

# 8

## Cell–Structure and Functions

### TOPICS COVERED

8.1 Cell, its Discovery and Variations

8.2 Basic Structure of Cell

8.3 Cell Organelles, Difference between Plant and Animal Cells

### IMPORTANT POINTS TO REMEMBER

- All living things are made up of cells, most of which are microscopic in size.
- Cell is the structural and functional unit of life.
- Cells were first observed in a thin slice of cork by Robert Hooke.
- Cells exhibit a variety of shapes and sizes.
- The number of cells also varies from organism to organism. Unicellular organisms consist of a single cell that performs all the life functions. Multicellular organisms are made up of different types of specialised cells.
- Some cells are microscopic while a few are big enough to be seen with unaided eye like hen's egg.
- A group of cells performing a particular job is called a tissue.
- Many tissues combine to form an organ that carries out a specific function. Various organs working together to carry on life activities constitutes an organ system.
- A cell has three main parts – (i) the cell membrane (ii) the cytoplasm—that contains the smaller components called organelles and (iii) the nucleus.
- Plant cells differ from animal cells in having an additional layer around the cell membrane termed as cell wall.
- Nucleus is separated from the cytoplasm by a nuclear membrane.
- Cells without a well organised nucleus i.e. lacking a nuclear membrane are called prokaryotic cells while the ones with a well organised nucleus are eukaryotic cells.
- Green plastids containing chlorophyll are called chloroplasts and are present in plant cells only.
- Plant cells have a big central vacuole unlike small vacuoles in animal cells.

### 8.1 CELL, ITS DISCOVERY AND VARIATIONS

**Cells:** Cell is the structural and functional unit of all living organisms. It is the building block of life. They were first seen in a thin slice of cork in 1665 by Robert Hooke. These tiny compartments looked like a honey comb separated from each other by partitions. He named them as cells.

Most cells are too small to be visible to the naked eye. They can only be observed with a microscope. Colouring agents called stains are used to distinguish between parts of a cell.

**Variations in Cells:** Living organisms show variations in size, shape and number of cells leading to the vast variety in nature.

**Number of cells:** On the basis of number of cells present in different organisms, they are classified as unicellular and multicellular.

Unicellular organisms like Amoeba, Paramecium, Euglena and bacteria consist of a single cell that performs all the life functions. They grow, move, digest food, excrete out wastes and reproduce using a single cell.

Plants and animals can be seen with naked eyes. They are multicellular. Multicellular organisms are made up of different types of specialised cells. All multicellular organisms begin life as a single cell which is the fertilised egg or zygote. The hierarchy of organisation in multicellular organisms is as follows:

Cells → Tissues → Organ → Organ system → Organism

**Shape of Cells:** The shape of cells mainly depends on the type of function it performs. Amoeba has an irregular shape. The projections on its surface are pseudopodia (false feet). They facilitate the movement and capture of food.

White Blood Cells (WBC) in our body are also irregular in shape. They engulf the pathogens that enter our body and kill them.

Red Blood Cells (RBC) are biconcave in shape so that they can flow easily and carry enough oxygen to transport it to all the parts of our body.

Smooth muscle cells are spindle shaped so that they can contract and relax to bring about movement in our body.

Nerve cells are long and branched to receive and transfer messages, thereby helping to control and coordinate the working of different parts of the body.

**Size of Cells:** Most of the cells are microscopic and are not visible to the naked eye. Some can be as large as a few centimetres. Generally the size of the cells are measured in micrometres or microns. 1 micrometre (m) is equivalent to  $1 \times 10^{-6}$  m.

	Cell	Size
1.	Egg of an ostrich	Largest cell in the world (170 mm × 130 mm)
2.	Neuron	Longest cell in the human body (upto 0.1 mm)
3.	PPLO (Pleuro Pneumonia like Organisms)	Smallest cell in the world (0.1 μ to 0.5 μ)

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## Exercise 8.1

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### I. Very Short Answer Type Questions (1 Mark)

1. What would you call an organism whose body is made up of many cells?
2. Name the smallest cell.
3. What are the finger like projections on the surface of Amoeba known as?
4. What do different types of tissues assemble into?
5. What is the shape of RBCs?
6. (a) Cells were first seen in 1665 by \_\_\_\_\_ .  
(b) A microscope \_\_\_\_\_ the size of the object kept on a slide.

### II. Short Answer Type Questions (2/3 Marks)

7. Schematically represent the hierarchy of organisation in a multicellular organism.
  8. Why are nerve cells long and branched?
  9. Explain the statement “All multicellular organisms begin life as a single cell.”
  10. What is the purpose of using stains to observe cells?
  11. Who discovered cells and how?
  12. Name two cells that are irregular in shape.
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## ANSWERS

1. Multicellular
2. PPLO
3. Pseudopodia
4. Organ
5. Biconcave
6. (a) Robert Hooke (b) Magnifies
7. Cells → Tissues → Organ → Organ system → Organism
8. Nerve cells are long and branched to receive and transfer the messages from and to the brain, thereby helping to control and coordinate the working of different parts of the body.
  - All multicellular organisms begin life as a single cell which is the fertilised egg or zygote. It is this zygote only, that after multiple divisions, is able to give rise to the organism.
10. Colouring agents called stains are used to distinguish between different parts of a cell.
11. Cells were first seen in a thin slice of cork in 1665 by Robert Hooke. These tiny compartments looked like a honey comb separated from each other by partitions.
12. Amoeba, white blood cells.

## 8.2 BASIC STRUCTURE OF CELL

Plants and animal cells show certain differences but most cells have a similar basic structure. The cells are covered by a cell membrane and in plant cells an additional covering is present over the cell membrane called the cell wall. Inside the cell is the nucleus and a jelly like material called cytoplasm. Many structures are present inside the cytoplasm and are called as cell organelles.

**Cell Membrane / Plasma Membrane:** It is the thin outer living cover of the cell, present in both plants and animals.

It is made up of proteins and lipids.

It is selectively permeable and allows the entry and exit of specific molecules only.

It thus helps to maintain the proper cell composition.

It separates the cell and its contents from the surroundings.

It protects the inner cellular contents and gives shape in case of animal cells.

**Cell Wall:** It is present in plant cells only as an outer membrane to the cell membrane.

It is a hard, rigid and non – living structure made up of cellulose.

It is freely permeable.

It provides mechanical strength and support; also it determines the size of the cell.

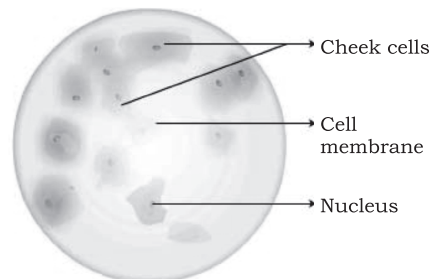
It protects the plant cell against variations in temperature, high wind speed, moisture, etc.

**Activity 1:** *To study the structure of an animal cell.*

Gently scrape the inside of your cheek with the blunt end of a clean toothpick. Dab this end of the toothpick in the middle of the slide that has a drop of glycerine in its middle. Place a drop of glycerine on it and carefully cover with a coverslip. Remove the extra stain using a blotting paper. Observe it under the microscope.

**Activity 2:** *To study the structure of a plant cell.*

Slice an onion into two. Take out one of the 'thick' leaves. With forceps, pull away the thin lining from the inner surface of the leaf. Put it in a watch glass containing water. Take a clean glass slide and put a drop of glycerine in its middle. Cut a small section of the thin lining (peel) and transfer it to the middle of the slide. Put a drop of safranin on it and leave it undisturbed



Cheek Cells

for 1-2 minutes. Put the coverslip and remove the extra stain using a blotting paper. Observe it under the microscope.

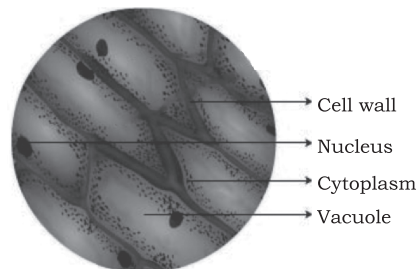
**Cytoplasm:** The cytoplasm is a jelly like substance present in between the nucleus and the cell membrane. Various cell organelles are present in it like mitochondria, ribosomes, plastids, vacuole etc. It provides a medium for all the chemical reactions taking place inside the cell.

**Nucleus:** It is a dark, dense, spherical structure present in the cytoplasm. It is separated from the cytoplasm by a double layered **nuclear membrane** that has nuclear pores which allow the movement of substances between inside the nucleus and the cytoplasm. The material inside the nucleus is called **nucleoplasm**. A small spherical body inside the nucleus is called **nucleolus**. Nucleus contains thread like structures called **chromatin**. The chromatin network arranges itself in the form of rod shaped **chromosomes** at the time of cell division.

Nucleus is the controlling centre of the cell. It contains chromosomes that carry genes. Genes are the functional segments of genetic material (DNA) that transfer characters from parents to the offsprings. It also controls the metabolic activities of the cell.

The nucleus and the cytoplasm together constitutes the living substance of the cell called the **protoplasm**.

Depending on the organisation of the nucleus, cells can either be classified as **prokaryotic** or **eukaryotic**. The cells having nuclear material without nuclear membrane are called prokaryotic cells. Example – bacterial cell, cyanobacteria etc. The cells having well organised nucleus with a nuclear membrane are designated as eukaryotic cells. *Example* – plant cell and animal cell.



Onion Peel Cells

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## Exercise 8.2

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### I. Very Short Answer Type Questions (1 Mark)

1. What is the term used for a cell that does not have a well defined nucleus?
2. Name the living substance of the cell.
3. What are genes?
4. What is the dark dense body inside the nucleus known as?
5. What is the function of cytoplasm?
6. Name the stains used in preparation of (a) Onion peel slide (b) Cheek cell slide.
7. Name the mounting material used in slide preparation.
8. Name the additional covering present in plant cells.

### II. Short Answer Type Questions-1 (2 Marks)

9. Compare the chemical composition of cell wall and cell membrane.
10. Write short notes on (a) Cytoplasm (b) structure of Nucleus.
11. How do chromosomes differ from chromatin?

### III. Short Answer Type Questions-2 (3 Marks)

12. List the functions of nucleus.
  13. How are cells classified on the basis of organization of nucleus?
  14. How will you prepare a temporary mount of onion peel?
  15. Differentiate between cell wall and cell membrane.
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## ANSWERS

1. Prokaryotic cell      2. Protoplasm
3. Genes are the functional segments of genetic material (DNA) that transfers the characters from parents to the offsprings.
4. Nucleolus
5. Cytoplasm provides a medium for all the chemical reactions taking place inside the cell.
6. (a) safranine, (b) methylene blue
7. Glycerine                      8. Cell wall
9. Cell wall is made up of cellulose while cell membrane is made up of proteins and lipids.
10. **Cytoplasm:** The cytoplasm is a jelly like substance present in between the nucleus and the cell membrane. Various cell organelles are present in it like mitochondria, ribosomes, plastids, vacuole etc. It provides a medium for all the chemical reactions taking place inside the cell.  
**Nucleus:** It is a dark, dense, spherical structure present in the cytoplasm. It is separated from the cytoplasm by a double layered nuclear membrane that has nuclear pores which allows the movement of substances between the nucleus and the cytoplasm inside the cell. The material inside the nucleus is called nucleoplasm. A small spherical body inside the nucleus is called nucleolus. Nucleus contains thread like structures called chromatin. Chromatin is made up of DNA and proteins.
11. Nucleus contains thread like structures called **chromatin** that is made up of the

- genetic material **DNA** and **proteins**. The chromatin network arranges itself in the form of rod shaped **chromosomes** at the time of cell division.
12. Nucleus is the controlling centre of the cell. It controls the metabolic activities of the cell.  
It contains chromosomes that carry genes. Genes are the functional segments of genetic material (DNA) that transfer characters from parents to offsprings. It also plays a very important role during cell division.
  13. Depending on the organisation of the nucleus, cells can either be classified as prokaryotic or eukaryotic. The cells having nuclear material without nuclear membrane are called prokaryotic cells. *Example:* bacterial cell, cyanobacteria etc. The cells having well organised nucleus with a nuclear membrane are designated as eukaryotic cells. *Example* – plant cell and animal cell.
  14. Slice an onion into two.
    - Take out one of the ‘thick’ leaves.
    - With forceps, pull away the thin lining from the inner surface of the leaf.
    - Put it in a watch glass containing water. Take a clean glass slide and put a drop of glycerine in its middle.
    - Cut the small section of the thin lining (peel) and transfer it to the middle of the slide.
    - Put a drop of safranin on it and leave it undisturbed for 1-2 minutes.
    - Put the coverslip and remove the extra stain using a blotting paper.
    - Observe it under the microscope.

15.	CELL WALL	CELL MEMBRANE
	It is present in plant cells only outer to the cell membrane.	Present in both plants and animals.
	It is made up of cellulose.	It is made up of proteins and lipids.
	It is freely permeable.	It is selectively permeable and allows the entry and exit of specific molecules only.

### 9.3 CELL ORGANELLES, DIFFERENCE BETWEEN PLANT AND ANIMAL CELLS

**Cell Organelles:** Organelles are small structures scattered in the cytoplasm that work together to carry out the basic life processes. Some of them are:

**Mitochondria:** It releases energy from the breakdown of glucose. They are also called the powerhouse of a cell.

**Ribosomes:** They synthesize proteins.

**Vacuoles:** They are sac like structures that store cell sap present generally in the plant cells. They are large and 1-2 in number. In animal cells, they are generally absent and if present, they are very small in size.

**Plastids:** They are present only in plant cells. They are of different colours and types:

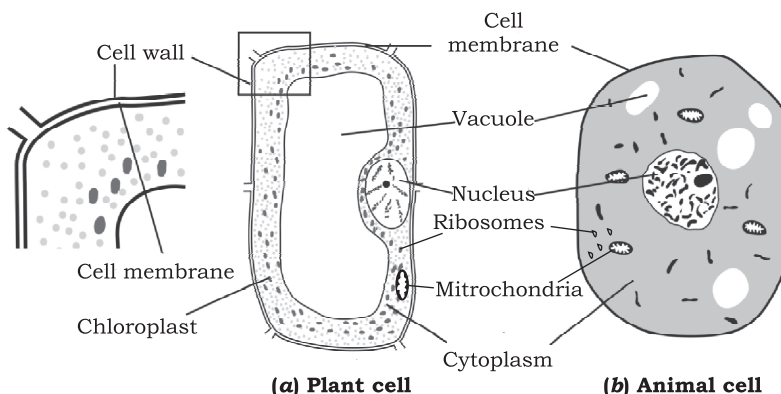
*Leucoplasts:* They are colourless plastids that store food in the form of starch, oil and proteins.

*Chromoplasts:* These plastids give bright colour to fruits and flowers.

*Chloroplasts:* Green coloured plastids are called chloroplasts that contain a green pigment called chlorophyll which traps sunlight for photosynthesis.

### Plant and Animal Cells

	Plant Cell	Animal Cell
1.	Has a cell wall made up of cellulose	Does not have a cell wall
2.	Has a large vacuole	Vacuoles are generally absent and if present, they are very small in size
3.	Plastids are present	Plastids are not found
4.	Nucleus is pushed towards the periphery	Nucleus is centrally located



## Exercise 8.3

### I. Very Short Answer Type Questions (1 Mark)

1. Name the powerhouse of the cell.
2. Which organelle is aptly termed as 'kitchen of the cell'?
3. Name the different kinds of plastids.
4. State the function of ribosomes.

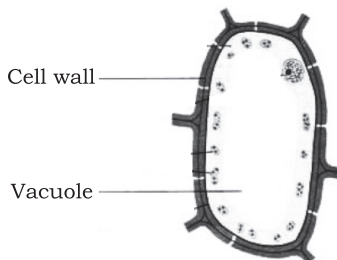
### II. Short Answer Type Questions (2 Marks)

5. What are cell organelles?
6. Draw the diagram of a plant cell and identify and label the part that  
(a) stores cell sap      (b) gives shape to the cell and protects it
7. Differentiate between plant cell and animal cell.

## ANSWERS

1. Mitochondria
2. Chloroplast
3. Leucoplasts, chromoplasts and chloroplasts.
4. Synthesis of proteins.
5. Cell organelles are the small structures scattered in the cytoplasm that work together to carry out the basic life processes of a cell.

6.



(a) Vacuole, (b) Cell wall

7.	Plant Cell	Animal Cell
	Has a cell wall made of cellulose	Does not have a cell wall
	Has a large vacuole	Vacuoles are generally absent and if present, they are very small in size
	Plastids are present	Plastids are not found
	Nucleus is pushed towards the periphery	Nucleus is centrally located

### Did You Know?

- Living cells were first observed by Anton Van Leeuwenhoek.
- Cell theory was given by M. Schleiden and T. Schwann.
- Size of cells has no relation with the size of an organism.
- Each organism has a fixed number of chromosomes in each body cell. For example each cell of a human body has 23 pairs or 46 chromosomes.
- A compound microscope uses a combination of lenses that can give magnification ranging from 300X to 1500X. An electron microscope, however, magnifies objects by over 50,000 times.
- Mitochondria and chloroplasts are semi-autonomous cell organelles that have their own genetic material and can synthesize some of their proteins.

## HOTS

1. The shape of the cell is related to its function. Justify.
2. Why is cell called the structural and functional unit of life?
3. Which type of plastids are present in tomatoes?

## ANSWERS

1. The shape of cell mainly depends on the type of function it performs. For example Amoeba has an irregular shape. The projections on its surface are pseudopodia (false feet). They facilitate movement and capture of food. White Blood Cells (WBC) in our body are also irregular in shape. They engulf the pathogens that enter our body and kill them. Red Blood Cells (RBC) are biconcave in shape so that they can flow easily and carry enough oxygen. Smooth muscle cells are spindle shaped so that they can contract and relax to bring

about movement in our body.

Nerve cells are long and branched to receive and transfer messages thereby helping to control and coordinate the working of different parts of the body.

2. Cell is the basic unit of all life forms. All living organisms are made up of cells. It is the smallest unit that performs all functions required for survival. The hierarchy of organisation in multicellular organisms is as follows:

Cells → Tissues → Organ →  
Organ system → Organism

3. Chromoplasts