Chapter

2

Cell - The Basic Unit of Life

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Our earth is a beautiful place where in different types of organisms co-exist. From minute mosses to huge conifers, invisible bacteria to huge blue whales all have a basic unit called 'Cell'. Let us study about the cell. Before the first microscope was invented around 350 years ago, people were not aware of the living world that was not visible to the unaided eye. Thereafter many scientists have been observing and describing unknown world with the help of microscopes.

Do you know?

A few of the many scientists mentioned are Athanasius Kircher (1601–1680), Jan Swammerdam (1637–1680), Antonie van Leeuwenhoek (1632–1723) and Robert Hooke (1635–1702) observed different things under the microscope

Antonie van Leeuwenhoek (1632–1723) in 1674 was one of the earliest to see living bodies like bacteria, yeast, protozoa, Red Blood Cell and the streaming life in a drop of water. He prepared several types of magnifying glasses, and used these (lenses) to study about both living and non living things.

You may recall that all living organisms carry out certain basic functions. Can you list those functions? Different sets of organs perform specific functions. Do you know, what is the basic structural unit of an organ? To study about basic structures, a proper use of microscopes, preparation of microscopic slides and staining is essential. (You can revise the use of microscope, preparation of microscopic slide and staining technique from Annexure.)

Discovery of the cell

It was in the year 1665 that Robert Hooke, a British scientist, observed thin slices of cork (soft bark from Oak tree) under a simple magnifying device which he had made himself (Fig-1)

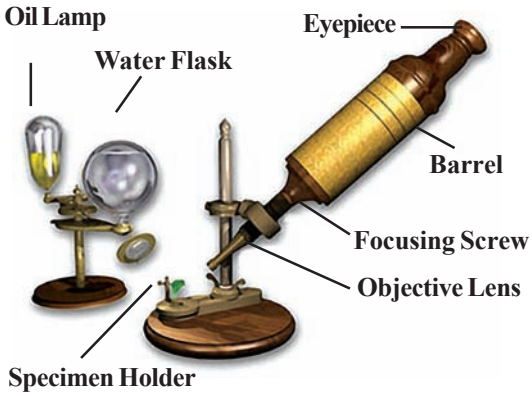

Fig-1 : Robert Hooke's Microscope

He observed that the cork resembled the structure of a honey comb consisting of many empty spaces or empty box like structures. He thought that the cork was made up of very small cavities. Robert Hooke called these cavities as "**cells**". Cell is a Latin word for a **little room** (Fig-2).

Fig-2 : The cells in the thin section of cork appeared like this to Robert Hooke

Now let us try to see what Robert Hooke might have observed in the cork.

Activity-1

Observing a match stick

In the place of cork, let us try to see a similar type of structure, as seen by Robert Hooke, in a section of match stick.

Take a match stick and soak it for half an hour in water and cut thin slices from it. Select a thin slice and place it on a slide with the help of a brush. Put a drop of water and cover it with a cover slip,without allowing air bubbles and observe it under the microscope. Draw the figure of what you have observed.

Compare your figure with Fig-2. Do you find both of them are similar or different? Have you noticed the box like structures? What are they called?

The discovery of 'cell' by Robert Hooke was a milestone in the history of science. Cells of cork and of match stick are dead cells. Can we see living cells under the microscope? If so, how? Will their structure be the same as those of dead cells? With the help of the given activities you will be knowing more about cells.

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Activity-2

Observing an onion peel

Peel an onion and cut out a small fleshy portion from the bulb [Fig-3(a)]. Break this piece into two small parts and try to separate them slowly [Fig-3(b)]. You will notice a thin translucent membrane holding the pieces together. Take out the membrane, cut a small piece from it and spread it evenly in a drop of water on a slide. While placing the peel on the slide, make sure that it is not folded. Cover it with a cover slip and observe it under the microscope. Draw the figure of what you have observed. Compare your figure with fig-4.

Are there any differences between these two figures? If so. What are they ?

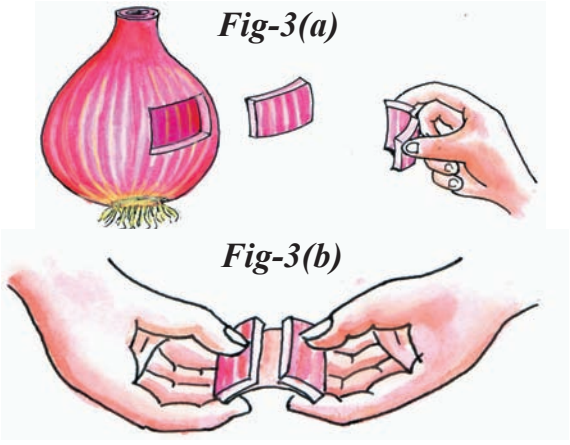

Fig-3 : Extracting the peel from an onion

The onion peel cells that you observed are plant cells. Do animal cells also look similar to these cells?

Now let us observe cells from our own body (animal cell).

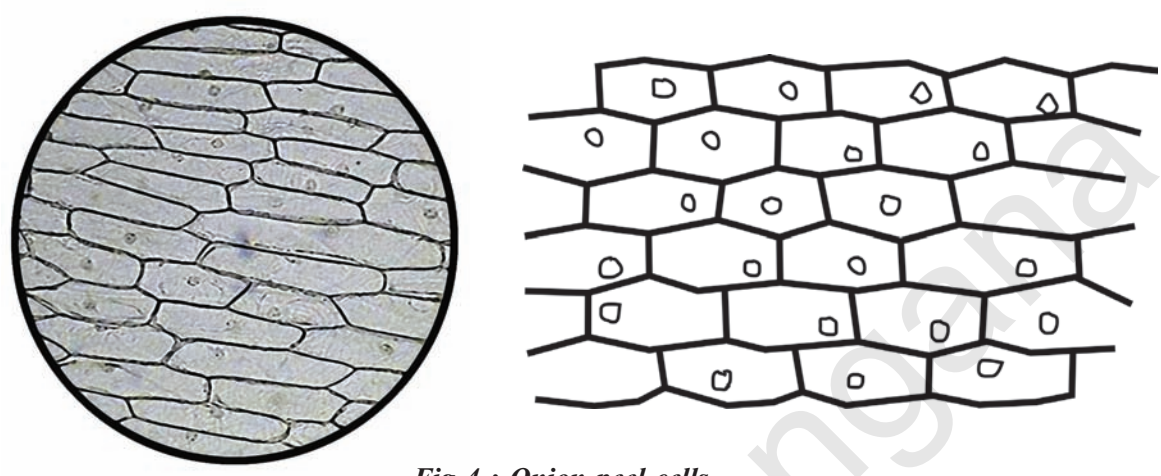

Fig-4 : Onion peel cells

Activity-3

Observing human cheek cells

You have already prepared a temporary slide of an onion peel. Now prepare a slide of your own cheek cells. Wash your mouth cleanly.Take a clean wooden or plastic spoon and scrape the inner surface of your cheek.

Keep two things in mind. Firstly, wash the spoon thoroughly before using it. Secondly, do not scrape too hard or else you may hurt yourself. Now take the scrapping that you have collected, and place it in a drop of water taken on a slide. Cover the slide with a cover slip. Observe the slide under the microscope. Draw the figure of what you have observed. The cells that you see would be very similar to those shown in Fig-5. Is the outer covering of both the types of cells similar?

Fig-5 : Human cheek cell (without stain)

Do you know?

The observations of a scientist named Robert Brown (1773–1858) have made a significant contribution to our understanding of cells. Among different parts of a cell, the nucleus is the most well known part. In 1831, while observing cells in the epidermis of Orchid leaves, Robert

Robert Brown (1773–1858)

Brown noticed a circular spot that was slightly more opaque than the surrounding areas (Fig-6). He noted that similar structures were present in other cells as well. Robert Brown claimed that this structure was an integral part of the cell and called it nucleus.

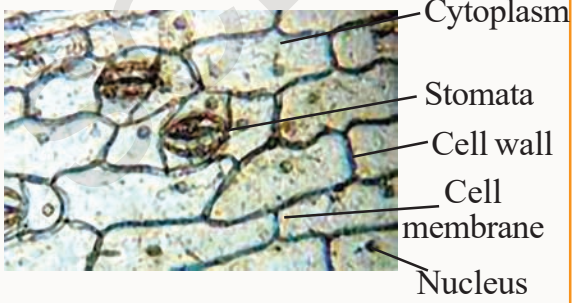

Fig-6 : Plant Cell

In the above figure we can see stomata and nucleus. Stomata are the pores through which the leaves exchange the gases.

Activity-4

Observation of the Nucleus in onion peel cells

For this, you need to peel a membrane from an onion once again. Now keep this membrane on a slide and add 1-2 drops of the stain (saffranin, methylene blue or red ink). Cover this with a cover slip and leave it for about five minutes. Then add water drop-wise from one side of the cover slip while removing the extra water with a filter paper from the other side. This will help in washing away the extra stain. Now observe this slide under a microscope.

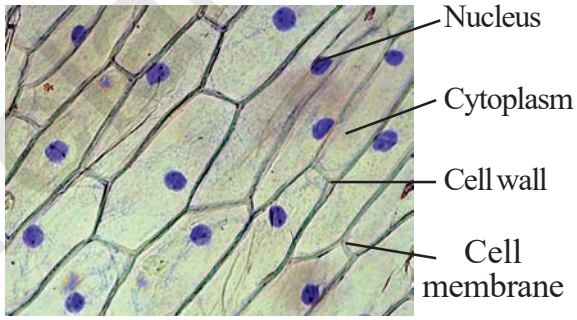

***Fig-7 : Onion cell showing nucleus* (stained)**

The blue or red spot observed within the cell is the nucleus.

Now let us see the nucleus in our own cells (animal cells).

Acitivity-5

Observation of the Nucleus in cheek cells

You could also take cells from the inner layer of the cheek, stain them with saffranin or methylene blue and try to observe the nucleus in them using microscope.

Now let us compare the onion and the cheek cells.

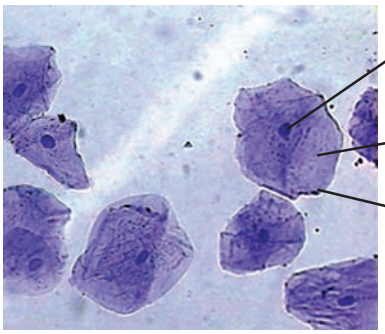

Fig-8 : Cheek cells showing nucleus (stained)

- What structures are observed in the cells?
- Did you see a tiny dark stained body in all the cells?
- Are they located in the centre in both the cells?
- What is the difference between boundary of onion cell and cheek cell?

The outer layer of a cheek cell is the **cell membrane**. This gives a shape to the cell and selectively allows substances to pass through it, in and out of the cell. About this you will learn more in higher classes. On the other hand, in the cells of the onion peel, the outer covering is clearer than in cheek cells. It is because there is another layer present over the cell membrane, known as the **cell wall**. This gives rigidity and strength to the cell.

In both the cells you can find a dense round body called **nucleus**. In cheek cells the nucleus is present more or less at the centre of the cell, whereas in onion cells it is not in the centre, but towards periphery. The jelly like substance between the nucleus and the cell membrane is called **cytoplasm**. It is a heterogeneous material. Ask your teacher why it is called as heterogeneous. It contains membrane bound structures, called **cell organelles**, as well as more complex chemicals. Cell organelles help to carry out several functions within the cell and you will study them in class IX. You shall also study why cells are considered to be, **'The basic structural and functional units of the living body'.**

DIVERSITY IN CELLS

In onion peel cells you have seen that nearly all cells are similar in structure and shape. If you repeat this experiment with peels of onions of different size, what do you think your observations would be? Does bigger onions have bigger cells?

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There are millions of living organisms in nature. They have different shapes, sizes and vary in the number of cells they contain. To know more about this, let us observe some more cells.

You will observe permanent slides of *Amoeba, Paramoecium, Chlamydomonas* etc. in the chapter on microorganisms. All these are single celled and are called **unicellular organisms** (Uni-single). In these, the single cell is capable of performing all the life processes like obtaining food, respiration, excretion, growth and reproduction.

Living organisms having more than one cell are called multicellular organisms. Basic life processes in multicellular organisms are carried out by different types of cells.

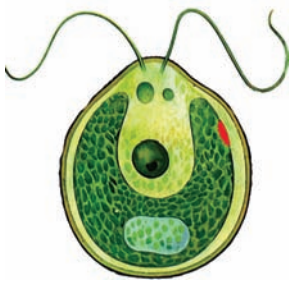

Fig-9(a) : Chlamydomonas

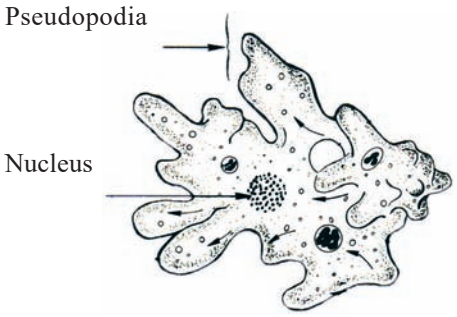

Fig-9(b) : Amoeba

Fig-9(c) : Escherichia coli (Bacteria)

Fig-9 : Unicellular organisms

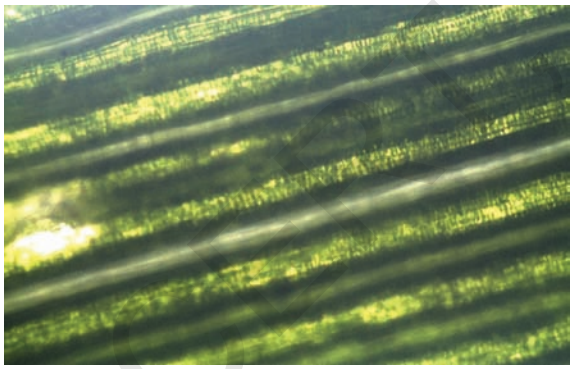

Fig-10 : Cells in a grass blade

Activity-6

Observing cells in a leaf

Take a peel of grass leaf on the slide, put a drop of water, cover it with a cover slip and observe it under the microscope.

Is your observation similar to the one given in fig-10? You may have seen different types of cells or groups of cells in the slide?

You can do this experiment with other leaves as well. It is preferable to choose thin leaves.

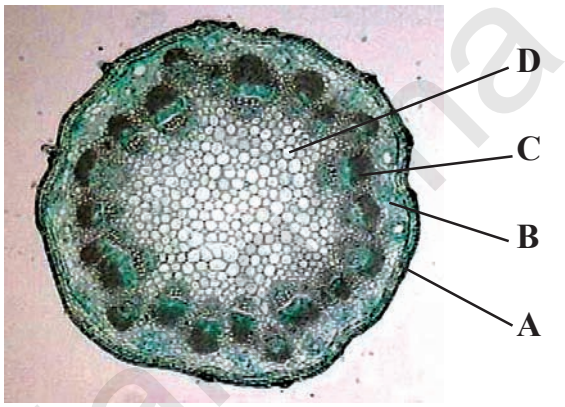

Fig-11 : Transverse Section of Dicot Stem (Tridax)

Observe the given diagram of a section of the stem of Tridax/Spinach. Note the different types of cells that you observe in the section. Fig-11 shows 4 different groups of cells as described below:

Group A cells form the outermost layer of the stem and they give shape to the stem as well as protection.

Major portion of stem is made up of **group B** cells. In a green stem this portion has special organs that carry out photosynthesis.

Group C consists of cells that join together to form long structures that conduct food and water in the plant body.

Group D cells are present in the centre of a young stem and form a hollow structure in the matured stem.

Thus in Transverse section of Tridax (Gaddichamanthi) /spinach stem you can see different shapes of cells in one plant. Think why do the stems contain different types of cells?

Activity-7

Observe the given figures of different kinds of cells in the human body. Observe permanent slides of these cells in your school laboratory.

Draw the diagram of these and label the parts that you have learnt so far and collect information about the functions of these cells.

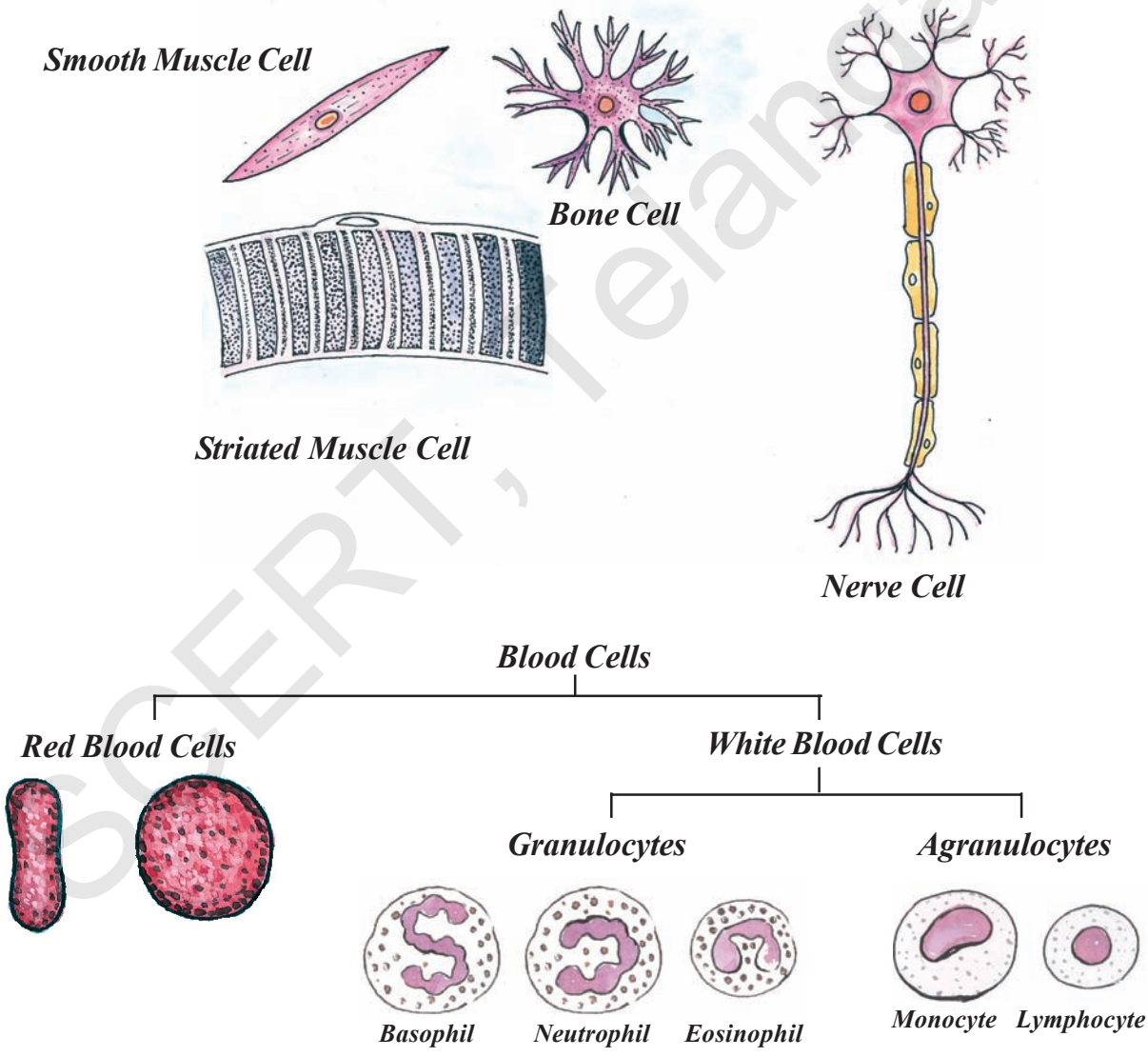

Fig-12 : Shapes of the different cells in the human body

Fill the following table with the help of your teacher or with reference books.

S. No.	Name of the Cell	Shape of the Cell	Parts observed in it
1	RBC		
2	Smooth Muscle Cell		
3	Nerve Cell		
4	Bone Cell		
5	White blood cell		
6	Striated muscle cell		

- Are there any similarities in shape of the cells?
- Do you find nuclei in all the cells?
- Can you name the longest cell in all animals?

So far you have seen many kinds of cells. Are all cells similar in shape and size? The shape and size of cells vary considerably but all of the cells are ultimately determined by the specific function of the cells. How do you define the shape of Amoeba? You may say that the shape appear irregular. In fact Amoeba has no definite shape. It keeps on changing its shape by protruding out of its body. These are called **Pseudopodia** (Pseudo: false, Podia: feet). The projections appear and disappear. Pseudopodia help Amoeba in feeding & locomotion.

Are the cells in an elephant larger than the cells in a man?

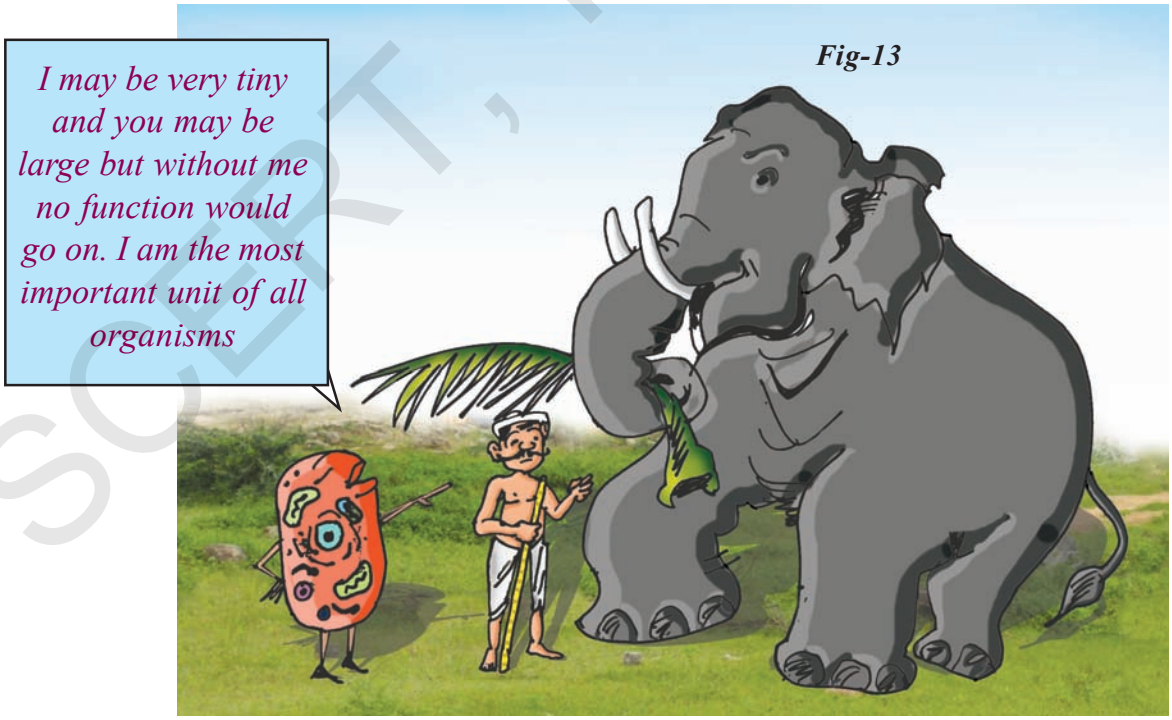

Fig-13

Have you listened to the words of the cell? Guess how big a cell is? Is the number and sizes of cells in both man and elephant the same? Are the cells of an elephant bigger than that of a man?

The size of the cells in living organism may be as small as the millionth of a meter (micron) or may be as large as a few centimeters. Majority of the cells are too small to be seen with unaided eye. They can be seen only through a microscope. The smallest cell 0.1 to 0.5 micrometers (Microns) is found in Bacteria. A human liver and kidney cell is 20 to 30 micrometers in size.

1 Meter = 100 Centimeters (cm)

1 centimeter = 10 millimeters (mm)

1 millimeter = 1000 micrometers/ microns (µm)

1 micrometer = 1000 nano meters (nm)

Some of the cells can be seen with naked eyes. Human nerve cell is nearly about 90 to 100 cms. long. The largest cell, measuring nearly 17 cm X 18 cm, is the egg of an Ostrich.

The size of the cell is related to its function. For example, nerve cell in both in man and elephant are long and branched. They perform the same function of transferring message in both of them.

The size of the organism is depends on the number of cells and not on the size of the cell. Cells are of different shapes, sizes, and number.

Key words

Cell, Cell membrane, Cell Wall, Cytoplasm, Nucleus, Unicellular, Multicellular, Organelles, Pseudopodia, staining, magnification, focusing.

What we have learnt

- All living organisms are made of cells.
- Cells were first observed by Robert Hooke in 1665.
- The cell has 3 main parts- The cell membrane, Cytoplasm, Nucleus.
- Robert Brown discovered nucleus in orchid leaf.
- Plant cells differ from those of animals in having an additional layer around the cell membrane termed as cell wall.
- Cell wall gives strength and rigidity to plants.
- Cell exhibits a variety of shapes and sizes and number.
- Single celled Organisms are called unicellular organisms and those with more than one cell are called multicellular organisms.
- Basic functions in multicellular organisms are carried out by different types of cells.

Improve your learning

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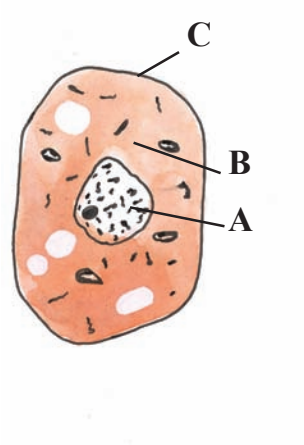
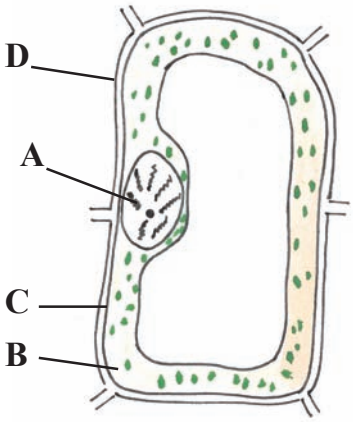
1. Who discovered the cell for the first time? What procedure did he follow? (AS 1)
2. Name the factors on which shape of the cells depend? (AS1)
3. Distinguish between unicellular and multi cellular organisms? (AS1)
4. How will you prepare slide without drying quickly? (AS1)
5. Deekshith said that, "we can't see cells with unaided eye". Is the statement true or false? Explain. (AS1)
6. Correct the statement and if necessary rewrite. (AS1)
   a. Cell wall is essential in plant cells.
   b. Nucleus controls cell activity
   c. Unicellular organisms perform all life processes like respiration, excretion, growth, and reproduction.
   d. To observe nucleus and organelles clearly, staining is not necessary.
7. Describe the functions of nucleus. (AS1)
8. What is difference between cells in onion peel and cells in spinach? (AS1)
9. Label parts of diagrammes given in page 25, And identify which is plant cell and which is animal cell. (AS5)
10. What questions will you pose to know about diversity in cells? (AS2)
11. If you want to know about unicellular and multi cellular organisms, what questions will you pose? (AS 2)
12. Get some floating slime from a puddle, pick a very small amount of slime and put it on a slide. Separate out one fiber and look at it through the microscope. Draw the digram of what you observed. (AS 3)
13. Collect different kinds of leaves from your surroundings and observe the shapes of the epidermal cells under microscope. Make a table which contains serial number, name of the leaf, shape of the leaf, shape of the epidermal cells. Do not forget to write specific findings below the table. (AS 4)
14. Make sketches of animal and plant cells which you observe under microscope. (AS5)
15. Ameer said "Bigger onion has larger cells when compared to the cells of smaller onions"! Do you agree with his statement or not? Explain why? (AS 2)
16. How do you appreciate the fact that animals, human beings and trees are made of cells,which are very small and we can look at them through microscope? (AS 6)
17. Deepak said, "A plant can't stand erect without cell wall "? Do you support this statement? (AS 7)





A .....

B .....

C .....

A .....

B .....

C .....

D .....

ANNEXURE

Major improvements were made in microscopes from around 400 years ago. In the early days, there used to be just a single lens in the microscope. This is known as the simple microscope. Gradually better lenses were made. The compound microscope with a combination of more than one lens was also invented. The first compound microscope was

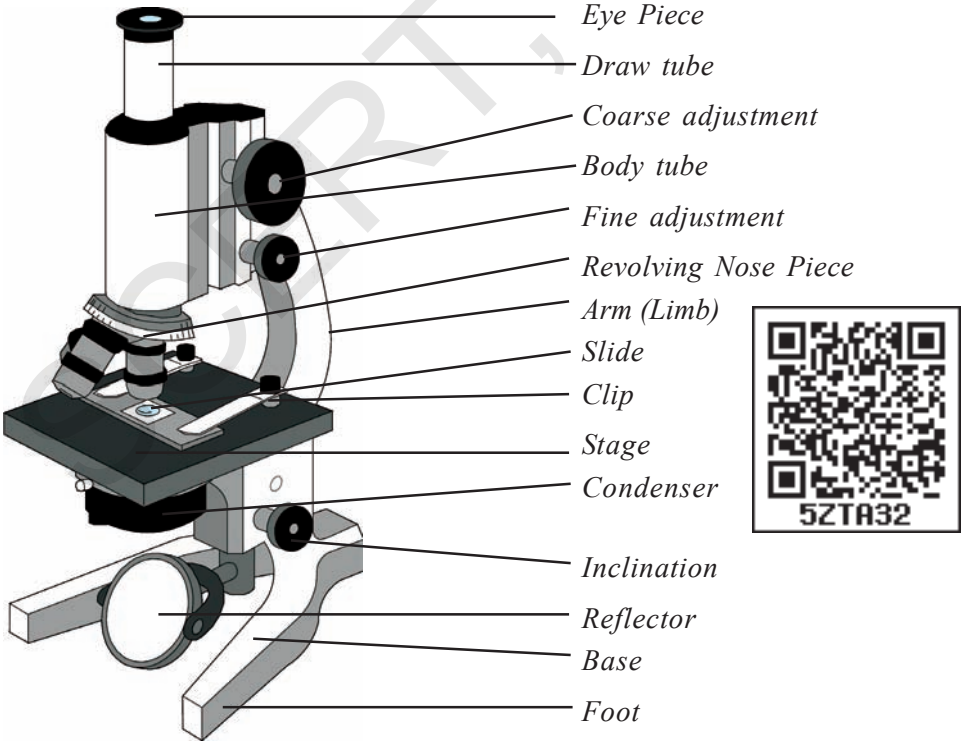


Fig-13: Compound Microscope

made in the year 1595 by the scientist named Jaquarius Janssen. Robert Hooke's microscope too was a compound microscope.) With the advent of compound microscopes, more detailed observations were made possible. Let us see how we can use the microscope.

The correct way to use microscope.

Recall what you have learnt in class VI about microscope. Now let us learn correct way to use microscope.

1. Check the microscope in the following way (a) remove the lens cap and take out the lens clean it with soft and clean cloth. (b) If the knob is loose, change the piece of valve tube covering it. (c) Mirror of the microscope is always to be kept clean. Adjust it to light in such an angle that you see a bright back ground, while looking through the lens.
2. Usually you will find three or four objective lenses on a microscope. They are 4X, 10X, 40X and 100X powers. When coupled with a 10X (most common) eyepiece lens, we get total magnification of 40X (4X times of 10X), 100X, 400X and 1000X.
3. Wash the glass slide well and wipe it dry with clean cloth.
4. You have to move lens up and down till image looks sharp, this is called **focussing.** While doing so, make sure that the material doesn't touch or water in which it is kept does not touches the lens, to prevent it cover the material with a cover slip (very thin glass).
5. Put a drop of water with finger or dropper, put specimen in water, you may use needle brush or babul thorn. With the help of needle, cover specimen with cover slip. Dry out excess water around cover slip with filter paper or blotting paper.
6. Fasten the slide under the clips on microscope by moving the slide sideways so that the things you want see focus right under the lens, move the lens up and down to focus. Now decrease or increase the amount of light by rotating the mirror. Do this until clear appearance of object with clear magnification is observed.

Preparation of a microscopic slide

The study material to be viewed under a compound microscope is mounted on a slide. For this:

1. Microscopic slide is prepared on a 2mm thick, 3cm X 8cm rectangular strip of clear and clean glass piece called slide.
2. If the object is thin and flat it can be directly placed on the glass slide towards the centre in a drop of water with the help of a soft and fine brush. A drop of glycerin is added to the water if the slide is to be kept for longer time. Glycerin saves the material from drying (dehydration).
3. If the object is thick, cut it into a thin, nearly 0.5 mm or less thick sections with the

help of a sharp razor. If the object is transparent, it may be stained with iodine, saffranin, fast green or any other suitable chemical dye, to bring contrast between the kinds of cells in the material.

4. Place the stained object on a slide. Add a drop of water should cover with cover slip without forming air bubbles. Remove excess of water on the slide using a blotting or filter paper.

The Cover slip protects the lense of the microscope from coming in contact with water and specimen. Now your slide is ready to observe.

Fig-14: Preparation of microscopic slide

Staining Techniques

This technique is based on the fact that there are a few coloured substances that get attached to different parts of a cell. This helps to highlight particular areas in the cell.

These colouring agents are known as stains and the process is called staining. We can use this technique to observe several things like microorganisms, different parts of the cell, etc. For this we need to use stains like saffranin, methylene blue etc. Red ink also works as an adequate stain. To make saffranin solution, dissolve ¼ tea-spoon of saffranin in 100 ml. of water.