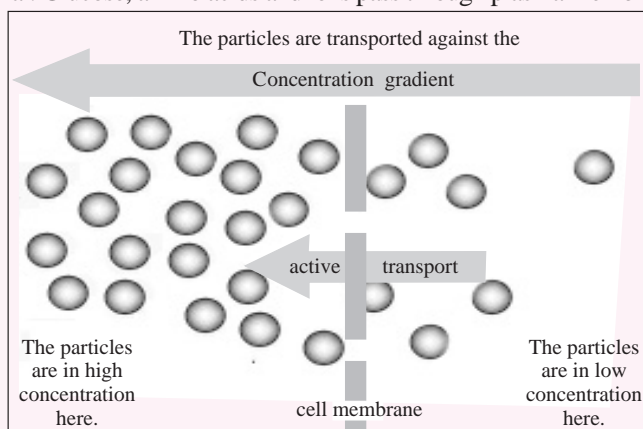
S.No	Diffusion	Osmosis
1.	It is the movement of substance from the region of higher concentration to the region of lower concentration.	It is the movement of water from the region of its higher concentration to its lower concentration through a semi-permeable membrane.
2.	It takes place in all three medium—solid, liquid and gas.	It takes place only in liquid medium.
3.	It does not involve semi-permeable membrane.	It requires semi-permeable membrane.
4.	It is not much influenced by the presence of other substances.	It is influenced by concentration and type of solute particle.



## CONNECTING TOPIC

**Active transport**

Active transport is the process of transport of molecules across the plasma membrane against the concentration gradient. The process requires the use of energy. For active transport, the cell membrane possesses ATP mediated carrier protein. Active transport is a rapid process and is usually unidirectional. Glucose, amino acids and ions pass through plasma membrane by active transport.



Active transport of molecules across a cell membrane

**Bulk transport**

The movement of macromolecules such as proteins or polysaccharides into or out of the cell is called **bulk transport**. There are two types of bulk transport, exocytosis and endocytosis, and both require the expenditure of energy (ATP).

**Exocytosis**

In exocytosis, materials are exported out of the cell via secretory vesicles.

**Endocytosis**

In endocytosis materials move into the cell by engulfing the food and other substances from the external environment. Endocytosis is three types i.e., phagocytosis, pinocytosis, and receptor-mediated endocytosis.

**Phagocytosis** is a type of endocytosis in which very large particles, such as cells or cell debris, are transported inside the cell. Cells such as the macrophage cells of the immune system take advantage of phagocytosis to 'eat' bacteria. Pinocytosis ("cell drinking") is a form of endocytosis in which liquid droplets are taken up by the cell. Receptor-mediated endocytosis is a form of endocytosis in which transmembrane receptor proteins across the cell membrane are used to take up a target molecule.

**Let's Connect**

- Identify the process that requires ATP energy in order to take place.  
(a) Osmosis (b) Diffusion (c) Facilitated transport (d) Active transport
- Transport proteins are required for –  
(a) diffusion (b) osmosis (c) facilitated transport (d) facilitated transport and active transport
- Which of the following processes causes substances to move across membranes without the expenditure of cellular energy?  
(a) Endocytosis (b) Exocytosis (c) Active transport (d) Diffusion

**Solutions:**

- (d) Active transport
- (d) 3. (d)

## Cell Wall

Cell wall is a rigid, non-living covering present outside the plasma membrane in plant cells. Animal cells **lack a cell wall**. The cell wall is mainly composed of carbohydrate rich materials. The major components of cell wall are cellulose, pectins, hemicelluloses, proteins and phenolics. Cell wall composition varies depending on the organism. Cellulose is permeable to water, solutes and gases.

Bacterial cell wall is composed of sugar and amino acid polymer called **peptidoglycan**. The main components of fungal cell walls are chitin, glucans, and proteins.

## Plasmolysis

Plasmolysis is the phenomenon of the loss of water from a plant cell by osmosis when kept in a hypertonic solution, so that the cytoplasm shrinks away from the cell wall.

If a plant cell is kept in a solution more concentrated than the cell sap *i.e.* in hypertonic solution, water moves out to the outside solution. Loss of water causes the vacuole to shrink and pull the plasma membrane with the cell contents away from the cell wall. This phenomenon is known as **plasmolysis**.

## Functions of cell wall:

- (i) It gives definite shape to the cells.
- (ii) It provides mechanical strength to plants.
- (iii) It protects the cell against mechanical injury and pathogens.
- (iv) It helps in transport of various substances across it.
- (v) It helps the plant cells to withstand a lot of variations in the surrounding environment.
- (vi) It prevents the bursting of cell on endosmosis as it is quite thick and rigid.

**Table : Difference between Cell wall and Cell membrane**

Sl. No.	Cell wall	Cell membrane
1.	It is found only in plant cells.	It is found in both plant and animal cells.
2.	It is outermost layer of the plant cell.	It lies on the outside of animal cell and inner to the cell wall in plant cell.
3.	It is thick and rigid.	It is thin and flexible.
4.	It is permeable.	It is selectively permeable.
5.	It is formed of cellulose and pectin.	It is formed of lipids and proteins.
6.	It provides protection and strength to the cell.	It acts as mechanical barrier and regulates the movement of molecules in and out of cells.



## Let's Do Activity

**Aim:-** To study the process of plasmolysis.

**Requirement:-** Rhoeo leaf, Sugar or Salt solution, Microscope.

**Procedure:-** Mount the peel of a Rhoeo leaf in water on a slide and examine cells under the high power of a microscope using sugar or salt solution.

☞ Now place Rhoeo leaf in boiling water for a few minutes.

☞ Mount the leaf again using salt or sugar solution.

**Observation:-** In salt or sugar solution, the cell swells, building up pressure against the cell wall. The wall exerts an equal pressure against the cell wall. After boiling, no water is absorbed by osmosis in dead cells.

## Nucleus

Nucleus is the membrane bound prominent, spherical structure found at the centre of the cell. It is the largest organelle present in cell. Basically, nucleus is the controlling centre of all cell activities and hence, it has been described as the **brain of the cell**. Nucleus was discovered by an English biologist, **Robert Brown** in 1831.

In plant cell, nucleus lies towards the periphery due to the presence of large central vacuole while in animal cell, nucleus lies in the central position.

Nucleus is present in all the cells in the body other than the red blood cells. The cells with nucleus are called **eukaryotes** and those without nucleus are called **prokaryotes**.

### Structure of nucleus:

#### Nuclear envelope

It is the double membranous structure that separates the nucleus from the cytoplasm and encloses the contents of nucleus during most of the stages of cell's life cycle. It is mainly made up of proteins and lipids.

#### Chromatin network

Chromatin is a network of fine thread like coiled filaments uniformly distributed in the nucleoplasm. It is usually made of DNA and protein. DNA molecules are compactly loaded with the assistance of a specialised standard protein called histone. So, chromatin is referred as DNA-histone complex. It forms the significant bulk of nuclear product. DNA is a double helix which twists around central core of 8 histone molecules to form the essential packaging unit of chromatin called nucleosome.

During cell division, chromatin become highly condensed, thick and rod like structures known as **chromosomes**.

The chromosome contains genes, which are composed of DNA. Genes are arranged in a single linear order along the chromosome. One gene is responsible for single characteristic or a single characteristic may be transmitted by a set of genes. Genes are responsible for storing and transmitting hereditary characteristics from one generation to another generation

#### DID YOU KNOW?

- Genes is a functional unit of chromosomes.
- The location of the centromere on each chromosome gives the chromosome its characteristic shape, and can be used to describe the location of specific genes.



### Let's Do Activity

**Aim:-** To observe the structure of nucleus in animal cell.

**Requirement:-** Glass slide, spoon, methylene blue, needle.

**Procedure:-**

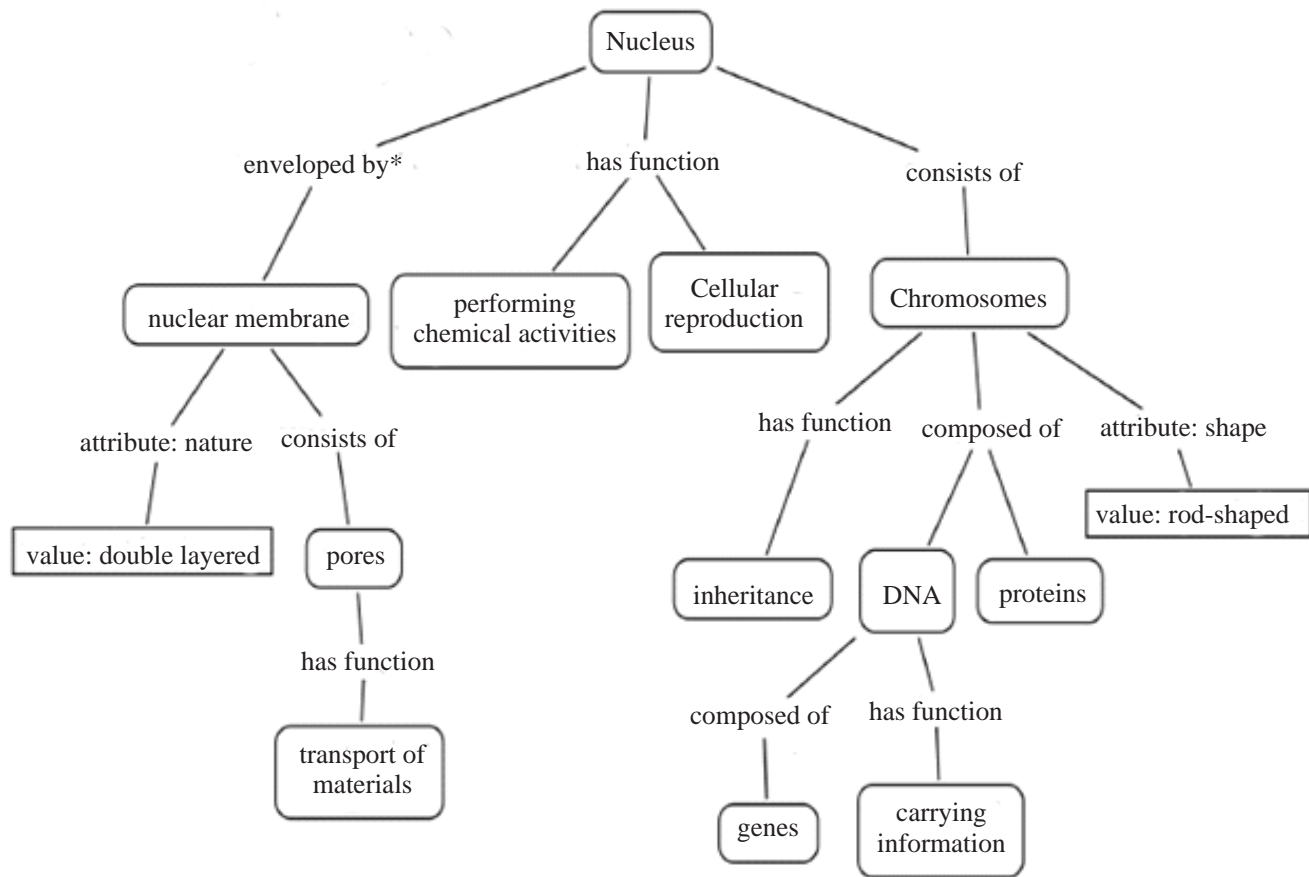
1. Let us take a glass slide with a drop of water on it.
2. Using a spoon gently scrape the inside surface of cheek.
3. With the help of a needle spread it evenly on the glass slide.
4. Put a drop of methylene blue solution in it.

**Observation:-** A darkly coloured dot-like structure near centre of each cell called nucleus will be seen.

### Functions of nucleus

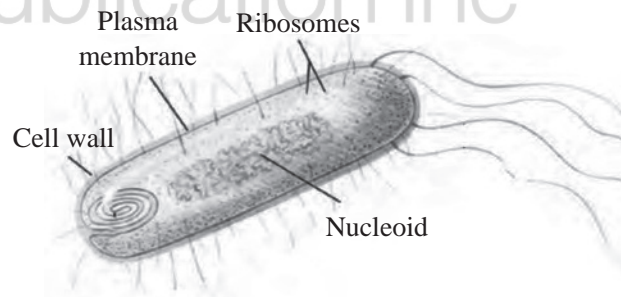
- (i) Nucleus is the chief controlling centre of cell. It contains chromosomes which carry genes which are responsible for transmission of hereditary characters from parents to offspring.
- (ii) Nucleus controls all the activities taking place in the cell growth, intermediary metabolism, protein synthesis etc.
- (iii) It participates directly in cell division to produce daughter cells by the process known as mitosis and meiosis.
- (iv) It is a site for transcription process in which messenger RNA (mRNA) are produced for protein synthesis.
- (v) It also regulates the integrity of genes and gene expression.





**Concept map: Nucleus at a glance**

In some organism like bacteria, the nuclear region is poorly developed. Such an undefined nuclear region containing only nucleic acid is called a **nucleoid**. Prokaryotic cells also lack most of the other cytoplasmic organelles present in eukaryotic cell. Many of the functions of such organelles are also performed by poorly organised parts of the cytoplasm. The chlorophyll in photosynthetic prokaryotic bacteria is associated with membranous vesicles.



**Prokaryotic cell**



**Illustration 3 :**

**Why does the skin of your fingers shrink when you wash clothes for a long time?**

**Solution :**

Clothes are washed with soap or detergent solution. The solution is hypertonic as compared to osmotic concentration of our skin cells. The detergent solution, therefore, causes exosmosis in the skin cells. Hence, the skin over the finger shrinks while washing clothes for a long time.



### Illustration 4 :

**Why cell wall is present only in plant cell but not in animal cells?**

**Solution :**

Cell walls are supporting structures that help the plant to have a fixed shape and protect them from injury. Other than that, it helps to keep the plant turgid so that it can stay firm and upright. Because when it enters a high water potential solution, as water moves in, the water exerts turgor pressure on the cell wall and the cell wall thus exerts an opposing pressure to keep water out. Hence, cell wall is needed for the plant.

On the other hand, animal cells do not need to keep the structures, as they have the skeletal system to protect the organs and cushion them against any external injuries.



### Illustration 5 :

**Give an example of a human cell which lack nucleus.**

- (a) Red blood cell      (b) White blood cells      (c) Platelets      (d) Epithelial cells

**Solution : (a)**

Red blood cells. The red blood cells of humans lose their nuclei, which enables them to carry more haemoglobin and thereby more oxygen.



### CHECK POINT-2

- The movement of water molecules across the selectively permeable cell membrane is known as  
(a) Diffusion      (b) Osmosis      (c) Active Transport      (d) Phagocytosis
- Shrinkage of contents of cell away from the cell wall occur in  
(a) Osmosis      (b) Plasmolysis      (c) Diffusion      (d) Endocytosis
- Nucleus plays a central role in  
(a) Cell growth      (b) Cell division      (c) Carrying genes      (d) All of these

**Solutions:**

1. (b)      2. (b)      3. (d)



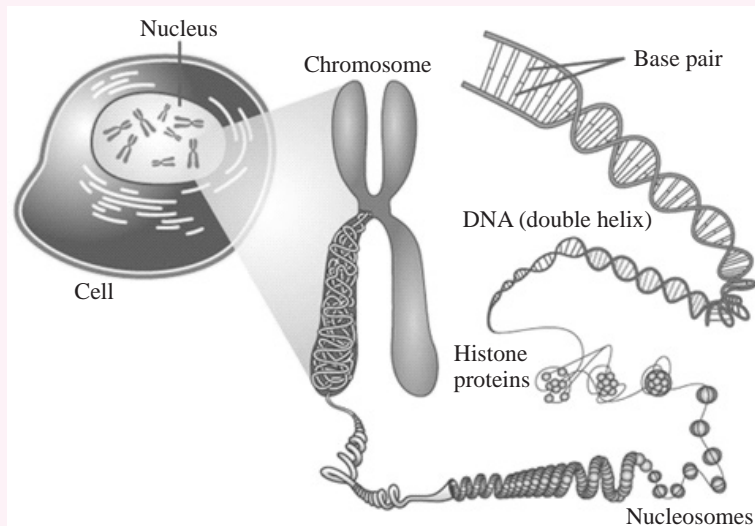
### CONNECTING TOPIC

#### Structure of Deoxyribonucleic acid (DNA)

DNA is made up of molecules called nucleotides. Each nucleotide contains a **phosphate group, a pentose sugar (deoxyribose) and a nitrogen base (purine and pyrimidine)**. The purines are adenine (A) and guanine (G) in both DNA and RNA; the pyrimidines are cytosine (C) and thymine (T) in DNA and cytosine (C) and uracil (U) in RNA. Base-pairing takes place between a purine and pyrimidine namely, A pairs with T, and G pairs with C. In other words, adenine and thymine are complementary base pairs, and cytosine and guanine are also complementary base pairs. Adenine and thymine are connected by two hydrogen bonds while cytosine and guanine are connected by three hydrogen bonds. In 1962, **James Watson, Francis Crick, and Maurice Wilkins** were awarded the Nobel Prize in Medicine for their work in determining the structure of DNA.

#### Chromosomes

Chromosomes are rod-like structures located inside the nucleus of animal and plant cells. Each chromosome is made of protein and a molecule of deoxyribonucleic acid (DNA) while a chromatid comprises of two DNA strands joining collectively by their centromere. It is a single, very long strand of DNA that is passed from parents to offspring. DNA contains the specific instructions that make every living creature unique.



### Structure of chromosomes

Chromosomes are not visible in the cell's nucleus—not even under a microscope—when the cell is not dividing. However, the DNA that makes up chromosomes becomes more tightly packed during cell division and is then visible under a microscope. There are **four main types of chromosomes** based on the position of centromere: metacentric, submetacentric, acrocentric, and telocentric. Centromere divides the chromosome into two sections, or “arms.” The short arm of the chromosome is labelled as “p arm.” The long arm of the chromosome is labelled as “q arm.”

In humans, each cell normally contains **23 pairs of chromosomes**, for a total of 46. Twenty-two of these pairs, called autosomes, look the same in both males and females. The 23rd pair, the sex **chromosomes**, differs between males and females.

### Let's Connect

- The two strands of DNA are held together by:
  - peptide bonds
  - phosphodiester bonds
  - hydrogen bonds
  - S–S bonds
- Which of the following is correct for Watson and Crick's model of DNA. It is duplex with:
  - 10 base pairs and 3.4 nm distance for every turn.
  - 10 base pairs and 0.34 Å distance for each turn of spiral.
  - 20 base pairs and 34 Å for each turn.
  - None of the above
- In DNA, base pairing occurs as:
  - thymine with adenine and cytosine with cytosine
  - adenine with thymine and cytosine with guanine
  - thymine with cytosine and guanine with adenine
  - adenine with cytosine and guanine with thymine
- The shorter and longer arms of a submetacentric chromosome are referred to as:
  - s-arm and l-arm respectively
  - p-arm and q-arm respectively
  - q-arm and p-arm respectively
  - m-arm and n-arm respectively

### Solutions:

- (c) In DNA, the two chains are held together by hydrogen bonds between pairs of bases which help to stabilise the interaction.
- (a) According to Watson and Crick model of DNA, it is a double helical molecule with 10 base pairs and 3.4 nm distance for every turn.
- (b)
- (b) Each chromosome has two arms, p (the shorter of the two) and q (the longer). In submetacentric chromosome, the centromere is present slightly away from the middle of the chromosome resulting into one shorter arm and one longer arm.

## Cytoplasm

Cytoplasm occupies the major part of the cell. It is a living component of cell, consisting of transparent, semi-fluid granular substance. It is limited on the outside by the cell membrane. Water is the main component of the cytoplasm.

**Cytoplasm has two major parts: Cytosol and cell organelles**

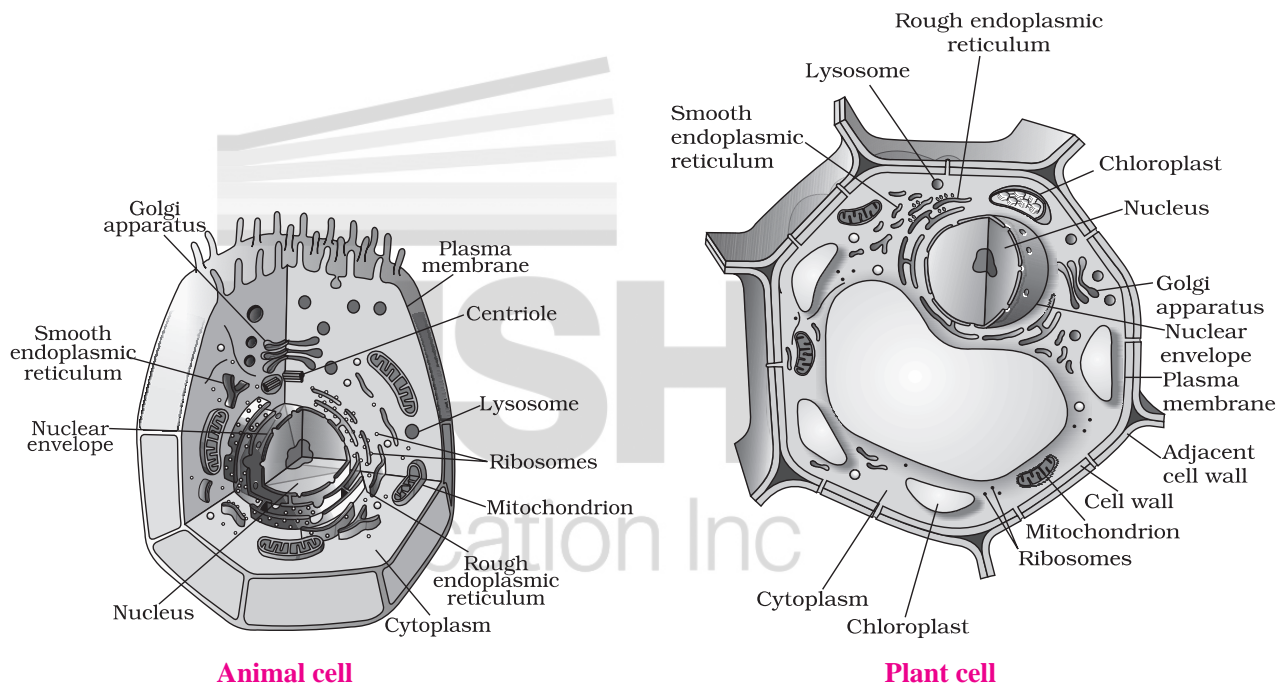
- (i) **Cytosol:** Cytosol is the fluid part of cytoplasm. It is viscous, and contains a number of substances like water, ions, enzymes, vitamins, carbohydrates, lipids and proteins. All major biochemical reactions take place in the cytoplasm.
- (ii) **Cell organelles:** Cell organelles are tiny, sub-microscopic structures that are specialised to perform specific functions.

These organelles are bounded by a membrane to keep their contents separate from the external environment. These organelles include endoplasmic reticulum, mitochondria, Golgi bodies, plastids, lysosomes, peroxisomes, ribosomes and centrosomes.

The significance of membranes can be illustrated with the example of viruses. Viruses lack any membranes and hence do not show characteristics of life until they enter a living body and uses its cell machinery to multiply.

### DID YOU KNOW?

*Protoplasm is composed of a mixture of small molecules such as anions, amino acids, monosaccharides and water; and macromolecules such as nucleic acids, proteins, lipids and polysaccharides.*



**Animal cell**

**Plant cell**

## Endoplasmic Reticulum

Endoplasmic reticulum (ER) is a complex network of membrane bound structure which runs through the cytoplasm. ER is connected to both the outer nuclear membrane as well as cell membrane.

ER is a major site of protein synthesis and transport, protein folding, lipid and steroid synthesis, carbohydrate metabolism and calcium storage.

It looks like long tubules or round or oblong bags (vesicles).

### Types of Endoplasmic Reticulum

Depending on presence or absence of ribosome on the surface of ER, it is divided into two types: **rough endoplasmic reticulum (RER)** and **smooth endoplasmic reticulum (SER)**.

- (i) **Rough Endoplasmic reticulum (RER):** It is lined with ribosomes and is rough in appearance, hence, named as rough endoplasmic reticulum. It is the site of protein synthesis (Translation).
- (ii) **Smooth Endoplasmic reticulum (SER):** It contains no ribosomes and hence is smooth in appearance. It helps in lipid and steroid synthesis. It also helps in detoxifying many drugs and poisons.

### Functions of Endoplasmic Reticulum (ER)

- (i) It is mainly responsible for the transportation of proteins and other carbohydrates to another organelle, which includes lysosomes, Golgi apparatus, plasma membrane, etc.
- (ii) It provides the increased surface area for cellular metabolic reactions.
- (iii) It helps in the formation of nuclear membrane during cell division.
- (iv) It plays a vital role in the formation of the skeletal framework.
- (v) It plays a vital role in the synthesis of proteins, lipids, glycogen and other steroids like cholesterol, progesterone, testosterone, etc.

#### DID YOU KNOW?

Translation is the process in which ribosomes in the cytoplasm or ER synthesise proteins after the process of transcription of DNA to RNA in the cell's nucleus.



### Mitochondria (Singular-Mitochondrion)

Mitochondria are rod shaped cell organelles surrounded by a double membrane. The outer membrane is smooth and porous while the inner membrane is folded into large number of finger like structures called **crisetae**. Crisetae increase the surface area of the inner membrane, which provides more surface area for the metabolic reactions to take place. The fluid inside the mitochondria is called the **matrix**.

#### DID YOU KNOW?

ATP = Adenosine Triphosphate. ATP is known as energy currency of the cell. It is a common cellular fuel that drives many energy requiring processes of the cell.



Mitochondria contain enzymes necessary for the total oxidation of food and for the release of large amount of energy in the form of ATP molecules. The energy stored in this ATP is used for synthesis of new products and other metabolic process. Hence, **mitochondria are commonly known as "Powerhouse of the cell"**.

Mitochondria have the ability to make their own protein, as they contain their own DNA and ribosome. That is why; mitochondrion is also known as **semi-autonomous organelle**.

### Functions of Mitochondria

- (i) Mitochondria are the site of cellular respiration. They use molecular oxygen from air to oxidise the carbohydrates and fats present in the cell to carbon dioxide and water vapour.  
Glucose + Oxygen → Carbon dioxide + Water + Energy (ATP)
- (ii) Mitochondria provide energy in the form of ATP for various metabolic activities of living cells. Since, the mitochondria synthesise ATP, it is also known as power house of cell.

#### DID YOU KNOW?

The matrix of the mitochondria is the site of Krebs cycle reactions. The electron transport chain and most ATP synthesis rely on the compartments created by the inner membrane of the mitochondria.



### Plastids

Plastids are double bound membrane organelle which are found in the cells of plants and algae. Plastids are responsible for manufacturing and storing the food. **Like mitochondria, plastids have their own DNA and ribosomes**. Hence, they may be used in phylogenetic studies and is also known as semi-autonomous organelle.

These often contain pigments that are used in photosynthesis and also can change the colour of the cell.

### Types of Plastids

On the basis of pigments present in them, plastids are of the following three types:

- (i) **Leucoplast** : Leucoplasts are **colourless (non-pigmented) plastids**. They are found in storage cells of roots, seeds and underground stems. They take part in storage of food.  
Leucoplasts are of three types depending on the storage products : **amyloplasts** stores starch, **aleuoplasts** stores protein while **elaioplasts** store oil and fat.
- (ii) **Chromoplast**: It is a site for the synthesis and storage of pigments in the plant. They are coloured organelles found in flowering plants, fruits, and aging leaves. The chloroplasts actually convert over to chromoplasts. It contains fat soluble red, orange and yellow pigments such as carotenoids. Carotenoid pigments in chromoplasts allow for the different colours in fruits and the fallen leaves. The green coloured chromoplasts are called chloroplasts. One of the main reasons for these structures having colours is to attract pollinators.
- (iii) **Chloroplast** : Chloroplasts are green colour plastids, found in the cells of mesophyll in plant leaves. The green colour is due to the presence of chlorophyll pigment. Chlorophyll traps the solar energy which is used for manufacturing food. They are the sites of photosynthesis. So, chloroplasts are known as the **"Kitchen of the cells"**.

### Functions of Plastids

- (i) Chloroplasts trap solar energy and utilise it to manufacture food for the plant, process is known as photosynthesis.
- (ii) Chromoplasts assist in pollination and dispersal of fruits by attracting pollinating agents.
- (iii) Leucoplasts store food in the form of carbohydrates (starch), fats and proteins.

### Golgi Apparatus

The Golgi apparatus is also known as the Golgi complex or Golgi body. Golgi apparatus was discovered in the year 1898 by an Italian biologist Camillo Golgi. It is a membrane-bound organelle, found in eukaryotic cells (cells with clearly defined nuclei) and is made up of a series of flattened stacked pouches called cisternae. It is located in the cytoplasm next to the endoplasmic reticulum and near the cell nucleus. Membranes of Golgi body may develop connections with membranes of ER to form complex called extramembrane system.

The Golgi apparatus receives vesicles from ER on its convex or *cis* face for elaboration of their contents. They are then dispatched to intracellular and extra cellular targets through vesicles that develop on the sides as well as maturing convex or *trans* face of this apparatus.

#### DID YOU KNOW?

*The Golgi apparatus occurs in all eukaryotic cells except male gametes of bryophytes and pteridophytes, mature sieve tubes, some fungal cells, and mature sperms and RBCs of animals. It is also absent in prokaryotic cells.*



### Functions of Golgi Bodies

- (i) It is involved in the synthesis and repair of cell membrane.
- (ii) It is also involved in formation of lysosomes and peroxisomes.
- (iii) Secretion is the major function of Golgi apparatus. All types of substances that are secreted and excreted are packed in vesicles by Golgi bodies for passage to the outside. It is the **secretory organelle** of the cell.
- (iv) Golgi apparatus also takes part in storage, modification and packaging of various biochemical products produced by different components of the cell.

### Lysosomes (Lysis = Breaking down; Soma = Body)

Lysosomes are small, spherical vesicle covered by a single membrane. It is scattered all over the cytoplasm.

It contains powerful digestive (hydrolytic) enzymes (about 40 in number) that are capable of breaking down the organic material. Thus, lysosome serves as an intracellular digestive system, and is called **digestive bags**.

The digestive enzymes contained in lysosomes are synthesised by RER, and are packed into lysosomes by Golgi bodies.

Lysosomes are also called **suicidal bags** as enzymes contained in them can digest the cell's own material when of it becomes damaged or dead.

### Functions of Lysosomes:

- (i) Lysosome helps in intracellular digestion of food particles as they are rich in various digestive enzymes.
- (ii) They help in destruction of foreign particles, as in white blood cells.
- (iii) They help in cleaning up the cell by digesting damaged materials of the cell. Lysosomes are therefore called **cellular scavengers**.
- (iv) Lysosomes digest the cell's own material when damaged or dead. Hence, they provide energy during cell starvation by digesting cell's own parts.

### Vacuoles

Vacuoles are single membrane bound fluid-filled cavities or sacs present in the cytoplasm. They are found in the cells of plants (including algae and fungi) and some protists and bacteria. Vacuoles are surrounded by a membrane called **tonoplast**.

A single, large vacuole is present in a plant cell and in animal cells, vacuole may or may not be present. If present, are numerous and smaller in size.

Generally, vacuoles occupy 50-90 percent of the cell volume; but this may vary from 5 percent to 90 percent, depending on the cell type. In mature plant cells, the small vacuoles fuse to form a single large central vacuole which occupies up to 90% of the volume of the cell. Vacuoles generally have no basic shape or size; its structure varies according to the requirements of the cell.

Vacuoles are of different types:

- (i) **Food vacuole:** In single-celled organisms, like *Amoeba*, the sacs containing ingested food fuse with lysosomes to form food vacuole. The process of digestion takes place inside the food vacuole.

- (ii) **Contractile vacuole:** Contractile vacuole occur in some protistan and algal cells found mostly in fresh water. A contractile vacuole has a highly extensible and collapsible membrane. Contractile vacuole collects liquid from the cell, swells up and rises to the surface and burst to release their contents. They take part in osmoregulation and excretion. Osmoregulation is required in fresh water habitats where water has tendency to enter the living cells.

#### Summary of the functions of various parts of a cell

Cell Organelle	Structure	Function
Cell membrane (found in all cells)	Composed of lipid and protein and are selectively permeable.	1. Protects and gives definite shape to the cell. 2. Regulates movement of ions across cell.
Cell wall (found only in plant cell)	Rigid, strong and composed of cellulose and hemi-cellulose	1. Provides mechanical strength to cell. 2. Makes cell turgid. 3. Protects cell against pathogen and injury.
Nucleus (master control of a cell)	Composed of protein, phosphorus and DNA/RNA.	1. Controls all the activities of cell. 2. Responsible for transmission of characters.
Cytoplasm	Composed of insoluble wastes and storage products.	1. Storehouse of amino acids 2. Site of metabolic activities
Endoplasmic reticulum (ER)	Occurs in three form - cisternae, vesicles and tubules. It is of two types : Smooth ER and Rough ER	1. Provide supporting skeletal framework to the cell. 2. SER - synthesises fat 3. RER - plays role in synthesis of proteins
Golgi apparatus (In plants, they are called as dictyosomes)	Consists of cisternae stacked together in parallel rows.	1. Packages materials synthesised in cell and dispatches from cell across plasma membrane. 2. Produces lysosomes
Mitochondria (Power house of the cell)	Semi-autonomous organelle	Site of cellular respiration and produces ATP - (universal currency of energy).
Chloroplast (Kitchen of the cell)	Semi-autonomous organelle	Site of photosynthesis and store food in the form of carbohydrate
Lysosome (suicidal bag of the cell)	Tiny sac like structure surrounded by single, thin membrane	Contains digestive enzyme and helps in intracellular digestion.
Vacuole	Fluid filled structure bounded by tonoplast.	1. Provide turgidity and rigidity to the plant cell. 2. Take part is excretion and osmoregulation.

## CELL DIVISION

Cell division is the process by which a parent cell divides into two or more daughter cells. Cell division usually occurs as part of a larger cell cycle. In unicellular organisms, cell division is the means of reproduction while in multicellular organisms, it is the means of tissue growth and maintenance.

### Types of Cell Division

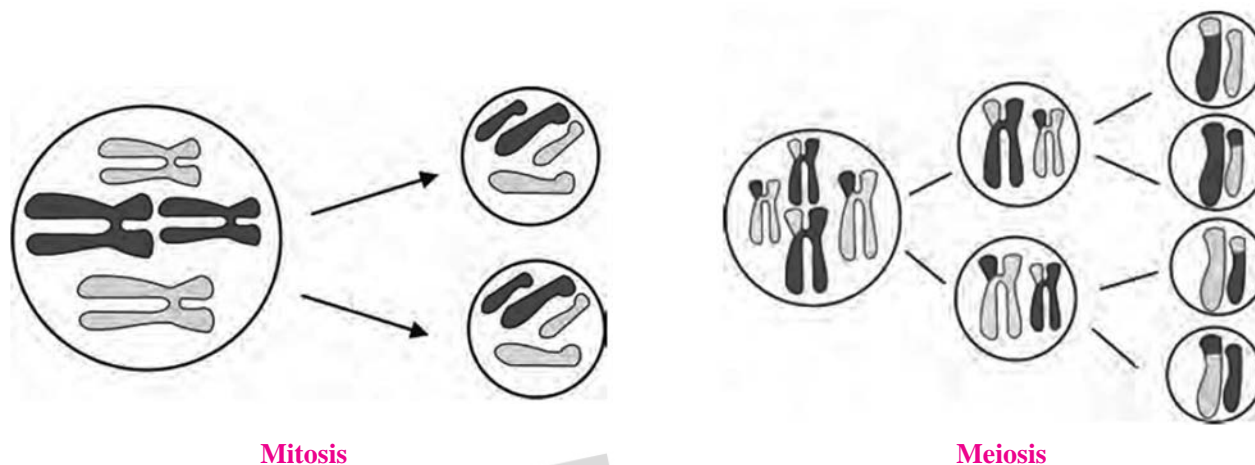
There are two types of cell division: **mitosis and meiosis**. Most of the time when people refer to “cell division,” they mean mitosis, the process of making new body cells. Meiosis is the type of cell division that creates egg and sperm cells.

#### Mitosis

Mitosis is a fundamental process of life. During mitosis, a cell duplicates all of its contents, including its chromosomes, and splits to form two identical daughter cells. Because this process is so critical, the steps of mitosis are carefully controlled by a number of genes. It helps in growth and repair of tissues in organisms.

## Meiosis

Meiosis ensures that humans have the same number of chromosomes in each generation. It involves two-consecutive division in which a cell divides by meiosis and produce four new cells instead of two. The new cells only have half the number of chromosome than that of the mother cells.



Mitosis

Meiosis



### CONNECTING TOPIC

Table: Difference between mitosis and meiosis

	Mitosis	Meiosis
Definition	A process of asexual reproduction in which the cell divides into two, producing a replica with an equal number of chromosomes in each resulting diploid cell.	A type of cellular reproduction in which the number of chromosome become reduce by half producing two haploid cells.
Occurs in	All organisms	Reproductive cells of humans, animals, plants and fungi.
Type of reproduction	Asexual	Sexual
Genetic behaviour	Produces identical organisms or cells	Different cells or organisms.
Crossing over	No, crossing over occur.	Yes, mixing of chromosomes can occur.
Pairing of homologous chromosomes	No	Yes
Number of divisions	1	2
Number of daughter cells produced	2 diploid cells	4 Haploid cells

### Stages of Meiosis

Meiosis consists of two divisions, both of which follow the same stages as mitosis (prophase, metaphase, anaphase, and telophase). Meiosis is preceded by interphase, in which DNA is replicated to produce chromosomes consisting of two sister chromatids. A second growth phase called interkinesis, may occur between meiosis I and II; however no DNA replication occurs in this stage.

#### Meiosis I

The first meiotic division (meiosis I) is a reduction division (diploid → haploid) in which homologous chromosomes are separated.

- (i) Prophase-I: Chromosomes condense, nuclear membrane dissolves, homologous chromosomes form bivalents, crossing over occurs.
- (ii) Metaphase-I: Spindle fibres from opposing centrosomes connect to bivalents (at centromeres) and align them along the middle of the cell



- (iii) Anaphase-I: Spindle fibres contract and split the bivalent, homologous chromosomes move to words opposite poles of the cell.
- (iv) Telophase-I: Chromosomes decondense, nuclear membrane reform, cell divides (cytokinesis) to form two haploid daughter cells.

### Meiosis II

The second division (meiosis II) separates sister chromatids (these chromatids may not be identical due to crossing over in prophase I).

- (i) Prophase -II: Chromosomes condense, nuclear membrane dissolves, centrosomes move to opposite poles (perpendicular to before)
- (ii) Metaphase-II: Spindle fibres from opposing centrosomes attach to chromosomes (at centromere) and align them along the cell equator
- (iii) Anaphase-II: Spindle fibres contract and separate the sister chromatids, which move towards opposite poles
- (iv) Telophase-II: Chromosomes decondense, nuclear membrane reforms, cells divide (cytokinesis) to form four haploid daughter cells.

### Let's Connect

1. Identify the meiotic stage in which the homologous chromosomes separate while the sister chromatids remain associated at their centromeres.
  - (a) Metaphase I                      (b) Metaphase II                      (c) Anaphase I                      (d) Anaphase II
2. Significance of meiosis lies in
  - (a) reduction of chromosome number to one half.
  - (b) maintaining consistency of chromosome number during sexual reproduction.
  - (c) production of genetic variability.
  - (d) all of the above.
3. In meiosis, each of the four daughter cells has one set of chromosomes. Due to randomness of process of chromosome separation in meiosis, large number of chromosome combinations can form gametes. How many such chromosome combinations in the gametes are possible in case of humans, assuming there is no crossing over taking place?
  - (a) 222                                      (b) 223                                      (c) 246                                      (d) 234

#### Solutions:

1. (c) During Anaphase I, the homologous chromosomes separate, after breaking apart (the process is called disjunction) while sister chromatids remain associated at their centromeres.
2. (d)
3. (b) To compute the chromosome combinations, during gametes formation =  $2^n$ , here n = number of different chromosomes.

In case of humans, One set of chromosomes contain = 23 chromosomes.

So, the chromosome combinations in the gametes are possible in case of humans =  $2^{23}$



### Illustration 6 :

Which cell organelles have their own DNA and ribosomes?

- (a) Vacuoles and Lysosomes
- (b) Mitochondria and Plastids
- (c) Golgi Apparatus and Lysosomes
- (d) ER and Plastids

Solution : (b)



### Illustration 7 :

Which type of cells have half the number of chromosomes than that of the mother cells?

Solution :

Gametes cell have half the number of chromosome to ensure same number of chromosome in each generation after fertilisation.

**CHECK POINT-3**

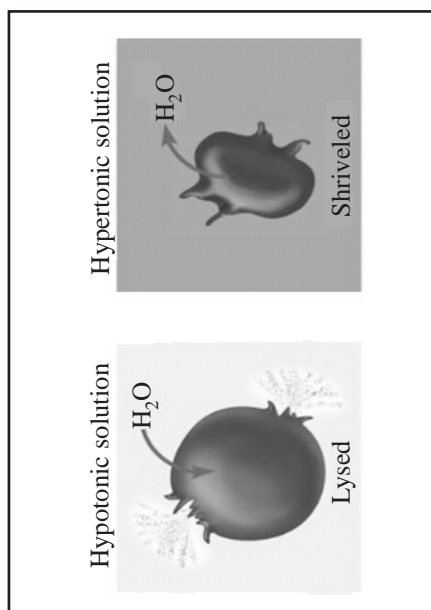
1. **Column I** **Column II**
- |                                       |              |
|---------------------------------------|--------------|
| (A) Structures with one unit membrane | (p) Lysosome |
| (B) Structures with two membrane      | (q) Ribosome |
| (C) Structures without membrane       | (r) Plastids |
2. Which cell organelle is called as suicidal bags?  
(a) Mitochondria (b) Lysosomes (c) Plastid (d) Vacuole
3. **Column I** **Column II**
- |                           |  |
|---------------------------|--|
| (A) Endoplasmic reticulum | (p) Organelle of photosynthesis                            |
| (B) Chloroplast           | (q) Production and segregation of proteins to be secreted. |
| (C) Golgi body            | (r) Digestion of nutrients and worn-out cell parts.        |
| (D) Lysosomes             | (s) Sorting, packaging, labelling of cell products         |

**Solutions:**

1. (A) → p, (B) → r, (C) → q  
2. (b)  
3. (A) → q, (B) → p, (C) → s, (D) → r

## CASE STUDY-1 :

## Types of Osmotic Solution

**CASE I: Why the animal cells swell when placed in dilute solution?**

The surrounding solution is less concentrated i.e., dilute solution as compared to the cytoplasm of the animal cell, so water moves from outside to inside of the cell due to the process of endosmosis. Hence, the cells become swollen in dilute solution.

**CASE II: When the plant cell is placed in hypertonic solution, what will happen?**

A phenomenon, known as plasmolysis will occur, on placing the plant cell into hypertonic solution i.e., concentrated solution. Due to this, water comes out from the cell and shrinkage of protoplasm will occur.

**CASE III: If the concentration of cell solution and surrounding solution is the same, water will move in which direction?**

As the concentration of both sides is similar so there will be no movement of water. Therefore, the size of the cell remains the same.

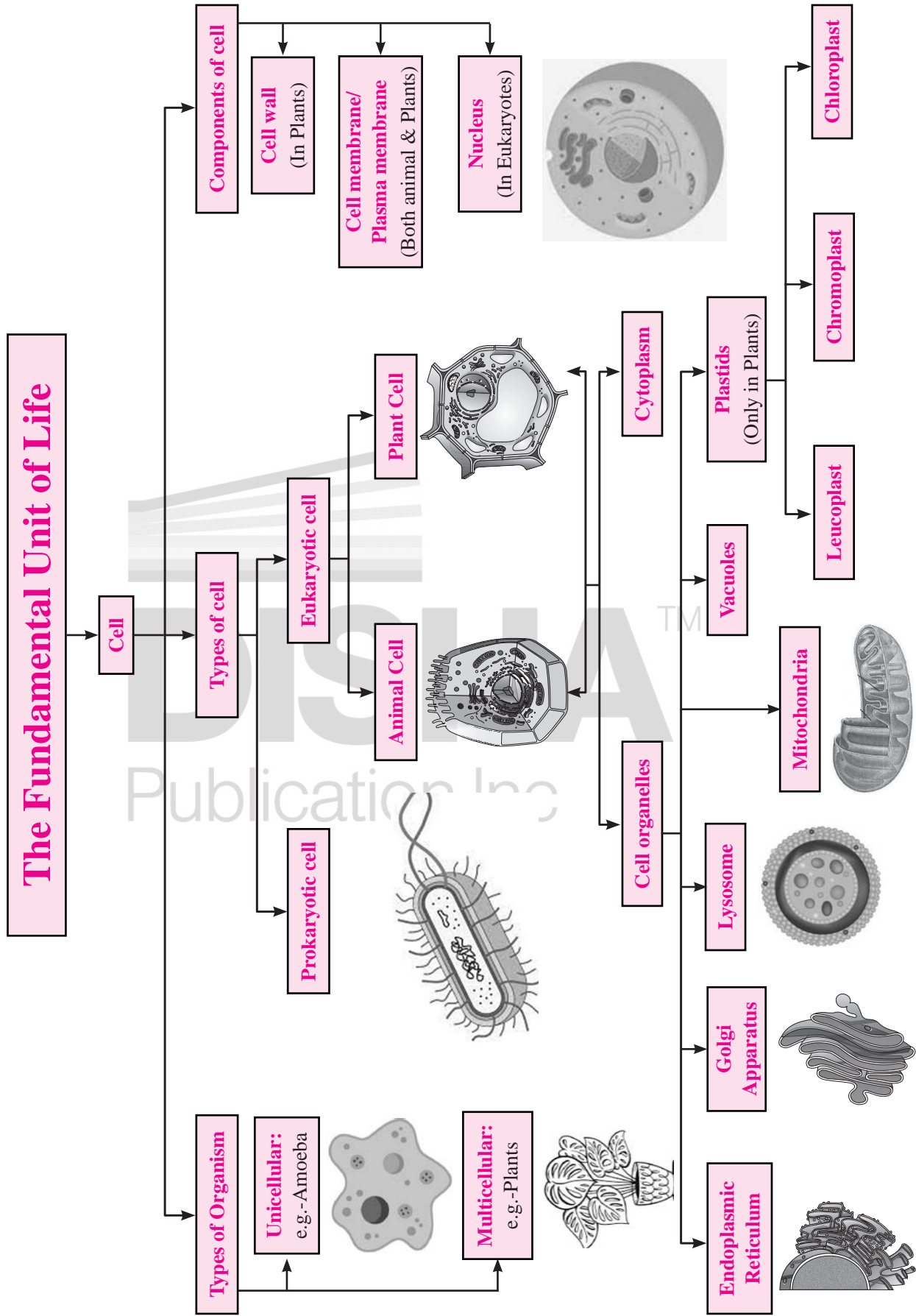
**CASE IV: If a cell swells or shrinks then what will be the type of surrounding solution?**

If a cell swells then the outer solution will be hypotonic i.e., less concentrated or dilute solution. If a cell shrinks, then the outer solution will be hypertonic i.e., more concentrated solution.

**Think Out of the Box**

- Q 1.** If a piece of the leaf peel is boiled in water and then placed in hypertonic solution, what will happen?
- Q 2.** There are two test tubes, A and B having hypotonic solution. In test tube A, raisins and in test tube B, RBCs (Red blood cells) are placed. What will you observe in both the test tubes after sometime? Explain the reason.
- Q 3.** A hen's egg is placed in dilute hydrochloric acid for decalcification of the egg shell. After that, it is put in concentrated salt solution for some time and then it is placed in water. What will occur in both the cases?
- Q 4.** We placed some apricots in a solution. After some time, we saw that the apricots have become shrunk. Identify the type of solution in which apricots were placed.

Walk Through the Chapter





## Let's Revise Through FIB & T/F

- Movement of water across cell membrane takes place by .....
- Cells are enclosed by a plasma membrane composed of ..... and .....
- Diffusion is the movement of molecules from a place of higher concentration to a place of lower concentration in liquid, solid, or gaseous state. (T/F)
- In plant cells, a cell wall composed mainly of ..... is located outside the cell membrane.
- Presence of cell wall enables bacteria to live in hypotonic medium without bursting. (T/F)
- In general, eukaryotic cells consist of a nucleus and a cytoplasmic region. (T/F)
- Protoplasm is the part of the cell which surrounds the nucleus. (T/F)
- The ER functions both as a passageway for intracellular transport and as a manufacturing surface. (T/F)
- Nuclei and mitochondria are surrounded by a double membrane. (T/F)
- Cristae create a large surface area for ..... generating reactions.
- In animal cells, mitochondria is the only cell organelle outside the nucleus that contains DNA. (T/F)
- Lysosomes keep the cells clean by digesting foreign materials. (T/F)

### EXERCISE -1

### Master Board

#### Multiple Choice Questions

**DIRECTIONS :** This section contains multiple choice questions. Each questions has 4 choices (a), (b), (c) and (d) out of which only one is correct.

- Vesicles are essential for the normal functioning of the Golgi apparatus because:
  - they provide energy for chemical reactions.
  - they move proteins and lipids between different parts of the organelle.
  - they contribute to the structural integrity of the organelle.
  - they produce the sugars that are added to proteins.
- Which of the following statements about the plasma membrane is true?
  - It is a solid layer of protein that protects the contents of the cell.
  - The plasma membrane of a bacterium has none of the same components as the plasma membrane of an animal cell.
  - It is a rigid and non-moving layer of phospholipids and proteins.
  - It allows selected molecules to pass into and out of the cell.
- Mitochondria are the site of:
  - Kreb's cycle
  - Calvin cycle
  - anaerobic respiration
  - trapping of sun light
- The total solute concentration in a red blood cell is about 2%. Sucrose cannot pass through the membrane, but water and urea can. Osmosis would cause such a cell to shrink the most when the cell is immersed in which of the following –
  - a hypertonic sucrose solution
  - a hypotonic sucrose solution
  - a hypertonic urea solution
  - a hypotonic urea solution
- Which of the following is found in plant cells, but not animal cells?
  - Cell wall
  - Nucleus
  - Endoplasmic reticulum
  - Mitochondria
- Plastid that are white in colour (pigment free):
  - chloroplast
  - lysosome
  - leucoplast
  - chromoplast
- In the mitochondrion, energy is stored in the form of:
  - Adenosine triphosphate (ATP)
  - Adenosine monophosphate (AMP)
  - Citric acid
  - Adenosine diphosphate (ADP)
- Which animal cell structure is characterised by selective permeability?
  - Chromosome
  - Cell membrane
  - Cell wall
  - Ribosomes
- Which of the following is not the function of cell wall?
  - Provides shape to the cell.
  - Protects the cell from mechanical damage and infection.
  - Helps in cell-to-cell interaction.
  - Provides barrier to undesirable macromolecules.
  - Only (i)
  - Only (iv)
  - Only (ii), (iii) and (iv)
  - None of these

10. The outermost boundary of an animal cell is:  
 (a) plasma membrane (b) nucleus  
 (c) cytoplasm (d) cell wall

### Assertion & Reason Questions

**DIRECTIONS :** The questions in this segment consists of two statements, one labelled as "Assertion A" and the other labelled as "Reason R". You are to examine these two statements carefully and decide if the Assertion A and Reason R are individually true and if so, whether the reason is a correct explanation of the assertion. Select your answers to these items using the codes given below.

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

1. **Assertion :** Larger cells are less efficient.  
**Reason :** Surface volume ratio is more in large cells.  
 2. **Assertion :** Diffusion is a passive process of membrane transport.  
**Reason :** Osmosis is an active process of membrane transport.  
 3. **Assertion :** Mitochondria and chloroplasts are semiautonomous organelles.  
**Reason :** They are formed by division of pre-existing organelles as well as contain DNA but lack protein synthesising machinery.

### Passage/Case Based Questions

**DIRECTIONS :** Read the passage (s) given below and answer the questions that follow.

#### Passage I

Chromosomes are rod like structures, present in the nucleus. They become visible only during cell division. A chromosome is composed of protein and DNA (deoxyribonucleic acid). DNA contains specific information which is transferred from one generation to next generation.

- List function of chromosome.
- How chromosome and DNA are linked?
- Name two types of chromosome based on the position of centromere.
- In humans, how many chromosomes are found?  
 (a) 23 pairs  
 (b) 23 chromosomes  
 (c) 46 pairs  
 (d) 48 chromosomes

#### Passage II

Chloroplasts are green coloured plastids. The green colour is due to the presence of chlorophyll pigment. Each chloroplast is bounded by two unit membranes. Chlorophyll traps the solar energy which is used in manufacturing of food.

- Where is the chloroplast located?
- Write function of chloroplast.
- In chloroplast, protein synthesis will occur or not. Give reason to support your answer.
- Chloroplast are present in  
 (a) Plant cell  
 (b) Animal cell  
 (c) Bacterial cell  
 (d) All of the above

### Very Short Answer Questions

**DIRECTIONS :** Give answer in one word or one sentence.

- What is the primary function of the plasma membrane?
- What is the energy source for active transport ?
- Give two examples of prokaryotic cell.
- Name the smallest and the largest cell.
- Name the cell organelle in which following structures are present:  
 (a) Cristae  
 (b) Stroma  
 (c) Centriole  
 (d) Chromosome
- Name the nucleic acids that are present in an animal cell.
- Define cell. Who coined the term 'cell'?
- Name the biochemicals present in cell membrane.
- What is protoplasm?
- What is nucleoid?
- What is osmotic solution?
- Define endosmosis.
- What do you mean by selectively permeable membrane?
- What is exosmosis?
- What do you mean by "semi-autonomous"?
- Why does water diffuse out of a cell if when cell is placed in a hypertonic solution ?
- What will happen if all the mitochondria of a cell are destroyed ?
- What is the main function of each of the following organelles?  
 (a) Golgi bodies  
 (b) Vacuole

### Short Answer Questions

**DIRECTIONS :** Give answer in 2-3 sentences.

- Write the names of the following organelles –  
 (A) Power house of the cell  
 (B) Digestive bag of the cell  
 (C) Protein factory of cell  
 (D) Head quarter of cell  
 (E) Kitchen of the cell
- Distinguish between rough endoplasmic reticulum and smooth endoplasmic reticulum, both structurally and functionally.
- How is osmosis a special type of diffusion ?

4. Organelles are the functional subunits of the cell. Each organelle has a specific function which makes it easier to master the names, structure, and function of each component. In the following table, indicate the functions associated with each structure.

**Organelles :**

- |                 |                   |
|-----------------|-------------------|
| (a) Nucleus     | (b) Golgi body    |
| (c) Lysosomes   | (d) Mitochondrion |
| (e) Chloroplast | (f) Peroxisomes   |
5. Define : (a) Hypertonic solution, (a) Hypotonic solution and (c) Isotonic solution.
6. (a) Is the cell wall in a plant cell living or non-living?  
(b) Is the cell wall in a plant cell permeable or selectively permeable?  
(c) What is its chemical composition?
7. (a) Name any two cell organelles which are bounded by double membranes.  
(b) Why are mitochondria called semiautonomous organelles?  
(c) Where one would find green chlorophyll pigment in a plant cell?
8. Why is the presence of organelles within eukaryotes significant? In other words, why are eukaryotes so complex and diverse as compared to prokaryotes?
9. What are the functions of vacuoles in plant cell and animal cell?
10. Proteins embedded in the plasma membrane have several important functions in the life of the cell. Describe two of these functions. Explain why they are important to the cell?
11. (a) List various components of the nucleus.  
(b) What are chromosomes? Give their chemical composition. List their two functions.
12. Why is nucleus called director of the cell?  
**(Reasoning Based Questions)**
13. Why do dry apricot placed in salt solution do not swell while they do so when kept in water?  
**(Reasoning Based Questions)**
14. What would happen if shelled raw egg and deshelled boiled egg are placed in water?  
**(Reasoning Based Questions)**
15. Give reasons why mitochondria are called 'power house' and ATP as 'energy currency' of the cell.  
**(Reasoning Based Questions)**
16. What will happen if **(Reasoning Based Questions)**  
(a) Excess amount of fertiliser is added to a green lawn?  
(b) Salt is added to cut pieces of raw mango.
17. Why are lysosomes commonly called 'natural scavengers and cellular housekeepers'?  
**(Reasoning Based Questions)**
18. What will happen if chloroplast is taken out of the cell and illuminated?  
**(Reasoning Based Questions)**
19. How are the following related to each other?  
**(Reasoning Based Questions)**  
(a) Chromatin network and chromosomes  
(b) Chloroplast and chlorophyll  
(c) Genes and DNA

20. What happens when : **(Reasoning Based Questions)**  
(a) methylene blue stain is added to human cheek cell.  
(b) rheo leaves are boiled in water and a drop of sugar added to it.  
(c) RBCs are kept in concentrated solution.

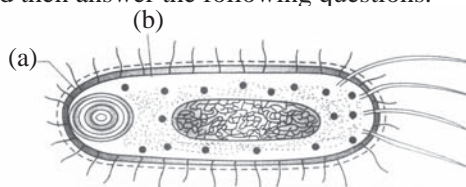
**Long Answer Questions**

**DIRECTIONS :** Give answer in 4-5 sentences.

- Draw a neat labelled diagram of plant cell and label its parts.
- Draw a neat labelled diagram of animal cell.
- How is the structure of a plasma membrane related to its function?
- Describe various components of a nucleus in a eukaryotic cell.
- Explain structure of chloroplast and functions of plastids.
- (a) What is endoplasmic reticulum?  
(b) Describe its structure.  
(c) Name the two types of endoplasmic reticulum.  
(d) What crucial role does it play in the liver cells of vertebrates?  
(e) What is membrane biogenesis?

**HOTS Questions**

- (a) Why does the plant cell, placed in a hypotonic solution, not burst?  
(b) What happens when a fully turgid plant cell is placed in a hypertonic solution? Name the phenomenon.
- (a) Name the phenomenon which helps fresh water unicellular organisms (e.g., *Amoeba*) to continuously gain water in their bodies. Also name the mechanism by which these organisms throw out excess of water from their bodies.  
(b) Give at least two examples in plants where similar phenomenon is used to gain water.
- What will happen if nucleus is removed from the cell?
- Given below is a diagram of the cell. Study it carefully and then answer the following questions.



- Give suitable title to the given figure.
  - What is the term used for the genetic material which lies in the cytoplasm and not covered by any envelope?
  - Name the only cell organelle present in this cell which is not membrane bound.
  - Label the following :  
(i) Outermost covering labelled as (a)  
(ii) Inner covering labelled as (b)
5. Once regarded as depositories for waste products in plant cells, vacuoles now are known to play many different roles. What are some of those roles?

## EXERCISE -2

## NCERT Questions

## Intext - Book Questions

- Who discovered cells and how ?
- Why is the cell called the structural and functional unit of life?
- How do substances like  $\text{CO}_2$  and water move in and out of the cell? Discuss.
- Why is the plasma membrane called a selectively permeable membrane?
- Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.

	Prokaryotic Cell		Eukaryotic Cell
1.	Size: generally small (1-10 $\mu\text{m}$ ) $1 \mu\text{m} = 10^{-6}\text{m}$	1.	Size: generally large (5-100 $\mu\text{m}$ )
2.	Nuclear region: _____ _____ and known as-	2.	Nuclear region: well defined and surrounded by a nuclear membrane
3.	Chromosome: single	3.	More than one chromosome
4.	Membrane-bound cell organelles are absent.	4.	_____

- If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?
- Why are lysosomes known as suicide bags?

## Text Book Questions

- Make a comparison and write down ways in which plant cells are different from animal cells.
- How is a prokaryotic cell different from an eukaryotic cell?
- What would happen if the plasma membrane ruptures or breaks down?
- What would happen to the life of a cell if there was no Golgi apparatus?
- Which organelle is known as the power house of the cell? Why?
- Where do the lipids and proteins constituting the cell membrane get synthesised?
- How does an *Amoeba* obtain its food?
- What is osmosis?
- Carry out the following osmosis experiment. Take four peeled potato halves and scoops each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now,

- Keep cup A empty
  - Put one teaspoon sugar in cup B
  - Put one teaspoon salt in cup C
  - Put one teaspoon sugar in the boiled potato cup D.
- Keep these for two hours. Then observe the four potato cups and answer the following :
- Explain why water gathers in the hollowed portion of B and C.
  - Why is potato A necessary for this experiment?
  - Explain why water does not gather in the hollowed out portions of A and D.

- Which type of cell division is required for growth and repair of body and which type is involved in formation of gametes?

## Exemplar Questions

- Which of the following can be made into crystal?
  - A Bacterium
  - An *Amoeba*
  - A Virus
  - A Sperm
- A cell will swell up if
  - The concentration of water molecules in the cell is higher than the concentration of water molecules in surrounding medium
  - The concentration of water molecules in surrounding medium is higher than water molecules concentration in the cell
  - The concentration of water molecules is same in the cell and in the surrounding medium
  - Concentration of water molecules does not matter
- Chromosomes are made up of
  - DNA
  - protein
  - DNA and protein
  - RNA
- Which of these options are not functions of Ribosomes?
  - It helps in manufacture of protein molecules.
  - It helps in manufacture of enzymes.
  - It helps in manufacture of hormones.
  - It helps in manufacture of starch molecules.
  - (i)and(ii)
  - (ii) and (iii)
  - (iii) and (iv)
  - (iv) and (i)
- Which of these is not related to endoplasmic reticulum?
  - It behaves as transport channel for proteins between nucleus and cytoplasm.
  - It transports materials between various regions in cytoplasm.
  - It can be the site of energy generation.
  - It can be the site for some biochemical activities of the cell.



6. Following are a few definitions of osmosis. Read carefully and select the correct definition
- Movement of water molecules from a region of higher concentration to a region of lower concentration through a semipermeable membrane
  - Movement of solvent molecules from its higher concentration to lower concentration
  - Movement of solvent molecules from higher concentration to lower concentration of solution through a permeable membrane.
  - Movement of solute molecules from lower concentration to higher concentration of solution through a semipermeable membrane.
7. Plasmolysis in a plant cell is defined as
- breakdown (lysis) of plasma membrane in hypotonic medium
  - shrinkage of cytoplasm in hypertonic medium
  - shrinkage of nucleoplasm
  - none of them
8. Which of the following are covered by a single membrane
- Mitochondria
  - Vacuole
  - Lysosome
  - Plastid
9. Find out the false sentences
- Golgi apparatus is involved with the formation of lysosomes.
  - Nucleus, mitochondria and plastid have DNA; hence they are able to make their own structural proteins.
  - Mitochondria is said to be the power house of the cell as ATP is generated in them.
  - Cytoplasm is called as protoplasm.
10. Find out the correct sentence
- Enzymes packed in lysosomes are made through RER (rough endoplasmic reticulum).
  - Rough endoplasmic reticulum and smooth endoplasmic reticulum produce lipid and protein respectively.
  - Endoplasmic reticulum is related with the destruction of plasma membrane.
  - Nucleoid is present inside the nucleoplasm of eukaryotic nucleus.
11. Which cell organelle plays a crucial role in detoxifying many poisons and drugs in a cell?
- Golgi apparatus
  - Lysosomes
  - Smooth endoplasmic reticulum
  - Vacuoles
12. The proteins and lipids, essential for building the cell membrane, are manufactured by
- rough endoplasmic reticulum
  - golgi apparatus
  - plasma membrane
  - mitochondria
13. The undefined nuclear region of prokaryotes are also known as
- nucleus
  - nucleolus
  - nucleic acid
  - nucleoid
14. The cell organelle involved in forming complex sugars from simple sugars are
- endoplasmic reticulum
  - ribosomes
  - plastids
  - Golgi apparatus
15. Which out of the following is not a function of vacuole?
- Storage
  - Providing turgidity and rigidity to the cell
  - Waste excretion
  - Locomotion
16. Amoeba acquires its food through a process, termed
- exocytosis
  - endocytosis
  - plasmolysis
  - exocytosis and endocytosis both
17. Cell wall of which one of these is not made up of cellulose?
- Bacteria
  - Hydrilla*
  - Mango tree
  - Cactus
18. Silver nitrate solution is used to study
- endoplasmic reticulum
  - Golgi apparatus
  - nucleus
  - mitochondria
19. Organelle other than nucleus, containing DNA is
- endoplasmic reticulum
  - golgi apparatus
  - mitochondria
  - lysosome
20. Kitchen of the cell is
- mitochondria
  - endoplasmic reticulum
  - chloroplast
  - golgi apparatus
21. Lipid molecules in the cell are synthesized by
- smooth endoplasmic reticulum
  - rough endoplasmic reticulum
  - golgi apparatus
  - plastids
22. Cell arises from pre-existing cell was stated by
- Haeckel
  - Virchow
  - Hooke
  - Schleiden

23. Cell theory was given by  
 (a) Schleiden and Schwann  
 (b) Virchow  
 (c) Hooke  
 (d) Haeckel
24. The only cell organelle seen in prokaryotic cell is  
 (a) mitochondria (b) ribosomes  
 (c) plastids (d) lysosomes
25. Organelle without a cell membrane is  
 (a) ribosome (b) golgi apparatus  
 (c) chloroplast (d) nucleus
26.  $1\ \mu\text{m}$  is  
 (a)  $10^{-6}\ \text{m}$  (b)  $10^{-9}\ \text{m}$   
 (c)  $10^{-10}\ \text{m}$  (d)  $10^{-3}\ \text{m}$
27. Lysosome arises from  
 (a) endoplasmic reticulum  
 (b) golgi apparatus  
 (c) nucleus  
 (d) mitochondria
28. Living cells were discovered by  
 (a) Robert Hooke (b) Purkinje  
 (c) Leeuwenhoek (d) Robert Brown
29. 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.
30. If cells of onion peel and RBC are separately kept in hypotonic solution, what among the following will take place? Explain the reason for your answer.  
 (a) Both the cells will swell.  
 (b) RBC will burst easily while cells of onion peel will resist the bursting to some extent.  
 (c) (a) and (b) both are correct.  
 (d) RBC and onion peel cells will behave similarly
31. Do you agree that “a cell is a building unit of an organism”. If yes, explain why?
32. A person takes concentrated solution of salt, after some time, he starts vomiting. What is the phenomenon responsible for such situation? Explain.
33. We eat food composed of all the nutrients like carbohydrates, proteins, fats, vitamins, minerals and water. After digestion, these are absorbed in the form of glucose, amino acids, fatty acids, glycerol etc. What mechanisms are involved in absorption of digested food and water?
34. If you are provided with some vegetables to cook. You generally add salt into the vegetables during cooking process. After adding salt, vegetables release water. What mechanism is responsible for this?
35. How is a bacterial cell different from an onion peel cell?
36. Which kind of plastid is more common in  
 (a) roots of the plant  
 (b) leaves of the plant  
 (c) flowers and fruits.

### EXERCISE -3

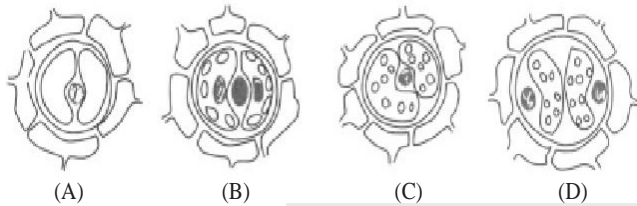
### Foundation Builder

#### Multiple Choice Questions

**DIRECTIONS :** This section contains multiple choice questions. Each questions has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. Which of these is the smallest in size ?  
 (a) Ribosome (b) Lysosome  
 (c) Mitochondria (d) Chloroplast
2. The scientist who saw the living cell for the first time was:  
 (a) Leeuwenhoek (b) M.J. Schleiden  
 (c) Kolliker (d) Palade
3. Who proposed the cell theory ?  
 (a) Schleiden and Schwann  
 (b) Watson and Crick  
 (c) Darwin and Wallace  
 (d) Mendel and Morgan
4. Which of the following organelles does not have membrane?  
 (a) Ribosome (b) Nucleus  
 (c) Chloroplast (d) Mitochondria
5. Which of the following organelles would not be found in a plant cell ?  
 (a) Chloroplast (b) DNA  
 (c) Food vacuole (d) Cell membrane
6. The rough endoplasmic reticulum owes its rough surface to:  
 (a) mitochondria (b) proteins  
 (c) ribosomes (d) DNA particles
7. Plant cell wall is mainly composed of:  
 (a) sugars (b) cellulose  
 (c) proteins (d) lipids
8. Nucleus was discovered by,  
 (a) Robert Brown (b) Robert Hooke  
 (c) A.V. Leeuwenhoek (d) Schwaan

9. The site of protein synthesis in plants is:  
 (a) Chloroplast (b) Ribosomes  
 (c) Lysosome (d) Mitochondria
10. Thickness of plasma membrane (unit membrane) is –  
 (a) 75 Å (b) 175 Å  
 (c) 125 Å (d) 150 Å
11. The infoldings of the inner membrane of mitochondria is referred to as:  
 (a) grana (b) stroma  
 (c) oxysome (d) cristae
12. The Golgi bodies are related to  
 (a) respiration (b) excretion  
 (c) secretion (d) circulation
13. Students observed the epidermal peel of a leaf under the high power of a microscope. The following are the sketches made by them.



The correct sketch is:

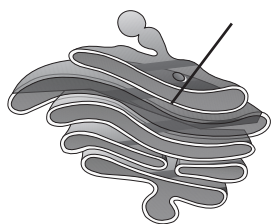
- (a) A (b) B  
 (c) C (d) D
14. The most abundant compound in cytoplasm is:  
 (a) fat (b) water  
 (c) protein (d) carbohydrates
15. Which organelle is made up of flat, membrane-enclosed sacs and functions as a processing center?  
 (a) Chloroplast  
 (b) Smooth endoplasmic reticulum  
 (c) Rough endoplasmic reticulum  
 (d) Golgi body
16. The cell's "garbage disposals" are the:  
 (a) lysosomes (b) peroxisomes  
 (a) mitochondria (d) vacuoles
17. What part of the cell does serve to process, package and export proteins ?  
 (a) Mitochondria (b) Endoplasmic reticulum  
 (c) Nucleolus (d) Golgi apparatus
18. The physical basis of life is:  
 (a) ectoplasm (b) protoplasm  
 (c) nucleoplasm (d) endoplasm
19. Which out of the following is not a function of vacuole?  
 (a) Storage  
 (b) Providing turgidity and rigidity to the cell  
 (c) Waste excretion  
 (d) Locomotion

20. Coverslip is put on the mounted material on a slide very gently to:  
 (a) avoid the crushing of mounted material  
 (b) avoid the entry of air bubbles  
 (c) avoid the oozing of stain  
 (d) avoid the oozing of glycerine
21. Which of the following is incorrect pair?  
 (a) Nucleus-Brain of the cell  
 (b) Mitochondria-Power house of the cell  
 (c) Chloroplast-Kitchen of the cell  
 (d) Lysosome-Secretory granules
22. What part of the cell does serves as the intracellular highway?  
 (a) Endoplasmic reticulum  
 (b) Golgi apparatus  
 (c) Cell membrane  
 (d) Mitochondria
23. Chromosomes contain hereditary units called:  
 (a) genes (b) ribosomes  
 (c) DNA (d) RNA
24. A series of membrane-enclosed channels studded with ribosomes are called:  
 (a) lysosomes  
 (b) Golgi complex  
 (c) rough endoplasmic reticulum  
 (d) mitochondria
25. The organelles that help the cell to use oxygen, and also contain a variety of enzymes that help the cell degrade rare biochemicals, among other things, are these:  
 (a) lysosomes (b) peroxisomes  
 (c) mitochondria (d) vacuoles
26. In the eukaryotic cell which one of the following is not a membranous compartment?  
 (a) Nucleus (b) Ribosome  
 (c) Vacuole (d) Lysosome
27. Which of the following helps in cell wall formation?  
 (a) Nucleus (b) Golgi complex  
 (c) Nucleolus (d) Endoplasmic reticulum
28. Protoplasm is:  
 (a) true solution (b) suspension  
 (c) colloidal solution (d) none of the above
29. Root hairs absorb water from soil through:  
 (a) diffusion (b) imbibition  
 (c) osmosis (d) All of these
30. Which organelle is usually found associated with the nucleus of the cell in animals?  
 (a) Centrosome (b) Vacuole  
 (c) Chromosome (d) Mitochondrion
31. One key function of nuclear pores is to:  
 (a) allow cells to communicate with one another.

- (b) aid in the production of new nuclei.  
 (c) allow molecules such as proteins to move into and out of the nucleus.  
 (d) form connections between different organelles.
- 32.** Which of the following statements is not true?  
 (a) Both mitochondria and chloroplasts provide energy to cells in the same way.  
 (b) Both mitochondria and chloroplasts have more than one membrane.  
 (c) Only chloroplasts contain the pigment chlorophyll.  
 (d) Both animal and plant cells contain mitochondria.
- 33.** Which of the followings best describes the structure of the plasma membrane?  
 (a) phospholipids sandwiched between two layers of proteins.  
 (b) proteins embedded in two layers of phospholipid.  
 (c) a layer of protein coating a layer of phospholipid.  
 (d) phospholipids embedded in two layers of protein.
- 34.** Choose the best definition of 'diffusion'.  
 (a) Passive movement from an area of greater concentration to one of lesser concentration.  
 (b) Active movement from an area of greater concentration to one of lesser concentration.  
 (c) Passive movement from an area of lesser concentration to one of greater concentration.  
 (d) Active movement from an are of lesser concentration to one of greater concentration.
- 35.** Cell to cell contact in plant cells is maintained through:  
 (a) tight junctions (b) desmosomes  
 (c) interdigitations (d) plasmodesmata
- 36.** Cyanobacteria have:  
 (a) a well-defined nucleus and chloroplast  
 (b) a well-defined nucleus but no chloroplast  
 (c) incipient nucleus and vesicles containing chlorophyll.  
 (d) incipient nucleus but no chloroplast or pigment.
- 37.** Which of the following could be found in both the nucleus and the cytoplasm?  
 (a) Nucleolus (b) Ribosomes  
 (c) RNA (d) Both (a) and (c)
- 38.** Which of the following structures has 9 + 2 arrangement?  
 (a) Flagella (b) Ribosome  
 (c) Mitochondria (d) Golgi apparatus
- 39.** Suggest which among the following is NOT a function attributed to endoplasmic reticulum.  
 (a) Detoxification of poisons and drugs  
 (b) Digestion / egestion of foreign materials outside the cell  
 (c) Manufacture of fat and lipid molecules  
 (d) Biogenesis of membranes
- 40.** Two sisters looked exactly same. This may be due to:  
 (a) mitochondrial DNA  
 (b) genes  
 (c) nucleoli and nuclei  
 (d) genes and RNA
- 41.** Mitochondria are not found in:  
 (a) human RBC (b) human liver cell  
 (c) human nerve cell (d) All of these
- 42.** Which of the cell organelle takes part in the formation of acrosome?  
 (a) Nucleus (b) Chromosome  
 (c) Golgi complex (d) Mitochondria
- 43.** Human cheek cells are commonly stained with  
 (a) methylene blue (b) safranin  
 (c) acetocarmine (d) eosine
- 44.** Name the stain which is commonly used to study plant cells:  
 (a) Methylene blue (b) Cotton blue  
 (c) Safranin (d) Acetocarmine
- 45.** When a plant cell is treated by cellulose and pectinate enzymes, which of the following is formed ?  
 (a) Chloroplast (b) Leucoplast  
 (c) Protoplast (d) None of these
- 46.** In a prokaryotic cell:  
 (i) enveloped genetic material is present.  
 (ii) ribosomes are absent.  
 (iii) an organised nucleus is absent.  
 The correct option is:  
 (a) Only (i) (b) Only (ii)  
 (c) Only (iii) (d) All of the above
- 47.** Mesosomes were taken as:  
 (a) Golgi bodies (b) Plastids  
 (c) Mitochondria (d) Endoplasmic reticulum
- 48.** Select incorrect statement about inclusion bodies in prokaryotes?  
 (a) These represent reserve food material.  
 (b) These are membrane bound bodies.  
 (c) These are found free in the cytoplasm of prokaryotic cells.  
 (d) Phosphate granules, cyanophycean granules and glycogen granules are examples of inclusion bodies.
- 49.** Order the following terms in a way that depicts how membranes are likely to move through the cell:  
 (i) ER (ii) nuclear envelope  
 (iii) Golgi apparatus (iv) vesicle  
 (v) plasma membrane  
 (a) (i), (ii), (iii), (iv), (v)  
 (b) (i), (iv), (ii), (iii), (v)  
 (c) (ii), (iii), (i), (iv), (v)  
 (d) (ii), (i), (iii), (iv), (v)

50. Lysosomes are specialised vesicles in \_\_\_\_\_ that contain digestive enzymes for the breakdown of food. A related organelle known as a vacuole, which is found in \_\_\_\_\_, also contains enzymes but in addition may act as a storage organelle for nutrients or water.
- (a) animals; plants and fungi  
(b) plants; animals and fungi  
(c) fungi; animals and plants  
(d) plants and fungi; animals
51. A segment of DNA contains 1200 nucleotides, of which 200 have adenine base. How many cytosine bases are present in this segment of DNA? [NTSE]
- (a) 100 (b) 200  
(c) 400 (d) 800
52. Which one of the following statements about cell organelles and their function is correct? [NTSE]
- (a) Mitochondria are associated with anaerobic respiration.  
(b) Smooth endoplasmic reticulum is involved in protein synthesis.  
(c) Lysosomes are important in membrane biogenesis.  
(d) Golgi bodies are involved in packaging and dispatching of materials.
53. The process in which water molecules moves from a high concentration to a region of low water concentration through a semi-permeable membrane is known as: [JSTSE]
- (a) osmosis (b) transpiration  
(c) diffusion (d) None of the above
54. Mitochondria are strange organelles as they have their own: [JSTSE]
- (a) nucleus (b) DNA  
(c) ribosome (d) Both (b) and (c)
55. The organelle which is primarily associated with storage of starch, oil and proteins etc are [JSTSE]
- (a) Leucoplasts  
(b) Inner membrane of Mitochondria  
(c) Endoplasmic reticulum  
(d) Ribosomes
56. The plasma membrane of the cells is mainly composed of: [JSTSE]
- (a) Sugars and lipids  
(b) Proteins and sugars  
(c) Proteins and Lipids  
(d) Sugars and fats
57. The smooth endoplasmic reticulum helps in the manufacture of: [JSTSE]
- (a) lipids (b) glycogen  
(c) sugars (d) proteins
58. Chromosomes are classified based on the position of centromere. A chromosome having a terminal centromere is called [KVPEY]
- (a) metacentric (b) telocentric  
(c) sub-metacentric (d) acrocentric
59. Eukaryotic organisms have different levels of organisation. Select the combination where the levels are arranged in the descending order. [NTSE]
- (a) DNA, chromosome, cell, nucleus, tissue  
(b) Tissue, cell, nucleus, chromosome, DNA  
(c) Nucleus, cell, DNA, chromosome, tissue  
(d) Tissue, cell, chromosome, nucleus, DNA
60. Which one of the following combinations of biomolecules is present in the ribosomes? [KVPEY]
- (a) RNA, DNA and protein  
(b) RNA, lipids and DNA  
(c) RNA and protein  
(d) RNA and DNA
61. Glycoproteins are formed in which one of the following organelles? [KVPEY]
- (a) Peroxisome (b) Lysosome  
(c) Golgi apparatus (d) Mitochondria
62. Choose one of the following alternative statements given below which correctly explains the process of osmosis. [NTSE]
- (a) Movement of water from regions of concentrated to dilute solutions.  
(b) The passage of solute from weak solution to strong solution through a selectively permeable membrane.  
(c) A passive transport of a solvent through a selectively permeable membrane from a region of low solute concentration to a region of high solute concentration.  
(d) An energy dependent transport of a solvent through a selectively permeable membrane from a region of low solute concentration to a region of high solute concentration.
63. Which of the following cell organelles do not have double membrane? [JSTSE]
- (a) Nucleus (b) Mitochondria  
(c) Lysosome (d) Plastid
64. Starch is stored in [JSTSE]
- (a) Aleuroplast (b) Amyloplast  
(c) Chromoplast (d) Chloroplast
65. Ribosomes are the centre for: [JSTSE]
- (a) Lipid synthesis (b) Protein synthesis  
(c) Photosynthesis (d) Respiration
66. Which cell organelles are capable of forming their own proteins? [JSTSE]
- (a) Mitochondria (b) Golgi apparatus  
(c) Plastids (d) Both (a) and (c)
67. A plant cell, an animal cell and a bacterial cell share the following structure features - [NTSE]

- (a) Cell membrane, Endoplasmic reticulum and Vacuole  
 (b) Cell wall, Plasma membrane, Mitochondria  
 (c) Cell wall, Nucleus and Cytoplasm  
 (d) Plasma membrane, Cytoplasm, Ribosome
- 68.** Select the incorrect option. [JSTSE]  
 (a) Anton von Leeuwenhoek first saw and described a live cell.  
 (b) Robert Brown later discovered the nucleus.  
 (c) Unicellular organisms are incapable of independent existence.  
 (d) All of the above
- 69.** Double hydrogen bonds occur in DNA between:  
 (a) adenine and thymine  
 (b) uracil and thymine  
 (c) adenine and guanine  
 (d) thymine and cytosine
- 70.** The structures that are formed by stacking of organised flattened membranous sacs in the chloroplasts are: [JSTSE]  
 (a) Grana (b) Stroma lamellae  
 (c) Stroma (d) Cristae
- 71.** Match the columns and identify the correct option. [JSTSE]
- | Column-I      | Column-II                              |
|---------------|--|
| A. Thylakoids | I. Disc-shaped sacs in Golgi apparatus |
| B. Cristae    | II. Condensed structure of DNA         |
| C. Cisternae  | III. Flat membranous sacs in stroma    |
| D. Chromatin  | IV. Infoldings in mitochondria         |
- (a) A – III; B – IV; C – I; D – II  
 (b) A – III; B – I; C – IV; D – II  
 (c) A – III; B – IV; C – II; D – I  
 (d) A – IV; B – III; C – I; D – II
- 72.** Microtubules are the constituents of: [JSTSE]  
 (a) Cilia, flagella and peroxisomes  
 (b) Spindle fibres, centrioles and cilia  
 (c) Centrioles, spindle fibres and chromatin  
 (d) Centrosome, nucleosome and centrioles
- 73.** Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP? [JSTSE]  
 (a) Ribosome (b) Chloroplast  
 (c) Mitochondrion (d) Lysosome
- 74.** Which of the following is true for nucleolus? [JSTSE]  
 (a) Larger nucleoli are present in dividing cells.  
 (b) It is a membrane-bound structure.  
 (c) It is a site for active ribosomal RNA synthesis.  
 (d) It takes part in spindle formation.
- 75.** Which of the following is not a product of light reaction of photosynthesis? [JSTSE]  
 (a) ATP (b) NADH  
 (c) Oxygen (d) NADPH
- 76.** Which of the following pair of organelles does not contain DNA? [JSTSE]  
 (a) Mitochondria and lysosomes  
 (b) Chloroplast and vacuoles  
 (c) Lysosomes and vacuoles  
 (d) Nuclear envelope and mitochondria
- 77.** Purines found both in DNA and RNA are: [JSTSE]  
 (a) Adenine and thymine  
 (b) Adenine and guanine  
 (c) Guanine and cytosine  
 (d) Cytosine and thymine
- 78.** Which of the following statements about inclusion bodies is incorrect? [JSTSE]  
 (a) These are involved in ingestion of food particles  
 (b) They lie free in the cytoplasm  
 (c) These represent reserve material in cytoplasm  
 (d) They are not bound by any membrane
- 79.** Which is the important site of formation of glycoproteins and glycolipids in eukaryotic cells? [JSTSE]  
 (a) Peroxisomes (b) Golgi bodies  
 (c) Polysomes (d) Endoplasmic reticulum
- 80.** Read the given paragraph and select the option that correctly fill the blanks. [Olympiad]  
 Vacuole is a space in the (i) of a cell which is enclosed by a (ii) membrane. Vacuole is filled with a liquid called (iii) which contains dissolved (iv) and (v).  
 (i) (ii) (iii) (iv) (v)  
 (a) Cytoplasm Single Cells sap Sugars Salts  
 (b) Cytoplasm Double Leucoplast Sugars Salts  
 (c) Nucleus Single Grana Lipids Sugars  
 (d) Protoplasm Double Matrix Lipids Salts
- 81.** Which of the given statements is not a function of plasma membrane? [Olympiad]  
 (a) It maintains individuality of the cell.  
 (b) It is impermeable therefore it prevents cell contents to mix with its environment.  
 (c) Its junctions help to keep the cells together.  
 (d) It protects the cell from injury.
- 82.** Given below are names of few cell organelles. [Olympiad]  
 Ribosome, Vacuole, Mitochondria, Plastids, Lysosome  
 How many of these are present only in plant cells?  
 (a) 1 (b) 2  
 (c) 3 (d) 4
- 83.** Figure given below is the schematic diagram of a cell organelle. Which of the following statements about the figure is true? [Olympiad]



- (a) The organelle shown is a chloroplast; the arrow points to a thylakoid
- (b) The organelle shown is the Golgi apparatus; the arrow points to a vesicle
- (c) The structure shown is a mitochondrion; the arrow points to a cristae
- (d) The structure shown is the Golgi apparatus; the arrow points to a cristae

84. Lipids and proteins constituting the cell membrane are synthesized at: [NTSE]

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

85. The cell organelle pertaining to energy release process is (a) Lysosome (b) Chloroplast (c) Mitochondria (d) Endoplasmic reticulum [NTSE]

86. Aadhya was asked by her teacher to list three basic features that are found in both prokaryotic and eukaryotic cells without exception. Which of the following options do you think can be Aadhya's correct answer? [Olympiad]

- (a) Endoplasmic reticulum, Nucleus, Cytoplasm
- (b) Cytoplasm, Plasma, membrane, Ribosome
- (c) Cell wall, Mitochondria, Cytoplasm
- (d) Plasma membrane, Mitochondria, Chloroplast

87. Ananya was asked by her teacher to write few points on phagocytosis. She wrote few statements. However one statement is incorrect. Identify the incorrect statements (s) and select the correct option. [Olympiad]

- I. It is the intake of extracellular particles.
- II. It is a nutritive and defensive process.
- III. Microfilaments play no role in it.
- IV. Cell membrane grows around the particle as pseudopodia.

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

88. The schematic diagram of the endoplasmic reticulum is shown here. Which of the following statements about ER is false? [Olympiad]



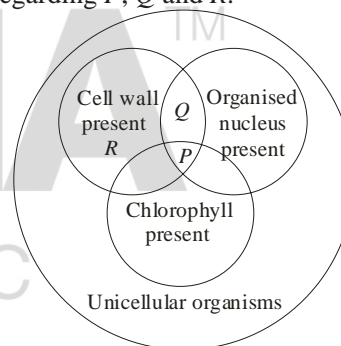
- (a) Cells that produce a lot of protein for export are packed with ER.
- (b) Carbohydrates are added to proteins to produce glycoproteins in the ER.
- (c) Ribosomes are located within the lumen of the Rough ER.
- (d) ER provides a pathway for the distribution of nuclear material from one cell to another.

89. Refer to the given figures and select the correct statement regarding them. [Olympiad]



- (a) P is double membrane bound cell organelle whereas Q, R and S are single membrane bound.
- (b) P is involved in synthesis of ATP whereas S is involved in synthesis of proteins.
- (c) Q is involved in storage of proteins whereas R is involved in synthesis of proteins.
- (d) R synthesises lipids whereas S is involved in storage of lipids.

90. Refer to the given Venn diagram and select the correct option regarding P, Q and R. [Olympiad]



- (a) P could be Chlamydomonas or Aspergillus.
- (b) Q could be Volvox or Penicillium.
- (c) R could be Lactobacillus or Nitrosomonas.
- (d) Q could be Clostridium and R could be Euglena.

91. Refer to the given figure and select the incorrect statement regarding X, Y, and Z. [Olympiad]



- (a) X is freely permeable to small molecules and ions
- (b) Y is arranged in characteristic pattern in different cells and bear oxysomes.
- (c) Z contains respiratory enzymes, lipids, RNA, etc.
- (d) None of these

# SOLUTIONS

## Brief Explanations of Selected Questions



### Let's Revise Through FIB & T/F

- |            |                     |
|------------|---------------------|
| 1. osmosis | 2. lipids, proteins |
| 3. True    | 4. cellulose        |
| 5. True    | 6. True             |
| 7. True    | 8. True             |
| 9. True    | 10. ATP             |
| 11. False  | 12. True            |

### EXERCISE-1

### Master Board

#### Multiple Choice Questions

- (b) 2. (d)
- (a) The Krebs cycle occurs in the mitochondrial matrix and generates a pool of chemical energy.
- (a) The shrinkage of a cell is occurred due to the hypertonic sugar solution, present in the surrounding medium. In hypertonic solution, the water concentration is less as compared to sugar concentration that causes the movement of water from inside to outside of the cell.
- (a) 6. (c) 7. (a) 8. (b)
- (d) All the given functions are related to cell wall. Cell wall is a very tough, flexible and fairly rigid layer that surrounds some types of cells. It surrounds the cell membrane and provides these cells with structural support and protection. It also acts as a filtering mechanism.
- (a)

#### Assertion & Reason Questions

- (c) Small cells are more efficient than large cells. As the cell grows in size, the distance between the surface of the cell and the center of the cell increases and this slows down the activity of the cell, therefore large cells are less efficient. The surface area to the volume ratio gets smaller as the cell gets larger.
- (c) Diffusion and osmosis both are the passive process that take place without the expenditure of energy. Thus A is true but R is false.
- (c) Mitochondria and chloroplast are semiautonomous cell organelles which are formed by division of pre-existing organelles, contain DNA and also contain protein synthesizing machinery. Thus A is true but R is false.

#### Passage/Case Based Questions

- Chromosomes are essential for the process of cell division, replication, division. Chromosomes are often called the 'packaging material' because it tightly holds the DNA and proteins together in the eukaryotic cells.

- DNA is a thread like material that is present in loose form in the matrix of the cell. During cell division, it becomes condense and form rod shaped chromosome.
- (i) Metacentric – Centromere is present in the middle of chromosome.  
(ii) Telocentric – Centromere is present at the end of the chromosome.
- (a) In human beings, 23 pairs of chromosomes i.e., 46 chromosomes are present.
- Chloroplast is situated in the mesophyll region of the leaves.
- Chloroplast performs the function to synthesize food by the process of photosynthesis.
- In chloroplast, protein synthesis occurs because in it, DNA and ribosome are present. Due to this, it is able to synthesis its own proteins. Therefore it is also called a semi-autonomus cell organelle.
- (a) Chloroplast is present in plant cell. In animal and bacterial cell, it is absent.

#### Very Short Answer Questions

- It regulates the movement of ions and molecules into and out of the cell.
- ATP (Adenosine Triphosphate)
- Bacteria and blue green algae.
- The smallest cell is Mycoplasma (PPLO) and the largest cell is Ostrich egg.
- (a) Mitochondria (b) Plastid (chloroplast)  
(c) Centrosome (d) Nucleus
- Deoxyribonucleic acid (DNA).  
Ribonucleic acid (RNA)
- Cell is the structural and functional unit of life. Robert Hooke coined the term 'cell'.
- Lipid (phospholipids), proteins and small quantity of carbohydrates.
- Protoplasm refers to the colourless semifluid mass comprising the living part of a cell including the cytoplasm, nucleus and other organelles which are often compartmentalised to perform different functions of life.
- The nuclear region in some cells that are poorly defined due to the absence of a nuclear membrane. It contains only nucleic acid. This undefined nuclear region with nucleic material is called nucleoid.
- Osmotic solution is the one which can cause osmosis if separated from its solvent by a semipermeable membrane.
- Endosmosis is the osmotic entry of water into a cell due to the presence of hypotonic solution in the surrounding.



13. Selectively permeable membrane allows the passage of solvent and some selected solutes in and out of the cell.
14. Exosmosis is the osmotic exit of water from a cell due to presence of hypertonic solution in the surrounding.
15. Cell organelles which contain their own DNA which replicate independently and ribosomes, which are protein synthesis factory are said to semi-autonomous. Mitochondria is semi-autonomous or partly independent.
16. The water concentration is more inside the cell than outside the cell hence, and water diffuses out of the cell.
17. The cell will die because mitochondria are the sites of respiration and contain various respiratory enzymes.
18. (a) Golgi bodies are involved in storage, modification and packaging of substances.  
(b) Vacuoles help to provide turgidity and rigidity to the cell.
6. (a) Plant cell wall is considered as non-living due to the presence of cellulose.  
(b) It is permeable because it is made of cellulose which is permeable to water, solutes and gases.  
(c) Plant cell wall is chiefly composed of insoluble fibrous polysaccharide, cellulose (carbohydrate). Certain other compounds (hemicellulose, pectins and proteins) also occur in the cell wall.
7. (a) Mitochondria and chloroplast.  
(b) Mitochondria contain their own DNA and ribosomes. Hence, they are capable of self duplication and also able to synthesise some of their own proteins. Therefore, they are regarded as semiautonomous organelles.  
(c) Chlorophyll pigments are found in thylakoids of chloroplasts in a plant cell.
8. Eukaryotes have different cell organelles which contain different enzymes, so that enzymes do not mix and interact with the cytoplasm of the cell. While Prokaryotes do not have such organelles. This arrangement allows for greater diversity in types of enzymes and reactions, hence greater diversity is found in eukaryotes.

### Short Answer Questions

1. (A) Mitochondria (B) Lysosome  
(C) Ribosome (D) Nucleus  
(E) Chloroplast
2. Rough ER consists of cisternae with numerous ribosomes on its outer surface, whereas smooth ER lacks ribosomes and is mostly tubular. Rough ER is involved in protein synthesis while smooth ER is involved in the synthesis of lipids.
3. Osmosis is a special type of diffusion because both the process involve movement of molecules of substance from the region of its higher concentration to the region of its lower concentration. In osmosis only water moves across a semi-permeable membrane while in diffusion, gases moves from one place to other place.
4. (a) Chief controlling centre of cell ; houses DNA  
(b) Center of packaging and secretion  
(c) Degrade debris, recycle cell contents  
(d) Organelle in which energy transformation occur.  
(e) Site of photosynthesis or food synthesis.  
(f) Contain enzymes that help in oxidation reaction of the cell.
5. (a) Hypertonic solution is the one which has higher solute osmotic concentration and less solvent concentration as compared to other solution.  
(b) Hypotonic solution is the solution that possesses lower (solute) concentration and higher solvent concentration as compared to other solution.  
(c) Isotonic solution is the solution that has the same concentration of solute (osmotic) as well as solvent, as that of other solution.
9. In plant cell, vacuoles :  
(a) Provide rigidity to the cell.  
(b) Store waste products, and useful substances like amino acids, sugars, organic acids, proteins, minerals and pigments.  
In animal cell,  
(a) In unicellular organisms like *Amoeba* food material is enclosed in vacuoles, called the food vacuole.  
(b) Contractile vacuoles expel water by the process osmo- regulation and waste products by process excretion from the cell.
10. One function of proteins embedded in the plasma membrane is to form gateways that allow selective passage of ions and molecules in and out of the cell. This allows wastes to be removed and entry of needed substances. Another function is to recognise changes in the outside environment and to communicate with other cells for the quick response of the change occurred.
11. (a) Nuclear envelope, nuclear sap, chromatin material, nucleolus and nuclear matrix.  
(b) Chromosomes are rod-like structures usually present in the nucleus and become visible only during cell division. Each chromosome is made up of DNA and proteins.  
(i) Chromosomes contain hereditary information of the cell in form of genes,  
(ii) DNA of chromosomes also controls all the activities of the cell.

12. Nucleus controls and coordinates all the metabolic functions of the cell so it is called director of the cell.
13. Dry apricot swell up in water because their cells have a high osmotic concentration as compared of water that causes passage of water into them i.e., endosmosis. They do not swell up when placed in salt solution because the external solution is hypertonic i.e., more concentrated as compared to apricot matrix.
14. There will be no change in the size of both the eggs. In case of raw egg, shell acts as an impermeable covering. and the boiled egg does not show any change because its membranous covering has become dead.
15. Mitochondria use molecular oxygen and bring about stepwise oxidation of food stuffs (carbohydrates, fats, proteins) present in the cells to produce carbon dioxide and water. Oxidation of food releases energy which is temporarily stored to form high-energy ATP molecules. ATP is used to bring about energy-requiring activities of the cell. On this account, mitochondria are called 'power houses' of the cell and ATP as the 'energy currency' of the cell.
16. (a) Application of excess fertiliser (i.e., urea) in green grass lawn will kill grass plants due to exosmosis and plasmolysis.
- (b) Application of salt to mango pieces will release water (sap) due to exosmosis. Consequent less moisture in fruit protects the cut pieces of mango from bacterial and fungal attack (i.e., it helps in the process of food preservation).
17. Lysosomes remove the dead cells and debris that accumulate during injury by digesting them and thus make a way for their replacements. Thus, they are also called 'natural scavengers' and 'cellular housekeepers'.
18. Chloroplast is a semiautonomous cell organelle of plant cells which on illumination can perform its function of photosynthesis and release oxygen even outside the cell provided it is kept in isotonic medium and receives raw material of carbon dioxide.
19. (a) On cell division, chromatin network organise themselves into chromosomes.
- (b) Chloroplast is a plastid. It contains a green pigment called chlorophyll which is responsible for photosynthesis.
- (c) The functional segments of DNA are called **genes**.
20. (a) As per its affinity for DNA and RNA, methylene blue will produce a darker stain leading the DNA in the nucleus to stand out so that nucleus can be clearly seen.

- (b) On boiling, all the cells of rheo leaves become dead. On adding sugar syrup nothing will happen as liquid cannot pass through dead cell membrane.
- (c) When RBC are kept in concentrated solution, the water will come out and the cell will shrink as the concentration of solution outside is higher than inside of the cell.

### Long Answer Questions

1.

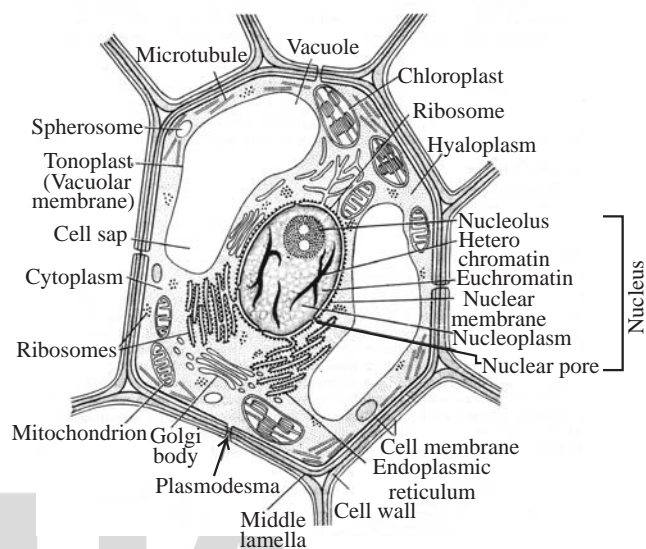


Fig. A plant cell (Electron microscopic structure)

2.

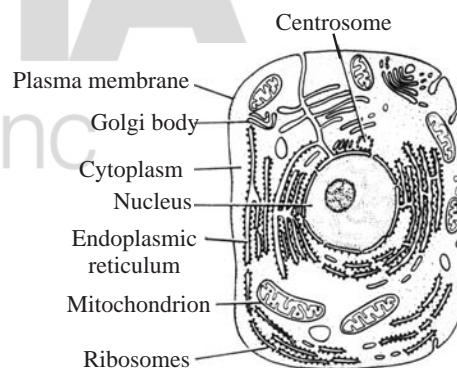


Fig. An animal cell

3. The membrane consists of a bilayer of phospholipids in which a variety of proteins are embedded. There are three major categories of membrane proteins:
- Transport proteins, which regulate the movement of most water-soluble substances through the membrane.
  - Receptor proteins, which bind molecules in the external environment, trigger changes in the metabolism of the cell.
  - Recognition proteins, which serve as identification tags and attachment sites.

The structure of plasma membrane is related to the functions of membrane, which are as follows-

- (i) It selectively isolates the cytoplasm from the external environment.
  - (ii) It regulates the flow of materials in and out of the cell.
  - (iii) It communicates with other cells.
4. The nucleus typically consists of following components:
- (i) **Nucleus envelope** : It is in form of two nuclear membranes, together referred to as nuclear envelope. The two nuclear membranes are designated as outer membrane and inner membrane.
  - (ii) **Nuclear sap** : It is a clear, fluid material present in the nucleus, also termed as nucleoplasm. It contains raw materials, enzymes, proteins and metal ions for the synthesis of nucleic acids (DNA and RNAs) and ribosomal sub-units.
  - (iii) **Chromatin material** : It occurs in a non-dividing form as fine filaments termed as chromatin fibres. These fibres lie criss cross and give the appearance of a diffuse network. Chromatin fibres help in cell division due to condensation of chromatin material. These are made up of DNA and proteins. The DNA possesses all the necessary information for the cell to function, grow and divide properly. The specific segments of DNA are termed genes. These are the hereditary units.
  - (iv) **Nucleolus** : There is/are one or more rounded bodies called **nucleoli** (singular : nucleolus) are present in the nucleoplasm. These are the site of ribosome synthesis.
5. The chloroplasts of higher plants are usually spherical, ovoid, discoidal or lens shaped. Each chloroplast is a vesicle bounded by double membrane envelope and filled with a fluid matrix like the mitochondrion. The outer membrane is smooth and freely permeable to small molecules. Inner membrane is, however, selectively permeable. It has carrier proteins that control the passage of molecules. It is greatly infolded but the infolds become free in the mature chloroplast to lie as lamellae in the matrix.

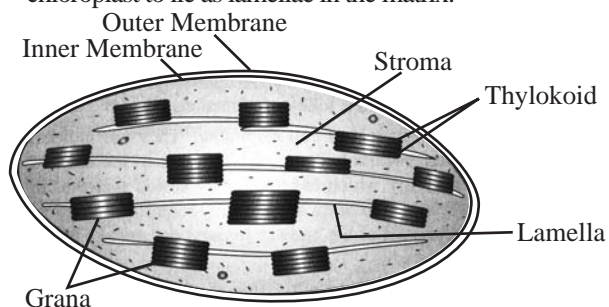


Fig. Diagrammatic representation of sectional view of chloroplast

Plastids perform many important functions :

- (i) The chloroplasts trap the radiant energy of sunlight and convert it into the chemical energy which is used in the process, called photosynthesis. Photosynthesis refers to the formation of food (glucose) from carbon dioxide and water in the presence of sunlight.
  - (ii) The chromoplasts impart various colours to flowers to attract insects for pollination and to the fruits for alluring certain animals for seed dispersal.
  - (iii) Leucoplasts store food in the form of starch (carbohydrates), fats and proteins.
6. (a) The ER is an extensive network of intracellular membrane-bound tubes and vesicles that occupies most of the cytoplasm in almost all eukaryotic cells.
- (b) The membranes of endoplasmic reticulum system are lipoproteinic in nature similar in structure to the plasma membrane. The ER is more prominent in young and dividing cells as compared to older cells. It is absent in prokaryotic cells.
- (c) ER is of two types-
- (i) Rough endoplasmic reticulum (RER)
  - (ii) Smooth endoplasmic reticulum (SER)
- (d) The SER brings about detoxification in the liver, i.e., it metabolises various toxic and poisonous substances such as drugs, insecticides, pollutants and poisons.
- (e) The endoplasmic reticulum helps in the manufacture of fat molecules or lipids and proteins which are important for the cell function. These proteins and lipids helps in the building of the cell-membrane. This process is known as **membrane biogenesis**.

### HOTS Questions

1. (a) A plant cell, when placed in a hypotonic solution, receives water by osmosis. It does not burst because it is surrounded by a rigid cell wall which can withstand the turgor pressure created due to the turgidity of the cell contents.
  - (b) When a fully turgid plant cell is placed in a hypertonic solution, the cytoplasm along with plasma membrane shrinks and separates from the cell wall as water comes out from the vacuole of the cell. This phenomenon is called **plasmolysis**.
2. (a) Fresh water unicellular organisms (e.g. *Amoeba*) continuously gain water in their bodies due to osmosis. These organisms have contractile vacuoles to throw out excessive water from their bodies.

- (b) (i) Absorption of water by the plant roots from the soil through root hairs occurs by the process osmosis.
- (ii) In plants, cells, tissues and soft organs (leaves, young shoots, flowers) maintain turgidity due to osmotic absorption of water.
3. Nucleus contains chromosomes which contain genes. Genes are the small segments of DNA which contain the information necessary for constructing and organising cells. Genes produce specific proteins and enzymes by sending messages through RNA into cytoplasm. If nucleus is removed, all metabolic activities of the cell will cease to occur.
4. (a) A prokaryotic cell  
(b) Nucleoid  
(c) Ribosomes  
(d) (i) Cell wall (ii) Plasma membrane
5. Vacuoles store primary metabolites, reserve proteins, and anthocyanins. In addition, vacuoles are involved in the breakdown of organelles and macromolecules, thus facilitating the recycling of chemical elements within the cell.

## EXERCISE-2

## NCERT Questions

## Intext - Book Questions

1. Robert Hooke discovered cells. In 1665 under a self-designed microscope, he examined a thin slice of cork. The cork resembled the structure of a honey comb consisting of many little boxes. These little boxes were termed cells by Hooke.
2. Cell is called structural and functional unit because all the living organisms are made up of cells. Each living cell has the capacity to perform certain basic functions of all living forms. Each kind of cell organelle performs a special function such as making new cell, clearing waste materials, utilization of energy in various metabolic reactions. These organelles together constitute the basic unit of structure and function called, the cell.
3. **Movement of CO<sub>2</sub>** : Substances like CO<sub>2</sub> and oxygen move in and out of the cell through plasma membrane by diffusion. When concentration of CO<sub>2</sub> is low outside the cell, CO<sub>2</sub> moves out of the cell by diffusion and vice versa.
- Movement of water :**  
Movement of water is affected by amount of substance dissolved in water. Water moves from a region of high water concentration to a region of low water concentration by osmosis.
4. Plasma membrane permits the entry and exit of selected materials. It also prevents movement of some other materials. Therefore, the plasma membrane is called **selectively permeable membrane**.

5.

	Prokaryotic Cell		Eukaryotic Cell
1.	Size: generally small (1-10 $\lambda\text{m}$ ) $1 \lambda\text{m} = 10^{-6}\text{m}$	1.	Size: generally large (5-100 $\lambda\text{m}$ )
2.	Nuclear region: Poorly defined and without nuclear membrane, known as <b>nucleoid</b>	2.	Nuclear region: well defined and surrounded by a nuclear membrane
3.	Chromosome: single	3.	More than one chromosome
4.	Membrane-bound cell organelles are absent	4.	Membrane bound cell organelles are present

6. In case of any physical or chemical injury of the cell, lysosomes become active. They burst and their digestive enzymes digest the whole cell. Ultimately, the cell will die.
7. Lysosomes are cell organelles which contain digestive enzymes capable of breaking down all organic materials. In case of any damage to the cell, lysosomes burst and release the enzymes which digest the other cell organelles and finally the whole cell. So, they are called "suicide bags"

## Text Book Questions

1. All living organisms are composed of cells which are the structural and functional units of life. Although the cells are similar in structure and function in all living organisms, plant cells are different from animals cells in some respects.
- A comparative study of plant and animal cell shows the presence of plasma membrane, cytoplasm with cell organelles like endoplasmic reticulum, golgi apparatus, lysosomes, vacuoles, mitochondria etc. Nucleus with nuclear membrane and chromatin material is also seen. Major points of differences between plant and animal cells are as follows:

	Plant cell	Animal cell
(i)	A rigid and protective cell wall of cellulose is present outside the plasma membrane. Cell wall provides a definite shape to the plant cell.	Cell wall is absent.
(ii)	Cytoplasm has plastids which contain green coloured pigment called chlorophyll.	Animal cell lack plastids.

(iii)	Large sized vacuoles are present which provide rigidity and turgidity to the cell.	Small vacuoles are present.
(iv)	Centriole is absent.	Centriole is present.

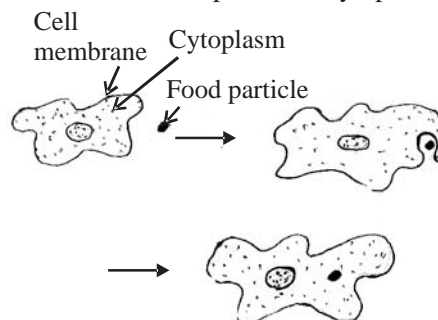
2. On the basis of presence or absence of a well organised nucleus, cells are of two types– Prokaryotic and Eukaryotic.

**Differences between prokaryotic and eukaryotic cell are as follows :**

Prokaryotic cell	Eukaryotic cell
(i) Lacks well organised nucleus surrounded by nuclear membrane. Such a nucleus is called nucleoid.	(i) Well organised nucleus surrounded by nuclear membrane is present.
(ii) Membrane-bound cell organelles is absent.	(ii) Membrane-bound cell organelles is present.
(iii) Single chromosome present.	(iii) More than one chromosome present.
(iv) Small in size.	(iv) Large in size.

3. Presence of plasma membrane is so crucial for a cell that we can't even imagine the existence of a cell without it. In case of any damage to the plasma membrane, the cellular metabolism get disturbed. Lysosomes become active and they burst. Their digestive enzymes digest the other cell organelles and finally the whole cell dies *i.e.*, the cell suicides.
4. Mitochondria is also known as the power house of the cell because here energy rich compound ATP or adenosine triphosphate is produced which is required by body to carry out various metabolic activities.
5. The lipids and proteins constituting the cell membrane get synthesised in endoplasmic reticulum present in cytoplasm. Rough endoplasmic reticulum containing ribosomes synthesise proteins while smooth endoplasmic reticulum synthesise lipids. The process of building cell membrane with those lipids and proteins is called 'membrane biogenesis'.
6. In the absence of golgi apparatus, the transport of proteins and lipids, which are synthesised near rough and smooth endoplasmic reticulum inside and outside the cell will stop. The essential materials synthesised inside the cell will not reach to the target where they are required. So the various activities carried out by different parts of the cell will be affected. Other functions of the cell like storage and packaging of products by vesicles and formation of complex sugars will also affected. Lysosomes would not be produced and bacteria could attack and destroy the cell as there will be no digestive enzymes of lysosomes to digest them.

7. The flexible nature of cell membrane helps unicellular *Amoeba* to engulf food by the process called **endocytosis**. Whenever, *Amoeba* comes in contact with a food particle, its cell membrane along with cytoplasm grows in that direction. Finally it surrounds the food and make it a part of its cytoplasm.



**Fig.-Intake of food by *Amoeba* (Endocytosis)**

8. The movement of water through a selectively permeable membrane from a region of high water concentration to a region of low water concentration is called osmosis. It is a kind of diffusion. *E.g.* unicellular fresh water organisms and plant roots absorb water by osmosis. Entry of water in a cell is called endosmosis and movement of water outside the cell is called exosmosis.
9. (i) In cups B and C the concentration of solution becomes more (due to sugar and salt) as compared to the outer surrounding. So, endosmosis will occur *i.e.*, the water will move inside the hollow portion.  
 (ii) To show that when the concentration is same on both sides, there is no movement of water.  
 (iii) The water does not gather in cup A due to the same concentration of solution.  
 The water does not gather in cup D because boiling kills the cells and dead cells are unable to absorb water by osmosis.
10. There are two way in which a cell divides:
- Mitosis
  - Meiosis
- Mitosis is a type of cell division that is involved in the growth and repair of the body, whereas meiosis is a type of cell division which results in the formation of gametes.
- Exemplar Questions**
1. (c) Viruses are considered as an intermediate between living and non-living cells because they cannot metabolise and reproduce on their own. They can reproduce only when enters in a host's body. They are an exception to cell theory. A virus crystal is a collection of thousands of viruses.

2. (b) Osmosis is a spontaneous process where movement of solvent molecules occurs into a region of higher solute concentration from lower solute concentration through a partially permeable membrane.
- When movement of the solvent takes place from outside to inside of the cell (inward movement) the process is endosmosis. It occurs in hypotonic solution and causes the swelling of cell.
3. (c) Chromosomes are thread-like structures usually present in the nucleus which becomes visible only during cell division. Each chromosome is made up of two components:
- Deoxyribonucleic acid (DNA)
  - Proteins (e.g., histones and acidic proteins)
- These consist of two (unreplicated) or four (duplicated) arms and a primary constriction or centromere which gives them a particular shape due to its position. The paired form of chromosome is called diploid and unpaired chromosome are called haploid.
4. (NA) Ribosomes are the sites of protein synthesis. The proteins synthesised by ribosomes may be used in the formation of new cell membranes (membrane biogenesis) or may function as enzymes and hormones. Among, the given functions, only (iv) *i.e.*, help in manufacture of starch molecules is not a function of ribosomes. Therefore, no option is correct.
5. (c) Endoplasmic reticulum (E.R.) exists as a membranous network, which is connected to the outer membrane of nucleus from one side and plasma membrane to the other.
- It is of two types, smooth endoplasmic reticulum (S.E.R.) *i.e.*, without ribosomes on its surface and rough endoplasmic reticulum (R.E.R.) with ribosomes on its surface.
6. (a) Osmosis is the passage of water from region of high water concentration through semipermeable membrane to a region of low water concentration. Unicellular freshwater organisms and most plant cells tend to gain water through osmosis. Absorption of water by plant roots is also an example of osmosis.
7. (b) When a cell is placed in a hypertonic solution *i.e.*, a solution in which concentration of water molecules concentrated is less than the concentration of water molecules inside the cell, the cell will loss water by the process of osmosis (exosmosis), resulting in the shrinkage of cell cytoplasm. This phenomenon of shrinkage of cell cytoplasm is called **plasmolysis**.
8. (c) Lysosomes are simple, tiny spherical sac-like structures evenly distributed in the cytoplasm each lysosome is surrounded by a double membrane and contains powerful enzymes capable of digesting or breaking down all organic material. These enzymes are made by rough endoplasmic reticulum.
9. (d) Along with the function of secretion of various enzyme proteins and producing vacuoles, Golgi apparatus is also involved in the synthesis of cell wall, plasma membrane and lysosome.
- Nucleus, mitochondria and plastids have their own genome (DNA) and ribosomes. They are self replicating organelles, they have power to divide and are able to synthesise their own structural protein (semi autonomous organelles). Mitochondria is site of cellulose respiration and synthesis of energy rich compounds (ATP). Therefore it is called as power house of the cell. The part of cell which between the plasma membrane and nuclear envelope is called the cytoplasm.
10. (a) The undefined nuclear region is the cytoplasm of prokaryotic cells is called nucleoid. The prokaryotic cells consist of a single chromosome, which is direct content of the cytoplasm, there is no nuclear envelope separates the nucleus from the cytoplasm. The nuclear envelope contains many pores (the nuclear pores) and encloses the liquid ground substance, the nucleoplasm. Within nucleoplasm two types of nuclear structures are embedded—the nucleolus and chromatin material.
11. (c) Smooth endoplasmic reticulum (SER) plays a crucial role in detoxifying many poisons and drugs in a cell by metabolising the toxic substances such as aspirin, insecticides, petroleum products, pollutants etc.
12. (a) The endoplasmic reticulum performs the following functions:
- It is associated with the synthesis, storage and transport of metabolic products.
  - It helps in the formation of the cell plate and nuclear membrane during cell division.
  - Rough Endoplasmic Reticulum (RER) is associated with the synthesis of proteins.
  - Smooth Endoplasmic Reticulum (SER) secretes liquids which along with proteins constitute cell membrane by a process called membrane biogenesis.
13. (d) The prokaryotic cells lack true nucleus and a circular DNA lies naked in the cytoplasm. The unidentified nuclear region of the cell is called nucleoid. The prokaryotic cell lacks chromosomes and nucleolus or nuclear membrane and nucleoplasm remains undifferentiated from the cytoplasm.

14. (d) 15. (d) 16. (b)
17. (a) Plant cells, in addition to the plasma membrane, have another rigid outer covering called the cell wall. The cell wall lies outside the plasma membrane. The plant cell wall is mainly composed of cellulose. Cellulose is a complex substance and provides structural strength to plants. Bacteria is not a plant therefore its cell wall is made up of peptidoglycan.
18. (b) Camillo Golgi (1898) discovered a method of staining individual nerve cells and other cell structures by using a weak solution of silver nitrate. Camillo Golgi discovered Golgi apparatus while he was examining the nerve cells of barn owl. Silver nitrate solution has been used since then to stain Golgi apparatus.
19. (c) Other than nucleus, mitochondria contains DNA and are able to synthesis their own proteins they are regarded as semiautonomous organelles.
20. (c) 21. (a)
22. (b) In 1938 Schleiden proposed the idea that plants consist of cells. Later in the year 1839, Schwann independently asserted that all animals and plants are made up of cells. This joint finding forms the basis of cell theory.  
The cell theory was refined further in 1855, when R. Virchow presented the idea that all cells arise from pre-existing cell.
23. (a)
24. (b) A prokaryotic cell lacks membrane-bound organelles like plastids, mitochondria and endoplasmic reticulum but smaller scattered ribosomes are seen.
25. (a) Nucleus is surrounded by two nuclear membranes both forming a nuclear envelope; Golgi apparatus is a set of membrane-bounded, fluid filled vesicles, vacuoles and flattened cisternae. Plastids are also membrane bound organelle but ribosomes moves freely in the matrix or remain attached to the endoplasmic reticulum.
26. (a) The micrometer commonly known as micron is SI derived unit of length equalling to  $10^{-6}$  of a metre.
27. (b) 28. (c)
29. (d) Plasma membrane is a living, thin, elastic, selectively permeable membrane which chemically consists of lipids (20-79%), proteins (20-70%), carbohydrates (1-5%) and water (20%). Chitin sugar is not present in the plasma membrane of plants
30. (c) Cells of onion peel are surrounded by a cell wall whereas the RBCs (red blood cells) do not have cell wall. When the cells of onion peel and RBCs are separately kept in hypotonic solution, RBCs will first swell up and then burst due to endosmosis. However, cell wall in the cells of onion peel exerts a counter wall pressure when the cells become fully turgid. This stops further entry of water into the cells and thus the cells do not burst.
31. Yes; cell is a building unit of an organism as every living organism is made up one or more cells. In unicellular organisms, single cell performs all the functions of life. However, in multicellular organisms, cells become specialized to form tissues; tissues form organs and various organs are grouped into organ-systems, each with a specific function. However, in all these hierarchical units, cell remains the basic building unit of the organism.
32. The phenomenon responsible for such situation is exosmosis. Concentrated solution of salt is hypertonic to the cells of our body. When a person drinks concentrated salt solution, water comes out of the cells of the alimentary canal (stomach, intestine etc.) by the process of exosmosis causing a loss of water in the cells. This results in dehydration, diarrhoea and vomiting.
33. Absorption is the process by which nutrients pass from the alimentary canal into the blood and lymph. The mechanisms involved in the absorption of digested food are simple diffusion, facilitated diffusion and active transport. Glucose and some amino acids are absorbed by active transport and some by facilitated diffusion, fatty acids and glycerol are absorbed by simple diffusion and water is absorbed by osmosis.
34. Addition of salt during cooking makes the surrounding medium hypertonic *i.e.*, the surrounding medium has lower water concentration than the cells of vegetables. Due to this water leaves the cell by the process of exosmosis resulting in its shrinkage. Therefore, vegetables release water after adding salt during cooking process.
35. A bacterial cell is a prokaryotic cell which contains a poorly defined region called **nucleoid**. All the membrane-bound cell organelles are absent in the prokaryotic cell while an onion peel cell is a eukaryotic plant cell which contains a well defined nucleus and all the membrane-bound cell organelles such as mitochondria, ER, etc.
36. (a) Leucoplasts are more common in non-photosynthetic organs such as roots of the plant.  
(b) Chloroplasts are more common in green photosynthetic parts such as leaves of the plant.  
(c) Chromoplasts are more common in colourful parts such as flowers and fruits of the plant.

## EXERCISE-3

## Foundation Builder

## Multiple Choice Questions

1. (a) 2. (a) 3. (a) 4. (a) 5. (c) 6. (c)
7. (b) 8. (a) 9. (b) 10. (a) 11. (d) 12. (c)
13. (b) Guard cells have both nucleus and chloroplasts.
14. (b) 15. (d) 16. (a) 17. (d) 18. (b) 19. (d)
20. (b) 21. (d) 22. (a) 23. (a) 24. (c) 25. (b)
26. (b)
27. (d) ER or endoplasmic reticulum helps in membrane biogenesis by helping in the formation of lipids, proteins and steroids which are important for it.
28. (c) 29. (c) 30. (a) 31. (c)
32. (a) Mitochondria are known for generating energy for the cell in the form of ATP (adenosine triphosphate) by using nutrients and oxygen while chloroplast is present in green plants where the process of photosynthesis occurs. So, both the organelles are not same in process of energy production.
33. (b) 34. (a) 35. (d) 36. (c) 37. (d) 38. (a)
39. (b) The function of endoplasmic reticulum is not related with digestion or egestion of foreign bodies but it detoxifies harmful chemicals, manufactures fat and lipid molecules and helps in biogenesis of membranes. It transports the synthesised proteins to different parts of cells and tissues.
40. (b) Two sisters looked exactly same due to the similar genes present in them. Genes carry genetic informations or characters that passed on from parents to offsprings.
41. (a)
42. (c) Acrosome develops over the anterior half of the head in the sperm. This part of sperm cell is formed by an organelle known as Golgi apparatus.
43. (a) Methylene blue has the affinity for DNA and RNA and produce a darker stain in areas where those components are present. In the case of the human cheek cell, methylene blue causes the DNA in the nucleus to stand out so that the nucleus can clearly be seen in a light microscope.
44. (c)
45. (c) Cellulase and pectinase are the enzymes that degrade the cellulose and pectin, present in plant cell wall. After the degradation of cell wall, protoplasm will remain. Protoplasm refers to a living plant or bacterial cell whose cell wall has been removed.
46. (c) In prokaryotes, a nucleus is absent but nucleoid is found which is equivalent to a single chromosome or prochromosome.
47. (c)
48. (b) Inclusion bodies are not bound by any membrane system.
49. (d) The typical flow of membrane within the cell is from nuclear envelope to rough ER, from rough ER to Golgi apparatus, and from Golgi apparatus to plasma membrane. Membrane movement between nuclear envelope, Golgi apparatus, and ER is via vesicles.
50. (a) Lysosomes are present in animals because of their special need for internal digestion of macromolecules. Plants and fungi store some enzymes in their large vacuoles.
51. (c) There are 1200 nucleotides in DNA. In DNA, adenine binds with double hydrogen bond to thymine and cytosine binds with triple hydrogen bond to guanine.
 
$$\begin{array}{l} A \equiv T \\ G \equiv C \end{array}$$

Since, in this DNA there are 1200 nucleotides, it means the sum of Adenine, guanine, thymine and cytosine is 1200 and the amount of thymine is also 200 [equal to the amount Adenine]

$$\begin{aligned} \text{Adenine} + \text{Guanine} &= \text{Thymine} + \text{Cytosine} \\ \text{Adenine} + \text{Guanine} &= \frac{1200}{2} = 600 \\ \text{Guanine} &= 600 - \text{Adenine} \\ &= 600 - 200 = 400 \end{aligned}$$

Thus, there will be 400 guanine and 400 cytosine in the DNA.
52. (d) Golgi bodies are involved in packaging and dispatching of materials. Mitochondria are the sites of aerobic respiration. Rough endoplasmic reticulum is involved in protein synthesis. Lysosomes contain hydrolytic enzymes.
53. (a) Osmosis is a process in which water moves from its high concentration to low concentration across a semipermeable membrane.
54. (d) Mitochondria has both DNA and ribosomes.
55. (a) Leucoplasts associated with the storage of starch (Amyloplast), oil (Elaioplast) and protein (Proteinoplast).
56. (c) Plasma membrane is a lipid bilayer in which proteins are embedded.
57. (a) SER are involved in the manufacture of lipids and steroids.
58. (b) 59. (b)



- 60. (c)** Ribosomes consist of two biomolecules (*i.e.*, RNA and proteins). In *E. coli*, they contain 34% protein and 66% RNA, while in eukaryotes, they contain 40% protein and 60% RNA. Chemical composition of large subunit is different from that of small subunit.
- 61. (c)** Glycoproteins are formed in the Golgi apparatus of the cell. Glycoproteins are proteins that contain covalently attached sugar residues. Glycoproteins are present at the surface of cells where they function as membrane proteins and play a role in cell to cell interactions.
- 62. (c)** Osmosis is the movement of a solvent or water through semipermeable membrane into a solution of higher solute concentration that tends to equalise the concentrations of solute on both the sides of the membrane.
- 63. (c)** Lysosome is a single membrane bound organelle while nucleus, mitochondria and plastid have double membranes.
- 64. (b)** Starch is stored in amyloplast.
- 65. (b)** Ribosomes help in protein synthesis.
- 66. (d)** Mitochondria and plastids both contain their own DNA and ribosomes, so they are capable of forming their own proteins.
- 67. (a)** The swim bladder or air bladder is a gas - filled internal organ which regulates buoyancy and prevents the sinking of most fishes.
- 68. (c)** Unicellular organisms are capable of independent existence and performing the essential functions of life.
- 69. (a)**
- 70. (a)** In chloroplasts which are green coloured plastids, thylakoids are arranged in stacks like the pile of coins called grana.
- 71. (a)**
- 72. (b)** Microtubules are long, hollow cylinders, part of a structural network (the cytoskeleton) within the cell's cytoplasm. Role of the microtubule cytoskeleton includes mechanical support, organisation of the cytoplasm, transport, motility and chromosome segregation so they are present in cilia and flagella for cellular movement, in centrioles for chromosomal movement and in spindle fibres, for chromosomal movement during nuclear division.
- 73. (c)** The site of aerobic oxidation of carbohydrates in cells to generate ATP is mitochondria.
- 74. (c)** The nucleolus (plural nucleoli) is a large, distinct, spheroidal subcompartment of the nucleus of eukaryotic cells and the site of ribosomal RNA (rRNA) synthesis and assembly of ribosomal subunits.
- 75. (b)** ATP, NADPH and oxygen are products of light reaction, while NADH is a product of respiration process.
- 76. (c)** Lysosomes and vacuoles do not contain DNA.
- 77. (b)** Purines, a heterocyclic compound, such as adenine and guanine are found both in DNA and RNA.
- 78. (a)** Inclusion bodies are nuclear or cytoplasmic aggregates which are stainable substances, usually proteins, and formed due to viral multiplication or genetic disorders in human beings these bodies are either intracellular or extracellular abnormalities and they are specific to certain diseases. These are not involved in ingestion of food particles.
- 79. (b)** Golgi bodies are site of formation of glycoproteins and glycolipids in eukaryotic cells.
- 80. (a)** Vacuole is a space in the cytoplasm of a cell which is enclosed by a single membrane. Vacuole is filled with a liquid called cell sap which contains dissolved sugar and salts.
- 81. (b)** Plasma membrane is selectively permeable in nature. It regulates the flow of selected materials between the cell and extracellular fluid.
- 82. (a)** Plastids are present in plant cells only while ribosome, vacuole, mitochondria and lysosome are present in both plant and animal cells.
- 83. (b)** The figure shows golgi apparatus and the arrow is showing towards the vesicle.
- 84. (a)** The endoplasmic reticulum bearing ribosomes on their surface called Rough Endoplasmic Reticulum (RER) which are actively involved in protein synthesis. The Smooth Endoplasmic Reticulum (SER) is the major site for synthesis of lipid. In animal cells, steroidal hormones synthesized in SER.
- 85. (c)** In the Aerobic respiration the complete oxidation of glucose takes place in mitochondria and energy is stored in the form of ATP. Mitochondria are also known as the power house of cell.
- 86. (b)** Cell organelles that are present in both prokaryotic and eukaryotic cells without exception are, cytoplasm, plasma membrane and ribosomes. Membrane bound organelles are absent in prokaryote.
- 87. (d)** Phagocytosis involves the formation of vesicles (phagosome) to hold the food particles and the vesicular trafficking to the lysosomes is aided by microfilaments, that play an important role in phagocytosis.

88. (c) Ribosomes are studded on the outer surface of endoplasmic reticulum and firmly attached to the outer cytosolic side.
89. (b) The given figures P, Q, R and S are mitochondria, vacuole, chloroplast and ribosome respectively both mitochondria and chloroplast are double membrane bound organelle and ribosome is a non-membrane bound organelle. Ribosome is responsible for protein synthesis.
90. (c) P - Chlamydomonas or Volvox  
Q - Aspergillus or Penicillium  
R - Lactobacillus or Nitrosomonas or Clostridium
91. (a) In the given figure of mitochondrion, X, Y and Z are inner membrane, crista and matrix respectively. the inner membrane is permeable to only some metabolites.  
Cristae helps in increasing the surface area inside the organelle. The matrix metabolizes nutrients into by-products the mitochondrion is use for energy-production.
2. Raisins present in test tube A will become swell due to the presence of hypotonic solution i.e., less concentrated or more water concentration in the surrounding medium that will cause endosmosis. In raisins, cell wall is present. RBCs, present in test tube B will become first swell but after sometimes it will burst because cell wall does not present in animal cells.
3. In first case, when egg is placed in concentrated salt solution, exosmosis will occur because the concentration of inside solution is less as compared to outside solution that will cause the movement of water from inside to outside. Hence, the egg will shrink.  
In second case, when the shrivel egg is placed in water, endosmosis will occur because the solution present inside the cell is more concentrated than the solution present outside the cell that will cause the movement of water to the inside of the egg. Hence, the egg will swell.
4. The solution will be hypertonic. When apricots are placed in this solution, the apricots shrink due to the presence of more concentrated solution outside the cell, that will cause the movement of water from inside to outside.

### Case Study-1

1. When a leaf peel is boiled in water, its cells become died. So, after placing it in hypertonic solution, there will be no movement of water take place in and out the cell.