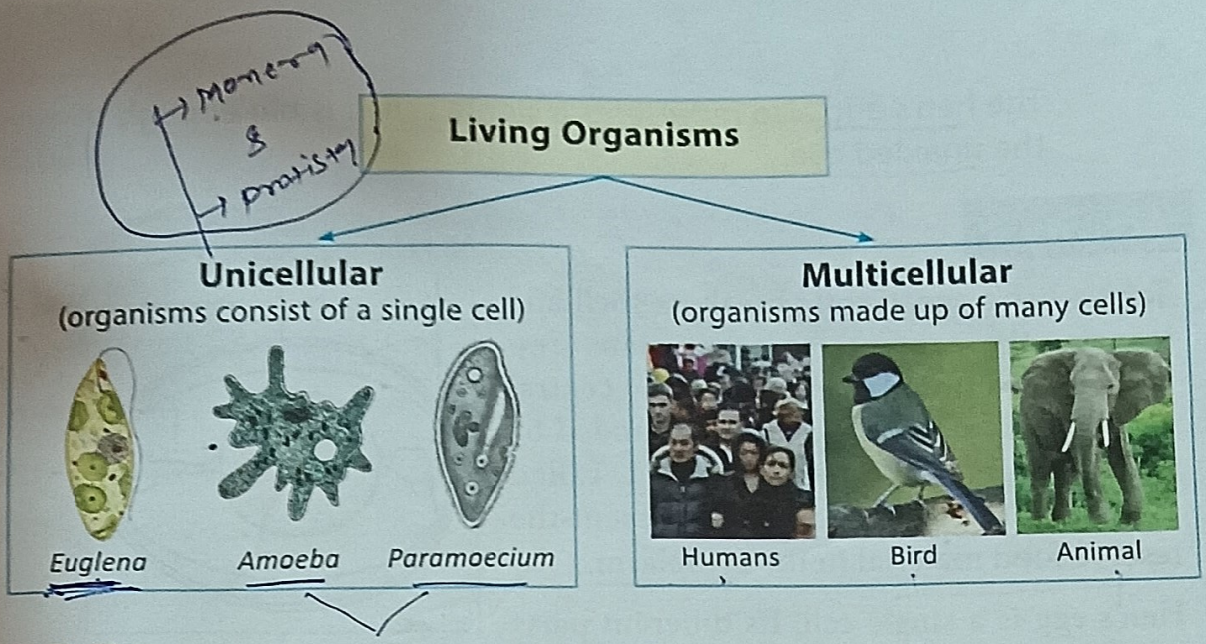
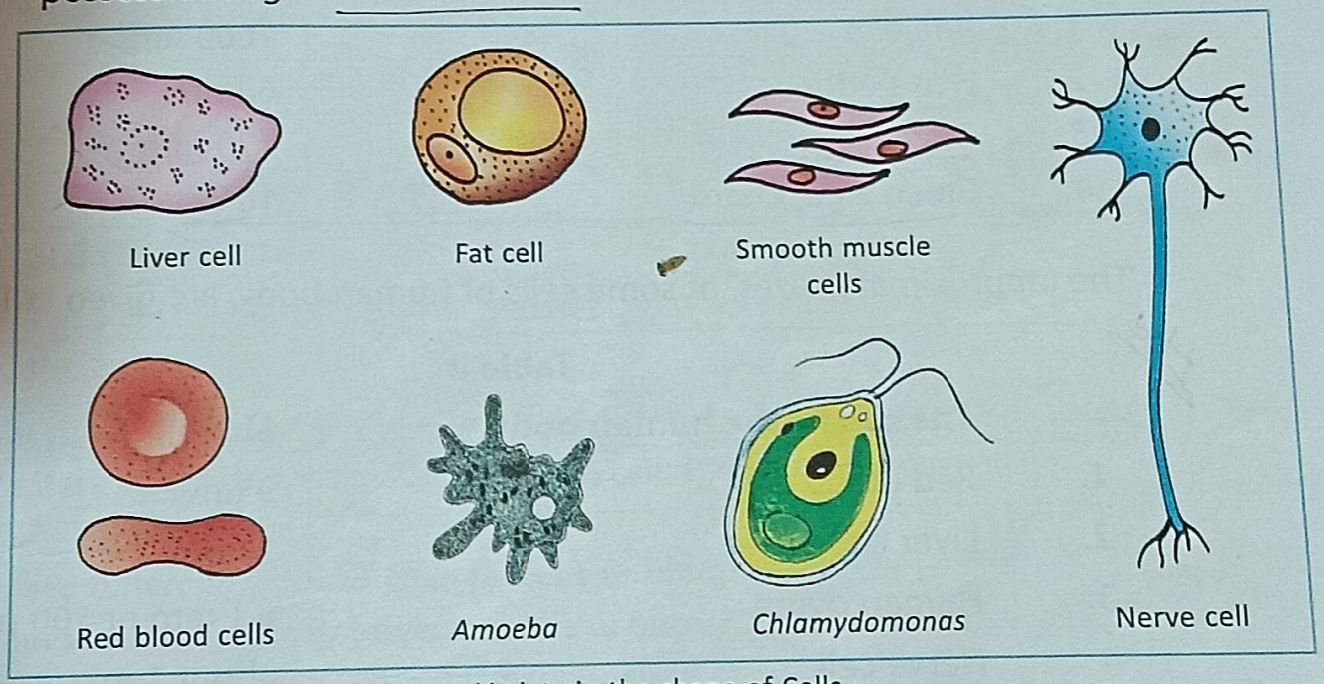


Cell Shape

The shapes 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 differences in shapes are due to 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

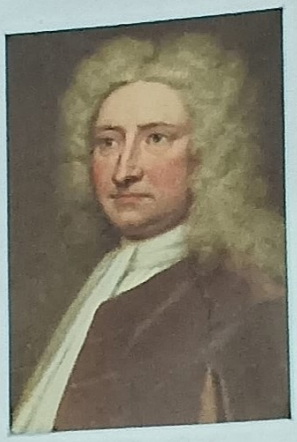
Cells vary considerably in their size. The smallest cell PPLO (Pleuro pneumonia-like organism), also called **mycoplasma**, is about 0.1 micron (denoted as 'μ') in diameter ($1\mu = 10^{-6}$m). The ostrich egg, considered to be the largest cell, is (nearly) 170 mm in diameter.

Discovery of the Cell

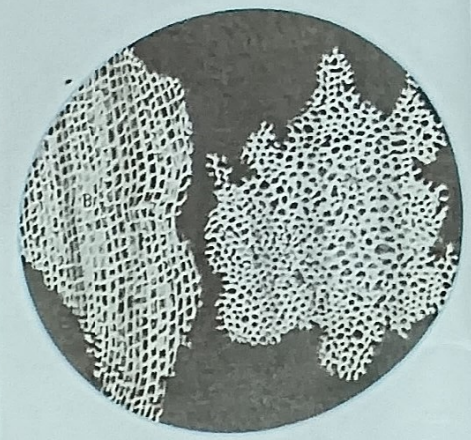
Cells are the basic 'structural unit' of all living beings. They remained undiscovered for a long time because the majority of the cells are too small to be seen by the unaided eye.

It was only after the advent of optical instruments, in the seventeenth century, that the cell was discovered and its basic features were studied.

Robert Hooke was the first scientist who, in 1665, observed thin slices of cork (obtained from the bark of a tree) through his self-designed microscope. He observed that they had honey-comb like structures consisting of little compartments (in Latin, '*cell*' means 'a little room'). It was later explained that these 'compartments' were actually 'dead cells', bound by a 'cell wall'.



Robert Hooke



'Honey-comb' structure of cork cells

The Cell

We now know that living organisms are made up of cells. The cells have the same basic structure, but they are different, with respect to their number, shape and size, in different living organisms.

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.

Variation in Cell Number, Shape and Size in Living Organisms

Cell Number

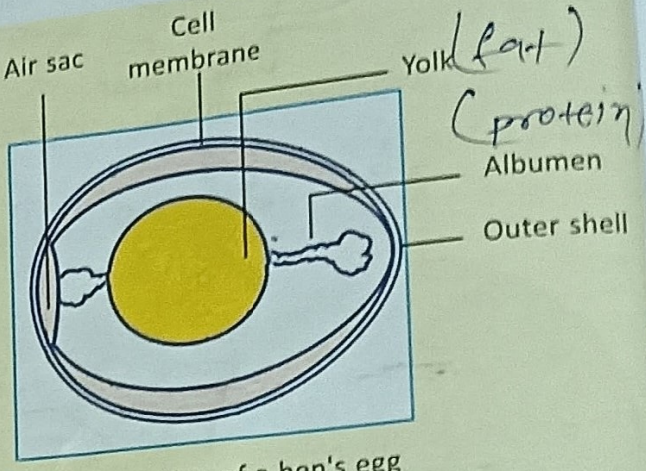
An *Amoeba* and an earthworm are of different sizes. This difference, in the size of the organism, is due to the number of cells present in them. While *Amoeba* is a living organism consisting of a single cell, an earthworm has millions of cells. Hence, on the basis of their 'number of cells', living organisms can be classified into two categories: **unicellular** and **multicellular**.

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

Activity 1

Take a hen's egg. Gently break its shell and transfer the contents to a flat plate. You will observe two clear portions. The central yellow mass is the yolk. It is surrounded by a transparent white jelly-like fluid, called albumen. Albumen and yolk represent the reserve food material in the cytoplasm.

Hen's egg is a single cell. Its different parts have been labelled in the diagram given here.



Cross-section of a hen's egg

The (approximate) sizes, of some of the plant and animal cells, are given in Table 1.

Table 1

	Cell	Size
1.	*Amoeba*	1000 µm
2.	Hen's egg	60 mm
3.	Ostrich egg	170 mm
4.	Green alga, *Chara*	10 cm

The (approximate) sizes, of some cells of human body, are given in Table 2

Table 2

	The cell of the human body	Size
1.	Red blood cell	9 µm
2.	Liver cell	20 µm
3.	Human ovum	0.1 mm or 100 µm
4.	Nerve cell	about 1 m

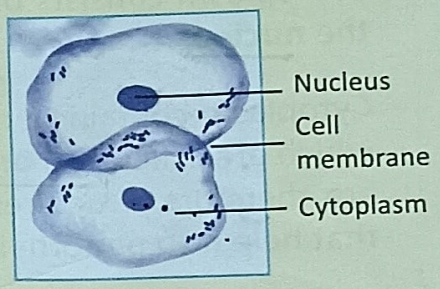
(**Note:** 1 µm = 10^{-6} metres = 10^{-3} millimetres)

Do You Know ?

The life span of a red blood cell is about 120 days.

Activity 2

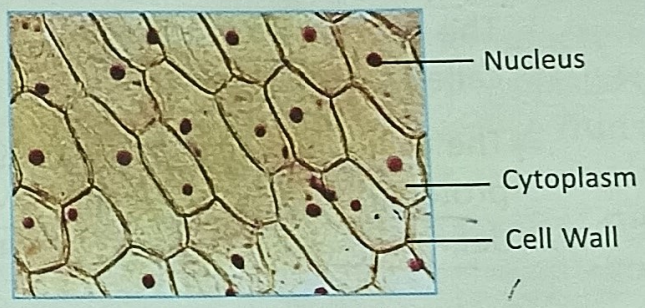
1. To observe animal cells make a temporary mount of cheek cells.
   - Take a clean toothpick.
   - Scratch it gently on the inner side of your cheek.
   - Some frothy material appears on the toothpick.
   - Rub it in the centre of a clean glass slide.
   - Put a drop of methylene blue.
   - Let it stain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



Cheek cells

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

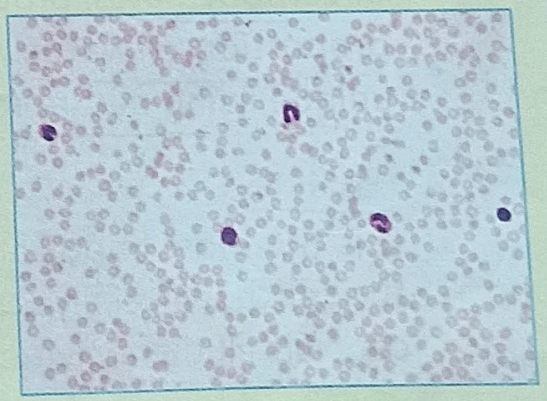
2. Follow the instructions given below to make a slide of onion peel. (Onion peel is the thin membrane-like layer present around fleshy scale leaves of onion.)
   - Put a drop of water on a glass slide.
   - Place a small piece of neatly cut onion peel on it.
   - Put a drop, or two, of saffranin.
   - Stain for a minute.
   - Put a cover slip and observe it under the microscope.



Onion peel showing its cells

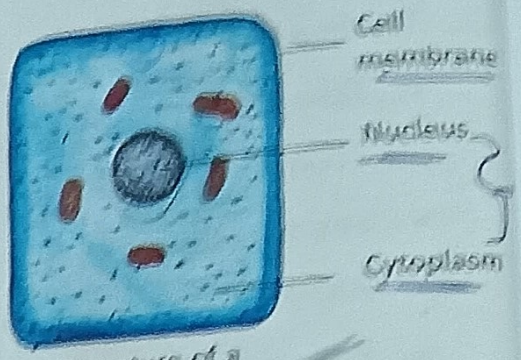
You will see that the cells here are arranged in rows. Observe their boundaries. There is a dark structure in the centre of each cell. It is the nucleus.

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


Microscopic view of blood cells

Parts of a Cell

A cell consists of a living protoplasm surrounded by a **cell membrane**. The protoplasm consists of the **cytoplasm** and the **nucleus**.



Structure of a typical cell

Cytoplasm contains a number of structures, which are called **cell organelles**. Organelles are, therefore, structures present within a cell that help it to perform its relevant functions.

Let us learn more about the different parts of a cell.

Cell Membrane

All living cells are bound by a membrane called the **plasma membrane**, or the **cell membrane**. It surrounds its inner gel-like material called **protoplasm**. The plasma membrane controls the entry and exit of substances as per the requirements of the cell.

The cells of plants, fungi and bacteria have an additional outer covering called the **cell wall**.

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

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 and 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 generally lies in the centre of the cell, however, in some cases, 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 a 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 characters (genes) inherited by one generation from the earlier generations.

Do You Know ?

The number of chromosomes in a cell differs in different organisms. Some are shown below.

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

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**. The plastids, associated with the different coloured parts of the plants (like fruits, vegetables and flowers) are called **chromoplasts**. They are responsible for imparting colour (other than green) to the different parts of the plant. Plants also contain some colourless plastids called **leucoplasts**; these provide space to store starch, proteins, oils, etc.

- **Mitochondria:** These are rod-shaped or spherical structures. They are present in large numbers in cells engaged in different physiological activities. They are responsible for cellular respiration and for generation of energy for different activities of life. Hence, they are also called the **powerhouse** of the cell.

- **Endoplasmic Reticulum (ER):** It is a network of membranes. It provides channels for transport of materials in a cell. ER is of two types:

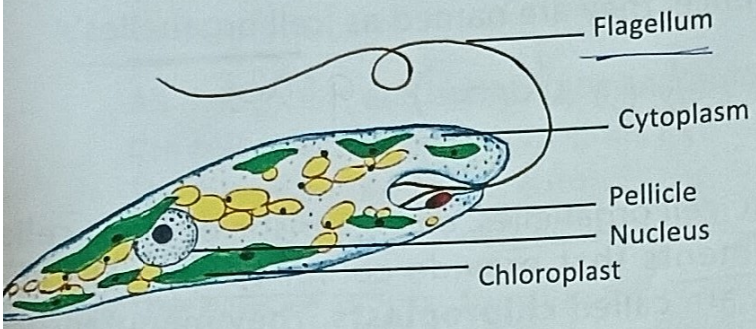
  Rough ER : This type of ER has a rough appearance as it is studded with ribosomes. It plays a vital role in synthesis of proteins.

  Smooth ER: This type of ER does not have ribosomes attached to it; it, therefore, has a smooth appearance. It helps in the synthesis of fats.

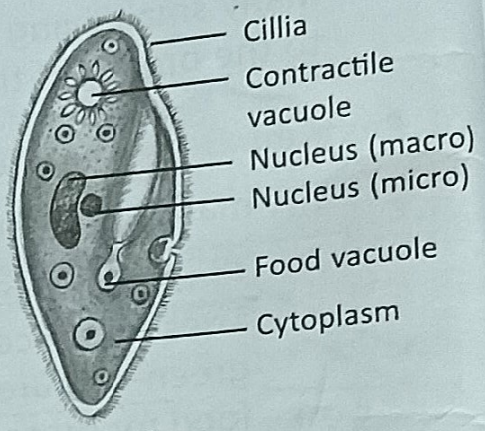
- **Golgi Complex :** They are sac-like structures stacked one above the

other. They are involved in the processing and packaging of materials produced by 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 its food vacuoles for digestion.
- **Ribosomes:** These are tiny granules present in the cytoplasm and on the rough ER. 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 these cell organelles work together to perform different functions of the cell.

Levels of Organisation in an Organism

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

ulticellular organisms have cells that are specialised to perform specific functions. group of cells, performing a specialised function, forms a **tissue** (for example, rvous tissue). A group of tissues, performing a specific function, forms an **organ** r example, kidney). A number of such organs work together to form an **organ stem** (for example, digestive system).

Levels of ganisation ⇒ Cell → Tissue → Organ → Organ System → Organism

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

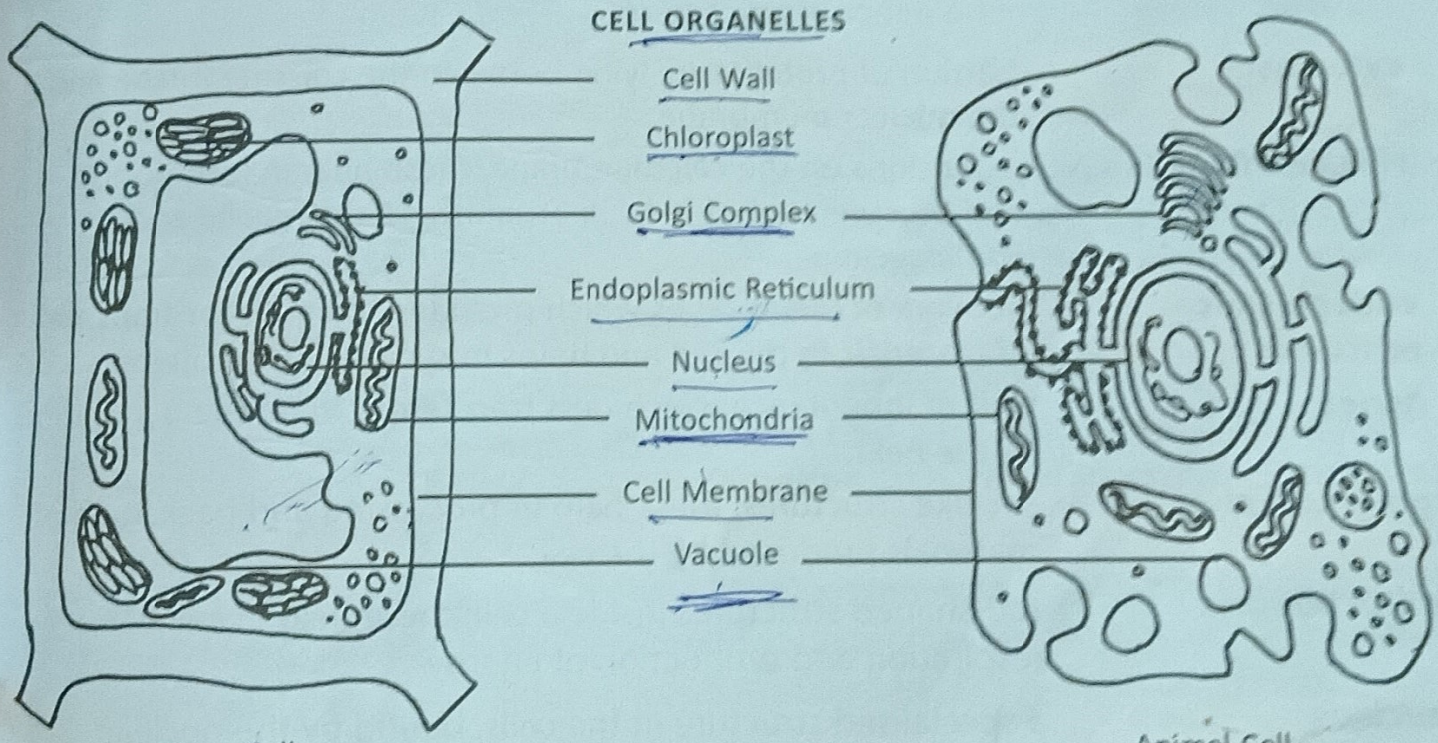
All the cells have some common features. However, they can appear different in different parts of the organism. For example, the blood and liver cells (in animals), the root or leave cells (in plants) have different appearances.

The plant and animal cells, however, have some major differences between them. Let us now, compare the features of the plant and animal cells.

▶ Comparison Between Plant and Animal Cells

Although all living cells have certain common features, detailed studies reveal some major differences between plant and animal cells.

Plant cells generally have a definite shape due to a rigid cell wall around them. In comparison, animal cells have a cell membrane as their outer cover. This provides flexibility to animal cells; hence they can show a large variation in their shapes. Moreover, plant cells have plastids; these are absent in animal cells. Plant cells generally have large vacuoles; animal cells, on the other hand, either lack vacuoles, or have very small vacuoles.



The main points of difference, between a plant cell and an animal cell, have be summarised in the table given below.

Difference between a Plant and an Animal Cell

Components/Characters	Plant Cell	Animal Cell
Shape	Fixed	Irregular/Not fixed
Cell Wall	Present	Absent
Plastids	Present	Absent
Vacuoles	One large vacuole is present	Vacuoles are either absent, or are present only as small vacuoles.

[**Note:** Cell organelles, other than the ones shown in the diagrams on the previous page, are a present in the cells. However, they will be discussed in higher classes.

Keywords

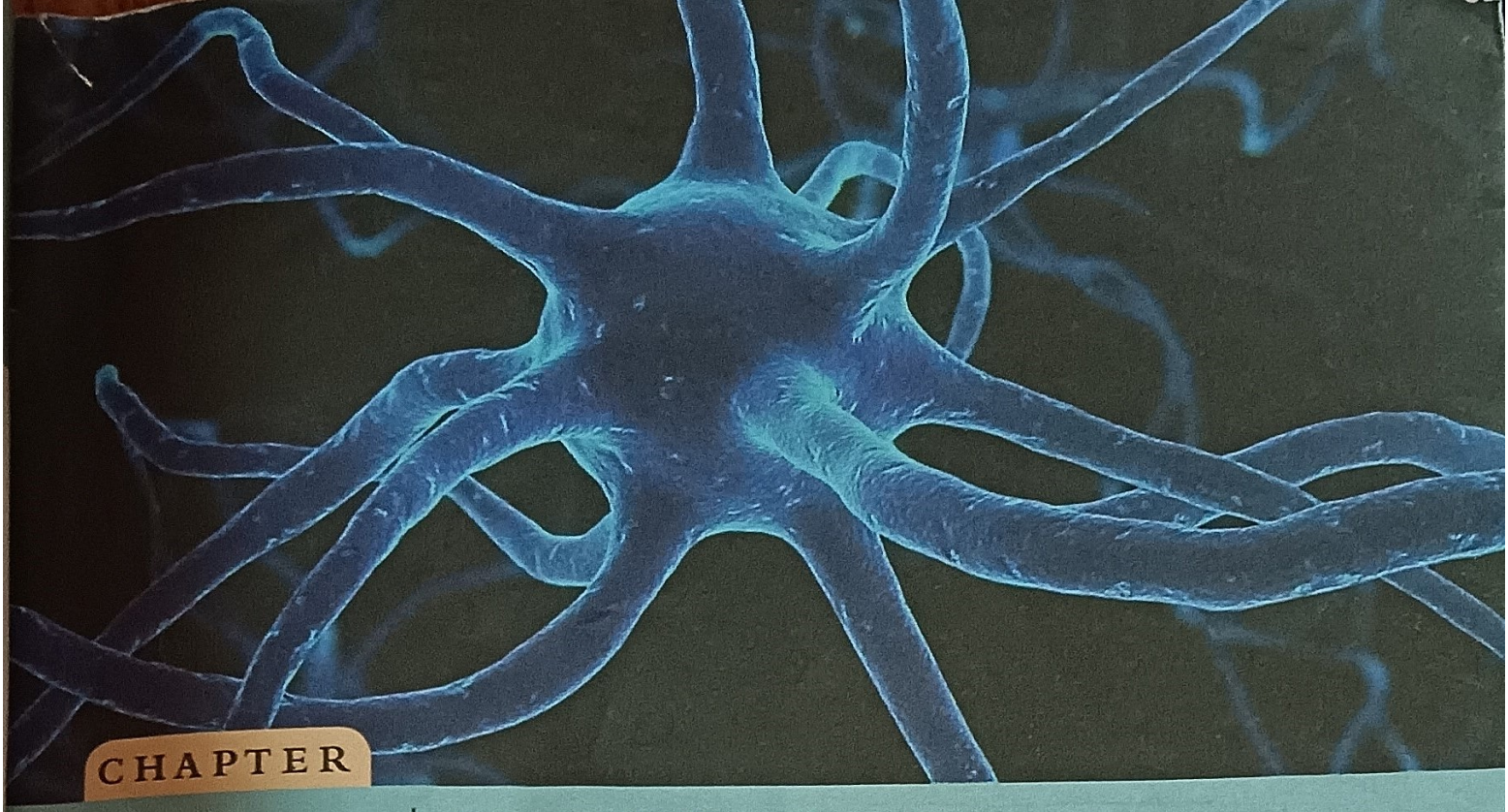
cell	basic structural and functional unit of life.
cell membrane	a thin membrane that surrounds the protoplasm of every cell.
cell organelles	a specialised sub-unit, within a cell, that has a specific function
chromosomes	thread-like structures found in the nucleus; responsible for the inheritance of characters.
cytoplasm	portion of protoplasm, lying between the cell membrane and the nuclear membrane.
cilia and flagella	extensions on the cell membrane, these help in locomotion and procurement of food in organisms like *Amoeba* and *Paramoecium*.
endoplasmic reticulum	network of membranes which provides channels for transport of materials in the cell and helps in synthesis of proteins.
genes	unit of inheritance which gets transferred from one generation to the next.
golgi complex	sac-like structures; these help in processing and packaging of materials produced by the cell.
mitochondria	rod-shaped structures inside a cell; these help in cellular respiration and production of energy.
nucleus	a specialised structure in the cells, bound by the nuclear membrane; responsible for controlling all cellular activities.

plastids	cell organelles found in plant cells. These may contain pigments which help in photosynthesis and are responsible for imparting colour to fruits, vegetables and flowers.
protoplasm	gel-like living matter present inside the cell membrane.
ribosomes	tiny granular structures found in the cytoplasm and on the endoplasmic reticulum; they help in protein synthesis.
tissue	group of cells performing a specialised function.
vacuole	sac-like membrane bound structures in cells; used for storing various materials.

You Must Know

1. Cell is the basic structural and functional unit of all living organisms.
2. Living organisms show variation in their cell number, shape and size.
3. Unicellular organisms, like *Amoeba*, are made up of a single cell; multicellular-organisms, like a mango tree or a parrot, are made up of many cells. Cell sizes may vary from (nearly) 0.1 micron (*Mycoplasma*) to 170 mm (Ostrich egg) in diameter.
4. A cell consists of living matter, called protoplasm, surrounded by a cell membrane. Plants, fungi and bacteria have an additional cover, known as the cell wall, outside their cell membrane.
5. Protoplasm consists of cytoplasm and a nucleus.
6. The nucleus controls all the activities of the cell. The cytoplasm contains many cell organelles; these perform various functions in a cell.
7. Some of the cell organelles, and their functions, are as follows:

   Mitochondria are responsible for respiration; green coloured plastids, or chloroplasts are the site of photosynthesis; golgi complex processes materials produced by the cell; vacuoles store excess water and waste; ribosomes help in protein synthesis, and cilia and flagella help in locomotion.
8. A tissue is a group of cells performing a specialised function.
9. An organ is formed by a group of tissues that perform a specialised function. When a number of organs work together, they form an organ system (for example, digestive system).
10. Plant and animal cells show some major differences. Plant cells possess a cell wall and plastids; these are not found in an animal cell. Also, plant cells contain large vacuoles; the vacuoles are either absent in animal cells, or if present, have a small size only.



CHAPTER

1 The Cell – Its Structure and Functions

There are a large variety of organisms on this earth that are all distinct in their form and structure. However, 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 'cells', the basic units of all organisms.

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 the cells in all organisms. These functions are essential for the survival of the organisms. We, therefore, regard the **cell** as the basic structural as well as 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 of different organisms.