Cell : Structure and Function

Cell

- Cell (derived from Latin word, *Cellula* = a small compartment) is a unit of structure and biological activity made up of an organised mass of protoplasm surrounded by a protective and selectively permeable covering.
- Organisms with a single cell-**unicellular** (e.g., protozoa, bacteria), organisms with more than one cell-**multicellular** (e.g., higher plants and animals), organisms without cell-**acellular** (e.g., virus).
- **Cytology** Study of structure and function of cell through microscope.
- **Cell Biology** Study of cell structure, function, development, biochemistry and physiology.
- **Robert Hooke (**1665**)** For the first time observed a honey comb-like pattern in a slice of cork under his primitive microscope and termed it as 'cell'.

Cell Theory

- In 1839, Schleiden, a Germen Botanist and Schwann, a British Zoologist led to the development of the cell theory.
- According to this theory all living organisms are made of cells and cell is the basic structural and functional unit of life.
- In 1855, Rudolf Virchow proposed an important extension of cell theory that all living cells arise from pre-existing cells (*Omnis-cellula-e-cellula*).

Shape and Size of Cells

- The cell may vary in their shapes. They can be round or spherical, e.g., RBCs, spindle-shaped, e.g., muscle cells, long and branched, e.g., nerve cells, etc.
- WBC's or White Blood Cells and *Amoeba* are cells, which can change their shape.
- Size of cell is related to its function.
- The largest known cell is unfertilised egg cell (size 6 inch diameter) of ostrich.
- The smallest cell is of **PPLO** (*Mycoplasma gallisepticum* of size 0.1-0.3 μm).
- **Human nerve cell** is the longest animal cell.
- The largest unicellular plant is *Acetabularia* (10 cm) and animal is *Amoeba* (1 mm).
- The largest human cell is **female ovum** and the smallest human cell is the **red blood cell**.

Parts of a Cell

- Though cells vary in shape and size, some of the parts are common to all of them. These are cell membrane, cytoplasm and nucleus.
- The various components of the plant and animal cells are described below.

Cell Wall

- It is a characteristic feature of only plant cells and fungi.
- It is an outer thick, additional layer surrounding the plasma membrane.
- It protects the cell against wind, temperature variation, moisture conditions. It also provides shape and rigidity to the cell.

Cell Membrane

- It is the outer boundary of the cell enclosing the cytoplasm and nucleus.
- It is also called **plasma membrane**.
- It is **selectively permeable**, i.e. allows certain substances to move inward and outward.
- It helps to separate cells from each other and their surrounding medium.

Protoplasm

It is the living substance including the entire content of cell, i.e., cytoplasm and nucleus.

Cytoplasm

It is a jelly-like substance present between cell membrane and nucleus containing various cell organelles.

Nucleus

- It was discovered by Robert Brown.
- It contains nucleoplasm, nucleolus and chromatin material.
- All this material is covered by a nuclear membrane.
- Chromatin is the controlling centre of the cell as it forms chromosomes.

Chromosome

- It is thread-like structure, found in the nucleus.
- Bead-like structures found on chromosomes are called **genes**. There are made up of DNA and are the carrier of genetic information from one generation to the next generation.

Cell Organelles

A cell performs different functions with the help of various small, highly specialised structures called organelles, present in the cytoplasm.

Some of these are given below.

Mitochondria

They are tiny rod-shaped structures which provide energy for all the activities of the cell by oxidising food. They are often called as the powerhouse of the cell.

Vacuoles

These are sac-like structures containing a solution of mineral salts and sugar i.e. cell sap.

In plant cells, the vacuoles are large, distinct and permanent, occupying most of the volume of the cell. On the contrary, an animal cell has small and temporary vacuoles or they may be absent.

Plastids

They occur in the most plant cells and are absent in animal cells. They are of different colours and types as given below

- **Chromoplasts** These are the coloured plastids (except green), give fruit and flower their colour.
- **Leucoplasts** These are the colourless plastids which store food.
- **Chloroplasts** These are the green coloured plastids. They are also called as kitchen of the cell. They contain the green pigment, chlorophyll that is essential for photosynthesis and provides green colour to the leaves.

Comparison of Plant Cells and Animal Cells

There are certain features that distinguish a plant cell from animal cell as given below

Plant cell	Animal cell
A plant cell has rigid wall on the outside.	A cell wall is absent.
It cannot change its shape.	An animal cell can often change its shape.
Plastids are found in plant cells.	Plastids are usually absent.
A mature cell has a large central vacuole.	An animal cell may have many small vacuoles.
Reserve food is generally starch and fat.	Reserve food is usually glycogen and fat.

Prokaryotic and Eukaryotic Cell

On the basis of the type of nucleus, cells are classified into two types

(i) **Prokaryotes** (*Pro*–primitive, *karyon*–nucleus) The cells having nuclear material without nuclear membrane are called prokaryotic cells, e.g., bacteria and blue-green algae.

(ii) **Eukaryotes** (*Eu*-true, *karyon*-nucleus) The cells having well organised nucleus with nuclear membrane are called eukaryotic cells, e.g., all the organisms except bacteria and blue-green algae.

All bacterial cells are prokaryotic cell organisms. These multiply and carry out special sexual reproduction called conjugation and transformation.

Cellular Composition in Different Organisms

Depending on the number of cells, organisms can be

(i) Unicellular organisms (having single cell)

(ii) Multicellular organisms (having many cells)

Unicellular organism	Multicellular organism
A single cell constitutes the whole organism.	Multiple cells are grouped together in a single body which assume different functions in the body to form various body parts.
There is no division of labour in prokaryotic unicellular organisms.	All cells are specialised to perform different functions of the multicellular body so that there is a division of labour within a single cell as well as group of cells.
e.g., *Amoeba*, *Chlamydomonas*, *Paramecium*, bacteria, etc.	e.g., fungi, plants, animals including humans, etc.

Practice Exercise

1. The structural and functional unit of life called cell was discovered by
(a) Robert Boyle
(b) Charles Darwin
(c) Robert Koch
(d) Robert Hooke

2. Cell theory was given by
(a) Schleiden and Schwann
(b) KR Porter
(c) Robert Hooke
(d) Camillo Golgi

3. The cell(s) which can change its shape is/are
(a) *Amoeba*
(b) WBC
(c) Both (a) and (b)
(d) None of the above

4. Some cells of our body can be over a foot long. These are
(a) nerve cells (b) muscle cells
(c) bones cells (d) gland cells

5. An ostrich egg is a
(a) tissue (b) organ system
(c) organ (d) cell

6. Majority of the cells cannot be seen directly with our naked eyes because
(a) organisms are generally unicellular
(b) cells are microscopic
(c) cells are present only inside the body
(d) cells are grouped into tissues

7. Which of the following is not a cell?
(a) Red Blood Cell (RBC) (b) Bacterium
(c) Spermatozoa (d) Virus

8. The another name of cell membrane is
(a) plasma membrane (b) nuclear membrane
(c) cell wall (d) None of these

9. Cell wall is the characteristic feature of
(a) Animals (b) Plants
(c) Viruses (d) Both (a) and (b)

10. The prokaryotic cell does not contain
(a) chromosomes (b) mitochondria
(c) plasma membrane (d) ribosomes

11. Which of the following gives the cell its shape, maintains its size, protects the structures inside and is selectively permeable?
(a) Cell wall (b) Nuclear membrane
(c) Cell membrane (d) Tonoplast

12. Which one of these organisms is not a eukaryote?
(a) *Euglene* (b) *Anabaena*
(c) *Spirogyra* (d) *Agaricus*

13. The nucleus contains
(a) nucleoplasm (b) nucleolus
(c) chromatin (d) All of these

14. The plastid which gives colour to fruit is
(a) leucoplast (b) chloroplast
(c) chromoplast (d) Both (a) and (b)

15. The plastid that provides green colour to the cell is
(a) chromoplast (b) leucoplast
(c) chloroplast (d) Both (a) and (b)

16. Robert Hooke used the term cell in the year
(a) 1650 (b) 1665 (c) 1865 (d) 1960

17. The living substance of the cell is called
(a) vacuole (b) leucoplast
(c) protoplasm (d) chloroplast

18. The thread-like structures present in the nucleus are
(a) nucleolus (b) chromosomes
(c) genes (d) ribosomes

19. Genes are found in the
(a) nucleus (b) cell wall
(c) cell sap (d) vacuole

20. Which of the following is not found in animal cell?
(a) Nucleus
(b) Cell wall
(c) Mitochondria
(d) Plasma membrane

21. Choose the correct statement with respect to unicellular organisms.
(a) In unicellular organisms, tissues work in coordination to perform different functions
(b) Unicellular organisms do not require food
(c) Unicellular organisms respire and reproduce
(d) All unicellular organisms move by cilia

22. Statement question
I. Cell wall II. Plasma membrane
Choose incorrect statement.
(a) I is found in plant cell only, whereas II is found in plant and animal cell both.
(b) I is found in animal cell only whereas II is found in plant and animal cell both.
(c) I and II both are found in plant cell and animal cell.
(d) I is found in plants, protozoa, fungi only, whereas II is found in all other kinds of living organisms.

23. Fill the appropriate words in the blanks form the options in sequential manner
..... is a unicellular aquatic animal. Cells in which nuclear membrane is absent from the nucleus are called ..... cells. The shape size of a cell are related to its ..... The kitchen of the cell is .....
(a) *Amoeba*, prokaryotic, function, chloroplast
(b) *Euglena*, eukaryotic, tonoplast, structure
(c) Eukaryote, *Euglena*, chloroplast, function
(d) None of the above

Answers

1	*(d)*	2	*(a)*	3	*(c)*	4	*(a)*	5	*(d)*	6	*(b)*	7	*(d)*	8	*(a)*	9	*(b)*	10	*(b)*
11	*(c)*	12	*(b)*	13	*(d)*	14	*(c)*	15	*(c)*	16	*(b)*	17	*(c)*	18	*(b)*	19	*(a)*	20	*(b)*
21	*(c)*	22	*(a)*	23	*(a)*														