The Cell — Its Structure and Functions

There is a large variety of organisms on this earth. They are all distinct in their form and structure, yet they all possess similarity in their basic structure and functions. Just as a building is made up of bricks, similarly, the bodies of all plants and animals are made up of cells. From microscopic bacteria or *Amoeba* to large organisms like elephants, whales or gigantic trees, all are made up of the basic units called **cells**.

Some cells exist as unicellular organisms (single-celled individuals) while others are a part of multicellular organisms. Certain basic functions like nutrition, respiration, growth, development and reproduction are performed by all the cells. These functions are essential for the survival of the cell. Therefore, a **cell** can be defined as the basic structural and functional unit of all living organisms.

In this chapter, we will study about the variety in the shape, size, structure and functions of the cells.

Discovery of the Cell

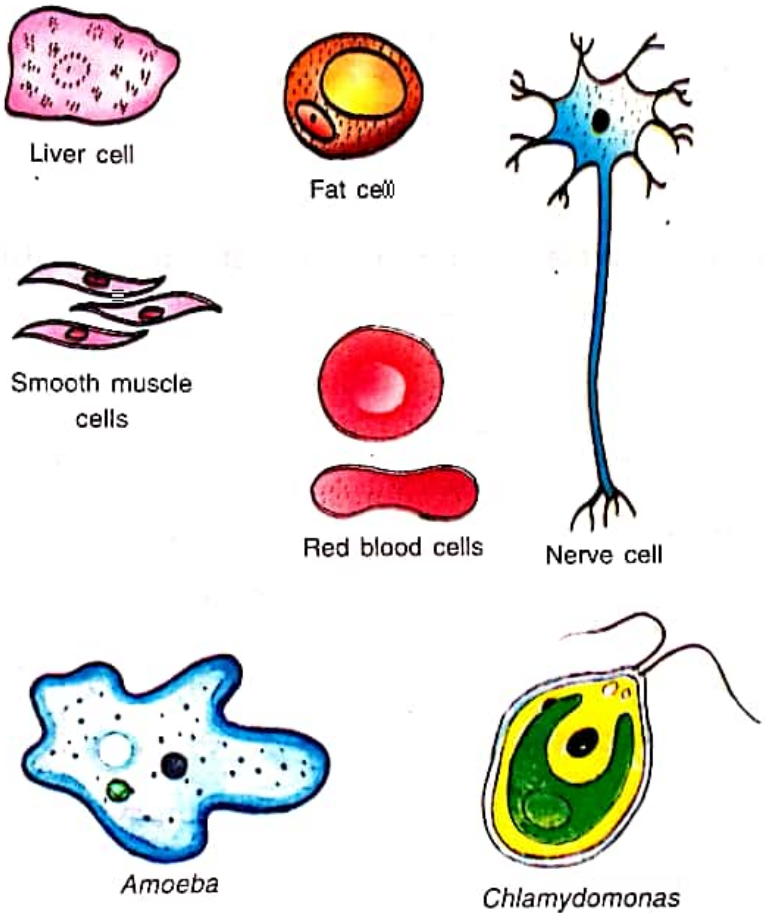
Cells are the basic structures of all living beings, yet they remained undiscovered for a long time. This is because the majority of the cells are too small to be seen by the naked eye.

DO YOU KNOW ?

The outermost layer of our skin consists of dead cells. This layer is shed periodically and is replaced by newer cells. You may be surprised to know that a person may lose about four kilograms of skin cells every year.

of the cell number, living organisms can be classified into two categories, i.e. **unicellular** and **multicellular**.

Cell Shape: The shape of cells differ not only in different organisms, but also in different organs of the same organism. They may be oval, spherical, cuboidal, fibre-like or polygonal. These shapes are influenced by their location and function in the tissue. For instance, a nerve cell has to transmit nerve impulses to organs located in different parts of the body. Hence, they possess a long fibre-like structure.



Variety in the shape of cells

Cell Size: Cells vary in size. The smallest cell PPLO (Pleuro pneumonia-like organism) also called **mycoplasma** is about 0.1 micron (denoted as 'μ') in diameter ($1\mu = 10^{-6}$ m). The ostrich egg is considered to be the largest cell with 170 mm in diameter.

The hen's egg also represents a single cell that is big enough to be seen with the naked eye.

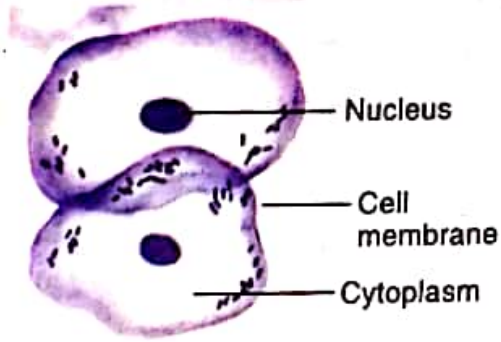
Cell	Size
Amoeba	1000 µm
Ostrich egg	170 mm
Human ovum	0.1 mm or 100 µm
Red blood cell	9 µm
Liver cell	20 µm
Green alga, *Chara*	10 cm
Hen's egg	60 mm
Nerve cell	about 1 m

Activities

1. Make a temporary mount of cheek cells to observe animal cells.

   • Take a clean toothpick. • Scratch it gently on the inner side of your cheek. • Some frothy material appears on the toothpick. • Rub it in the centre of a clean glass slide. • Put a drop of methylene blue. • Let it stain for a minute. • Put a cover slip and observe it under the microscope.

   You will observe polygonal, isolated cells or cells in clusters. Note the darkly stained nucleus in each cell.

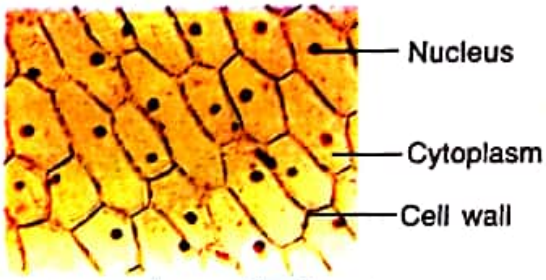


Cheek cells

2. Follow the instructions given below to make a slide of onion peel. (Onion peel is the thin membrane-like layer present around fleshy scale leaves of onion.)

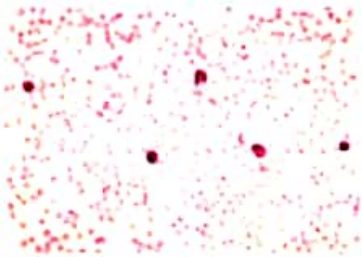
   • Put a drop of water on a glass slide. • Place a small piece of neatly cut onion peel on it. • Put a drop or two of saffranin. • Stain for a minute. • Put a cover slip and observe it under the microscope.

   You will see that cells are arranged in rows. Note their boundaries. There is a dark structure in the centre of each cell. It is the nucleus.



Onion peel showing its cells

3. Request your teacher to prepare a slide of human blood to see different types of cells present in blood. You may also use a permanent slide of blood to study various types of blood cells. You can observe red blood cells with characteristic red colour and their disc shape. Notice a few *Amoeba*-like white blood cells present between red blood cells.


Microscopic view of blood cells

Cell Membrane: All living cells are bound by a membrane called the **plasma membrane** or the **cell membrane**. It surrounds the inner gel-like material called **protoplasm**. The plasma membrane controls the entry and the exit of substances according to the requirements of the cell.

Plants, fungi and bacteria have an additional outer covering called the **cell wall**.

Cell wall is an important covering in plant cells as it provides rigidity and protection against variations in the environment. It also gives a definite shape, size and support to the cell.

DO YOU KNOW ?

The number of chromosomes in a cell differs in different organisms.

Organisms	Chromosome number
Man	46
Dog	78
Pigeon	80
Yeast	32
Wheat	42

Cytoplasm: The portion of the protoplasm lying inner to the cell membrane, but outside the nuclear membrane, is called **cytoplasm** (*kytos*-hollow, *plasma*-liquid). It acts as a ground substance for all cell activities. It is made up of carbohydrates, proteins, fats, minerals, vitamins along with a large proportion of water. All these components work together to provide a unique living nature to the protoplasm.

Nucleus: It is the most important part of the cell. It lies in the centre of the cell, but it may also occupy peripheral positions. It controls all the activities of the cell.

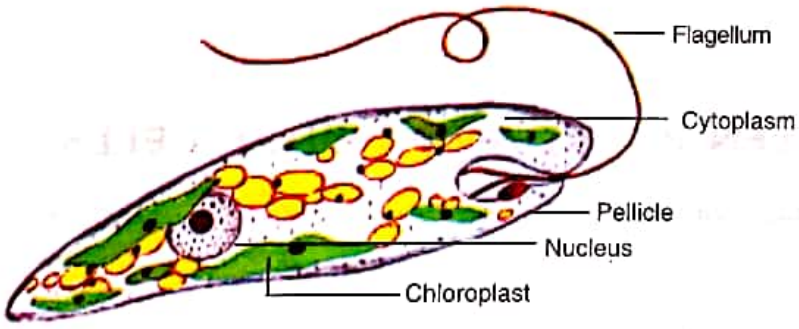
The nucleus is a dense structure bound by a **nuclear membrane.** The protoplasm of the nucleus is called **nucleoplasm**. It has thread-like network called **chromatin**. When the cell is ready to divide, this chromatin condenses to form thicker, thread-like structures, called **chromosomes**. These chromosomes are the structures responsible for the inheritance of characters (**genes**) from one generation to another.

Many small living structures are present in the cell. These are equivalent to the organs of the body. Hence, they are named as 'cell organelles'.

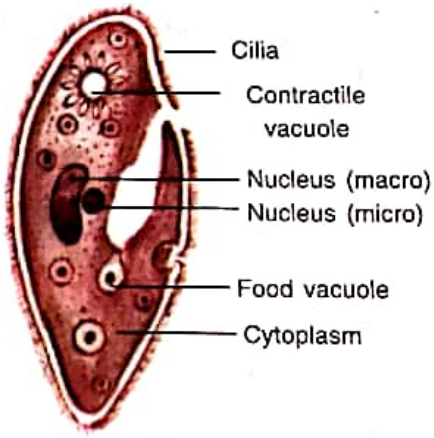
Cell organelles: The main cell organelles are:

- **Plastids:** These are large cell organelles, characteristic of plant cells. These may contain pigments that provide colour to the cell. The green-coloured plastids are called **chloroplasts**. They manufacture food for green plants by the process of **photosynthesis**. Various coloured parts of the plants like fruits, vegetables and flowers possess the plastids called **chromoplasts**. They are responsible for imparting colour, other than green to different parts of the plant.

- **Mitochondria:** These are rod-shaped or spherical structures. They are present in a large number in cells engaged in different physiological activities. They are responsible for cellular respiration and generating energy for different activities of life. Hence, they are also called the **power house** of the cell.
- **Endoplasmic reticulum (ER):** It is a network of membranes. It provides a skeletal framework to the cell.
- **Golgi complex:** They are sac-like structures stacked one above the other. They store the materials which are produced by the cell. Hence, they are also called the **store-house** of the cell.
- **Vacuole:** It appears as an empty space in the cytoplasm. It is generally large in plant cells. It stores excess of water and waste products. In *Amoeba*, food materials are held in food vacuoles for digestion.
- **Ribosomes:** These are the tiny granules present in the cytoplasm. They help in protein synthesis.
- **Cilia and flagella:** Some cells have these small extensions on their cell membrane. They help in locomotion and collection of food. Unicellular organisms like *Paramoecium* have numerous cilia while *Euglena* has a single flagellum.



Euglena

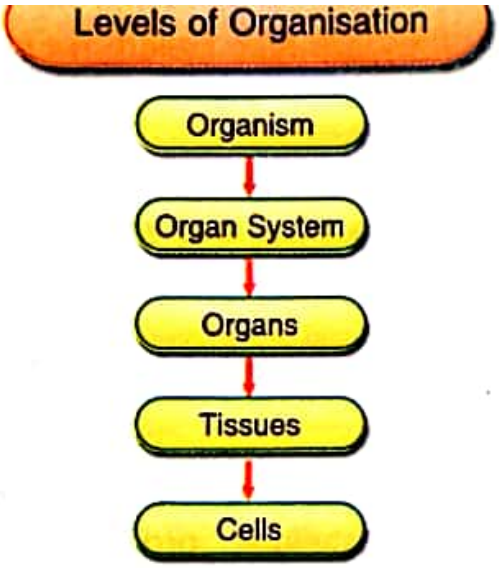


Paramoecium

All the cell organelles work together to perform different functions of the cell.

Levels of Organisation in an Organism

In unicellular organisms like *Amoeba*, a single cell performs all the necessary functions. It captures and digests food, respires, excretes, grows and reproduces.

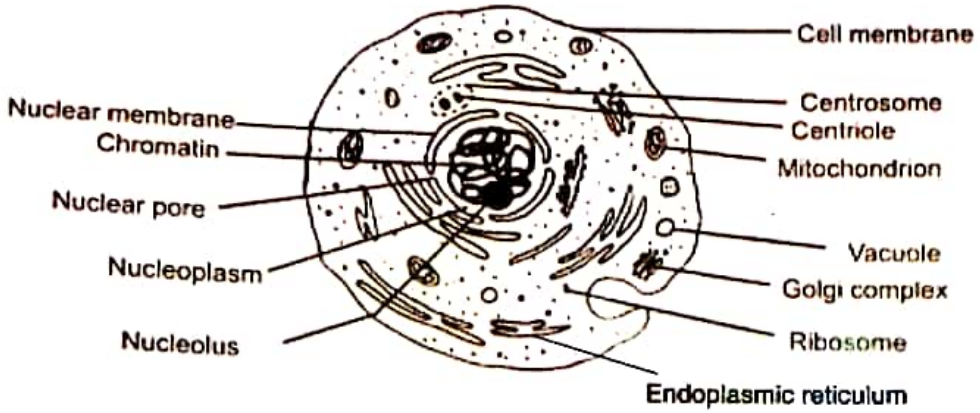


DO YOU KNOW ?

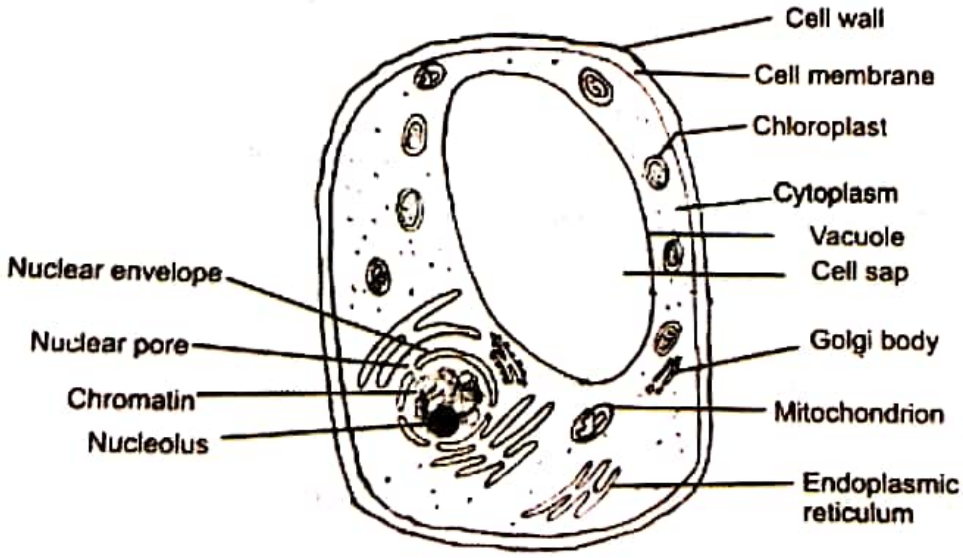
The following organ systems work in the human body:

(i) Digestive	(ii) Respiratory
(iii) Circulatory	(iv) Excretory
(v) Skeletal	(vi) Muscular
(vii) Nervous	(viii) Reproductive
(ix) Endocrine	(x) Integumentary

Thus, the cells have some common features but they appear different in different pa like blood, liver (in animals), root or leaves (in plants). Even plant and animal cells show so major differences. Let us compare them.



An animal cell with its organelles



A plant cell with its organelles

	Cell Components/Organelles	Plant Cell	Animal cell
1.	Cell wall	Present	Absent
2.	Cell membrane	Present	Present
3.	Plastids	Present	Absent
4.	Mitochondria	Present	Present
5.	Nucleus	Present	Present
6.	Vacuoles	Large size and more in number	Small size or absent

Something to Know

A. Tick (✓) the correct choice for the following statements:

1. Thread-like body that lies in the nucleus of the cell is
   (a) cytoplasm (b) chromosome
   (c) nucleoplasm (d) mitochondrion
2. Which organelle is known as the power house of the cell?
   (a) Mitochondrion (b) Chromosome
   (c) Golgi complex (d) Endoplasmic reticulum
3. The longest cell in the human body is
   (a) blood cell (b) muscle cell
   (c) liver cell (d) nerve cell
4. The smallest known cell in the living world is
   (a) *Amoeba* (b) PPLO
   (c) RBC (d) Egg of ostrich
5. Which of these cells will have cell wall around them?
   (a) Cheek cells (b) Nerve cells
   (c) Onion peel cells (d) Blood cells

B. Match the following:

1. *Amoeba*	(a) Nucleus
2. The largest animal cell	(b) Cell
3. Controlling centre of the cell	(c) Unicellular
4. Locomotory structures	(d) Cilia and flagella
5. Plastid	(e) Plant cell
6. Robert Hooke	(f) Ostrich egg

C. State whether the following statements are true or false:

1. Cells are the basic units of all living organisms.
2. Ribosomes are responsible for generating energy in the cell.

3. Golgi complex is called the power house of the cell. _____
4. Cell membrane is present in all living cells. _____

D. Answer the following questions in brief:

1. Who observed cells for the first time? How was he able to observe the tiny cells?
2. Name one unicellular and two multicellular organisms.
3. Give one similar feature observed in the cells of bacteria, fungi and plants.
4. When do chromosomes appear in a cell? What role do they play in it?
5. Name the organelle responsible for imparting green colour to the plants. What is its function?
6. Why are plant cells more rigid than the animal cells?

E. Answer the following questions:

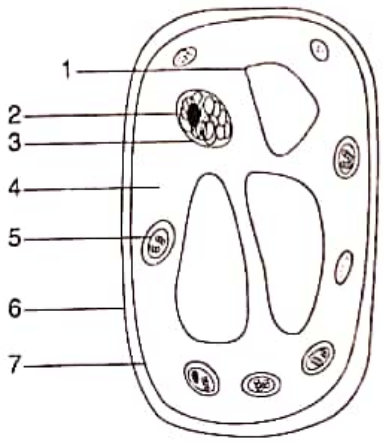
1. Which of the following organelles are common to both plant and animal cells?

   Cell membrane, cell wall, plastids, large vacuole, nucleus, endoplasmic reticulum. What is the role of these organelles in the cell?
2. Give the differences between a plant cell and an animal cell with the help of labelled diagrams.
3. Give one important function of the following cell organelles/structures:

   (a) Chloroplast (b) Golgi complex

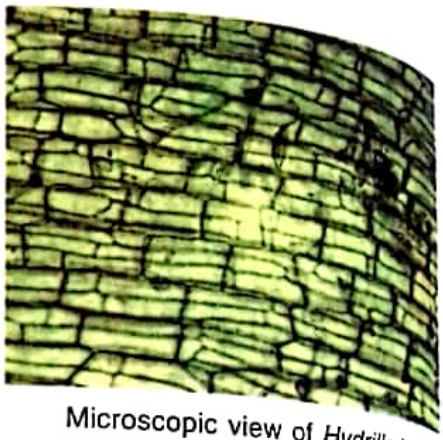
   (c) Vaculoes (d) Mitochondria

   (e) Ribosome (f) Endoplasmic reticulum
4. Why is the cell called the basic unit of structure and function of all living organisms?
5. Identify and label the following organelles in the given diagram:



Something to Do

1. *Hydrilla* is an aquatic plant that can be seen in lakes and ponds. It has small, thin leaves. Take a *Hydrilla* leaf and place it on a glass slide. Observe under the microscope. What do you see? Note your observations.



Microscopic view of *Hydrilla* leaf

2. Divide the class into four groups of students. Each group will prepare a short report on the topics given below. Two students from each group may present the report in the class.

   (a) When were cells discovered? Were they discovered before or after the invention of the compound microscope?

   (b) Does the size and number of cells depend upon the size of the organism?

   (c) List the functions of cell organelles and also mention the organ/organ system that the organelle is similar to in our body.

   (d) Advantages of having a cell wall as the outermost boundary in cells.