

## 11. Cell Structure and Micro-organisms



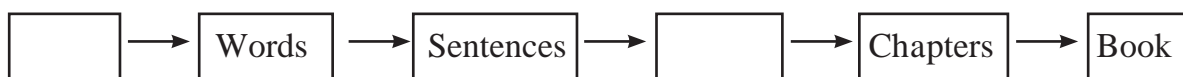
**Let's recall.**

What is the name of the minute components of which the body of a living organism is made? Is the number of these smallest units the same in the bodies of all living organisms?

### Cell

We have learnt that cellular organization is the primary characteristic of all living organisms and that the cell is the fundamental structural and functional unit of living organisms.

**Complete the flow chart:**

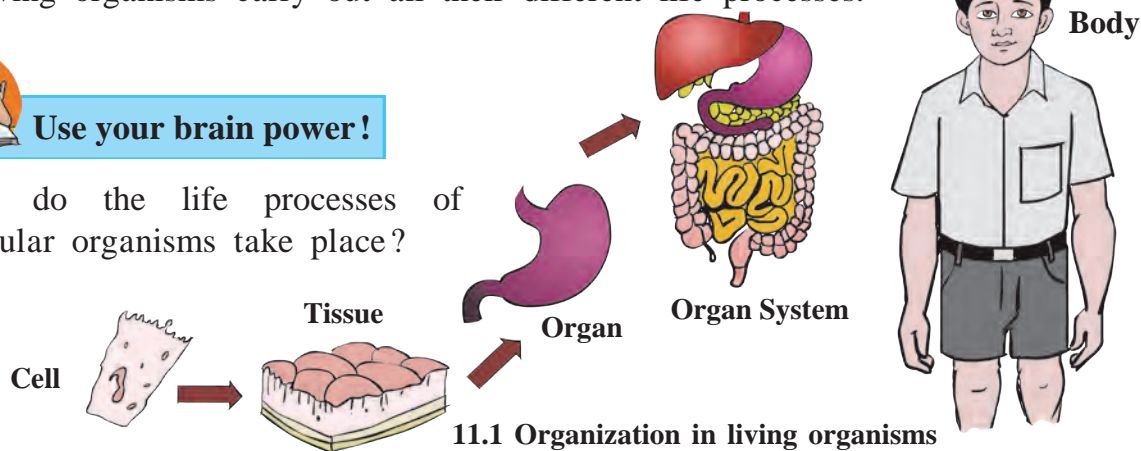


We see the structural organization of a book in the above flow chart. Similarly, there are organizational levels in living organisms, too. These are : cells, tissues, organs, organ systems, organism. Cells form the basis of the structure and function of all living organisms. It is only with the help of cells that living organisms carry out all their different life processes.



**Use your brain power !**

Where do the life processes of unicellular organisms take place?



11.1 Organization in living organisms

### Great Scientists



In 1665, a scientist, Robert Hooke observed a thin section of cork under a microscope. In this section, he saw hexagonal compartments like those of a bee-hive. He named those compartments 'cells'. This term is derived from the Latin word '*cella*' which means 'small room'.



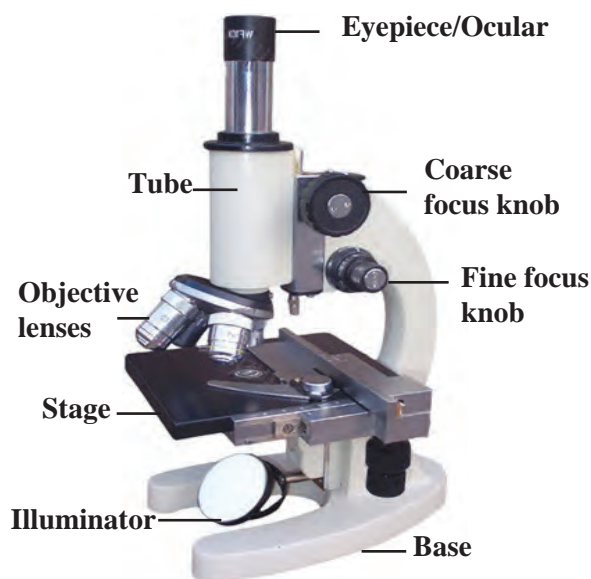
In 1838, the two scientists M. J. Schleiden and Theodore Schwann formulated a theory about cellular structure which stated, 'All the living organisms are made up of cells and the cell is the fundamental component of living organisms'. In 1885, Rudolph Virchow stated that all cells are formed from pre-existing cells.



## Measurement and observation of cells

In 1673, Anton van Leeuwenhoek assembled various lenses to construct a microscope. He was the first to observe live bacterial and protozoan cells under the microscope.

Cells are extremely minute in size. We cannot see cells with the naked eye. Micrometre and nanometre are the units used for measuring their sizes. The compound microscope is used for observing cells. An object on a glass slide magnified many times by the lenses of this microscope.



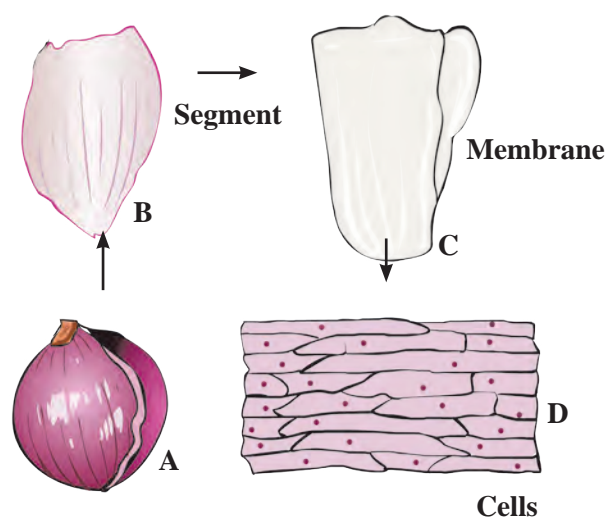
11.2 Compound microscope

1 centimetre = ..... millimetres, 1 millimetre = 1000 micrometres,  
1 micrometre (or micron) = 1000 nanometres



### Let's try this.

Take a piece/segment of onion and carefully separate the thin skin from its concave surface with the help of forceps. Place the membrane on a glass slide and put a drop of water on it. (Take care that the membrane does not get folded while placing on the slide). Put a drop of a dilute solution of iodine or eosin over it and observe under the 10X objective of the compound microscope. Don't forget to put a cover-slip over the onion skin on the slide before placing it under the microscope.



11.3 Onion cells seen under a compound microscope

In the same way, observe the cells from various parts of plants like leaves, bark, root tips, etc. Do you remember that last year you had observed the amoeba and paramecium that are found in water?



### Can you tell ?

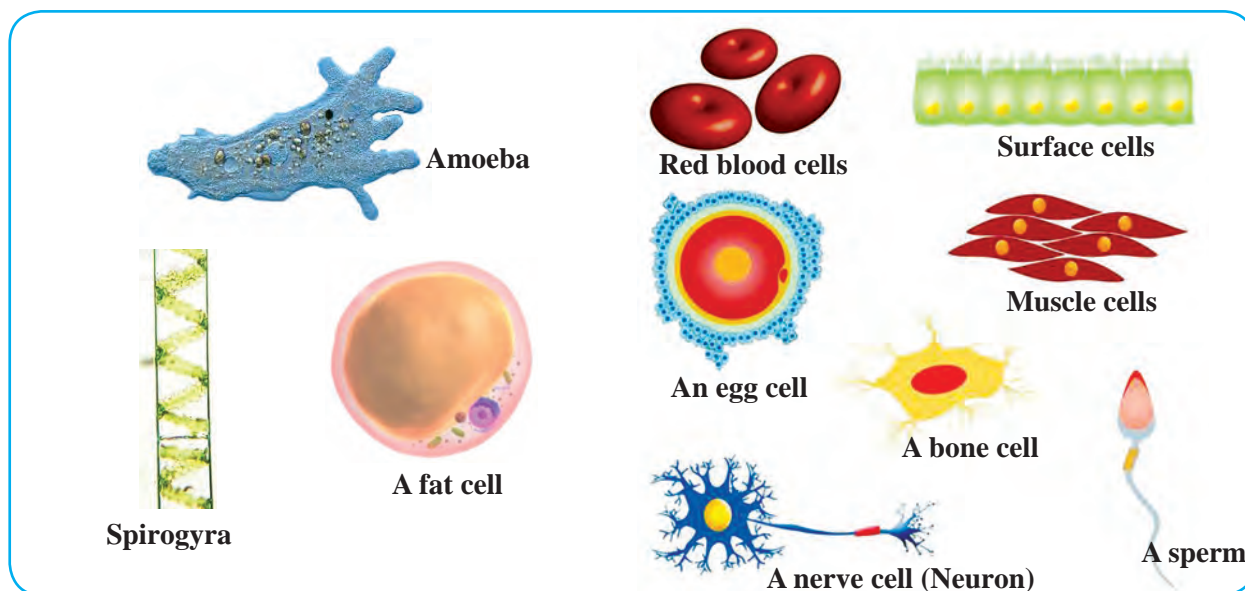
Are the cells that you observed, all alike? What is their structure? What are their shapes?

### Books, my friends!

Collect interesting information about cells, from the reference books in the school library. For example, the largest cell, smallest cell, etc.

## Cell size

There is great variation in the shapes of cells. Their shapes are mainly related to their function. Observe the cells of different shapes shown below.



11.4 Various cells

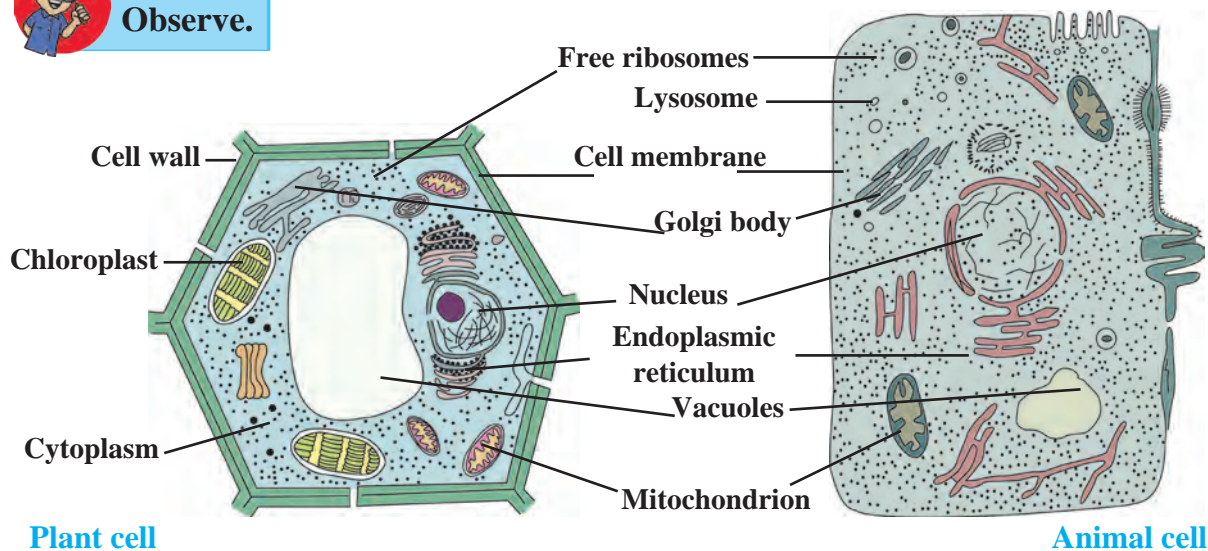
Cells are of many different shapes e.g. circular, rod-shaped, columnar, spiral, oval, rectangular, etc.

Each cell contains various components for carrying out the life-processes of the living organism. These components are called organelles. These organelles are studied in detail with the help of the electron microscope which can magnify images up to ( $2 \times 10^9$ ) two billion times their actual size.

There are two main types of cells - animal cells and plant cells. These cells consist of various types of membrane-bound cell organelles. Plant cells have a definite shape due to the presence of the cell wall around them. Besides, unlike animal cells, plant cells contain single large vacuole. All these cells are known as eukaryotic cells.



**Observe.**



11.5 Cells as seen under the electron microscope

The cell has four main parts - the cell wall, cell membrane, cytoplasm and cell organelles.

- (a) **Cell wall** : The cell wall is the outermost covering of a cell. It is present only in plant cells.
- (b) **Plasma membrane** : The plasma membrane, also called the cell membrane, is a kind of thin covering. It is extremely delicate and flexible. It is the outermost covering of animal cells.
- (c) **Cytoplasm** : The liquid part in the cell, present around the nucleus is called cytoplasm. It occupies the space between the plasma membrane and nucleus. Cell organelles are scattered in the cytoplasm.
- (d) **Cell organelles** : These mainly include the nucleus, endoplasmic reticulum, Golgi bodies, lysosomes, mitochondria, vacuoles, plastids, etc. Plant cells contain chloroplasts.

Which are the common components of plant and animal cells? Which are the different ones?

The nucleus is the most important organelle of the cell. There is a porous double membrane around it. The nucleus controls all functions of the cell. The endoplasmic reticulum is a sprawling net-like organelle. Its function is to make necessary changes in the proteins produced by ribosomes and send them to the Golgi bodies. Golgi bodies are made up of several flat sacs. Their function is the proper distribution of proteins. Mitochondria and plastids are organelles with double outer coverings. As mitochondria produce energy, they are called the powerhouses of the cell. The chloroplasts in plant cells carry out the function of photosynthesis. Vacuoles help to throw out waste products of the cell. Vacuoles in animal cells are small whereas there is only one large vacuole in a plant cell.



**Use your brain power!**

1. How do the cells acquire definite shapes?
2. How are cells protected?
3. What are the needs of cells?

### Micro-organisms



**Let's recall.**

1. What is meant by micro-organisms?
2. Categorise the following organisms into two groups, according to size - amoeba, paramecium, euglena, snail, elephant, pigeon, worms.

We have learnt that there are countless living organisms on the earth. Of these, the organisms which cannot be seen with our eyes but can only be observed under a microscope are called **micro-organisms**.

### Occurrence of micro-organisms

Micro-organisms are present all around us in the air, water, soil, food, sewage, garbage as well as in the bodies of plants and animals, including humans. Some micro-organisms are solitary, that is, they live singly, e.g. amoeba, paramecium, whereas some live in colonies. Some micro-organisms live on the remains of dead plants and animals.



## Observation and measurement of micro-organisms



### Try this.

1. Keep a moistened piece of bread or bhakari in a closed box. Observe it after 3-4 days using a magnifying lens.

2. Observe a drop of muddy water or water from a stagnant puddle, under the compound microscope.

3. Take a drop of yoghurt or buttermilk on a glass slide and observe it under a compound microscope.

In your notebook, draw sketches of the microbes you observe.



### Use your brain power!

Can the point of a needle accommodate micro-organisms?

### Nature of micro-organisms

Among the sketches you have drawn, do you find any of the micro-organisms you see below? What inferences can you draw about their sizes?



11.7 A variety of microbes



### Do you know?

We cannot see objects smaller than 100 micrometres in size, with our eyes. So, we make glass slides of the micro-organisms and observe them under a compound microscope. However, if a magnification of 1000 x proves to be insufficient, then, we need to use an electron microscope to observe those micro-organisms.

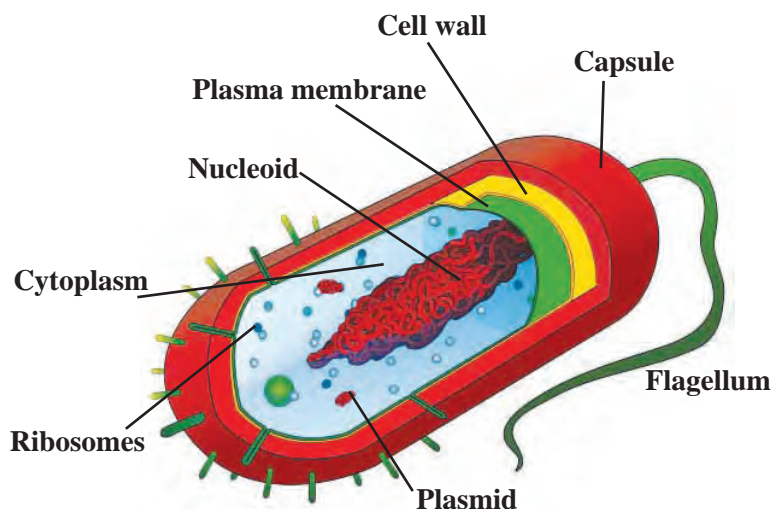
#### Sizes of some microbes :

- Paramoecium : about 100 micrometres
- Bacteria of typhoid: 1 to 3 micrometres
- Polio virus: 28 nanometres

Microbes measure less than 100 micrometres.

Even in these minute organisms, their organelles carry out all life-process within the single cell.

Some micro-organisms like the fungus that grows on bread or strands of algae in ponds are multi-cellular. However, most micro-organisms such as bacteria and viruses are unicellular. They have a somewhat different cellular structure. They do not have the membrane-bound organelles found in eukaryotic cells. The plasma membrane, cytoplasm and nucleoid are their only components. Such cells are called prokaryotic cells.



11.6 Prokaryotic cell

### National Institutions

**National Center for Cell Science (NCCS), Pune,** is an institute involved in research in the field of cell science (cytology), biotechnology, etc.

**Web address:**

[www.nccs.res.in](http://www.nccs.res.in)

### Growth of micro-organisms

Each micro-organism needs a specific environment for growth and reproduction. Many microbes need oxygen for their growth whereas some microbes can grow without oxygen. Some micro-organisms survive even in extreme and adverse conditions like the ocean floor, ice in polar regions, hot water springs, etc. During adverse conditions, micro-organisms form a thick covering around themselves and stop their life-processes. On return of favourable conditions, they come out of the protective covering and continue their life processes.

#### Where do the micro-organisms grow?

**Medium :** Soil, water, decaying matter, etc.

**Temperature :** 25° - 37°.

**Nutrition :** specific nutrients, e.g. algae-chlorophyll, oxygen.

**Atmosphere :** Moist, humid, warm

According to shape, and life-processes, micro-organisms are classified as algae, fungi, protozoa, bacteria and viruses.

### Useful micro-organisms



**Try this.**

Take two earthen pots half filled with soil and mark them 'A' and 'B'. Mix some waste material like garden waste, dung, fruit peel, vegetable stalks, paper scrap, etc. with the soil in pot 'A'.

Mix things like pieces of glass, scrap metal, plastic bags, etc. with the soil in pot 'B'. Keep both pots at the same spot in the garden and observe them after 3 to 4 weeks.

**Can you tell ?**

Did the garbage in pot 'B' remain unchanged?

Where did the garbage in pot 'A' disappear? Why?

Microbes present in soil, dung, etc. decompose the garbage to obtain food material. As a result, garbage is soon converted into manure of the best quality and our surroundings are kept clean. As in the case of garbage, for proper sewage disposal, too, microbes are released into the sewage so as to help in the quick decomposition of the organic compounds in it.

**Use your brain power!**

Why should dry and wet waste be collected separately?

**Can you tell ?**

Observe the roots of the pea, bean and fenugreek plants. What could be the functions of the nodules on their roots?

We have seen that some micro-organisms present in the soil and those in the root nodules of leguminous plants convert atmospheric nitrogen into its compounds. These nitrogenous compounds help to increase soil fertility and thereby the protein content of the pulses grown in that soil.

**Project :** Visit the garbage depot near your village/city. Find out the reason for burying the garbage in the large pits there?

**Let's recall.**

What does your mother do to make yoghurt from milk?

If a few drops of yoghurt or buttermilk are mixed with lukewarm milk and it is kept at that temperature for 8-10 hours, microbes present in the drops of yoghurt quickly multiply and the milk gets converted into yoghurt. Microbes are thus useful for producing milk products like butter, buttermilk, cheese, etc.

**Fermentation**

The chemical process of conversion of one type of carbon compound into another type of carbon compound by the action of micro-organisms is called fermentation. Heat is generated in this process and carbon dioxide and some other gases are released. These gases cause an increase in volume, e.g. bread dough and idli batter are seen to 'rise'. The process of fermentation is used for making yoghurt from milk, producing alcohol from grains and fruits, bread from flour as well as in the production of acetic acid, citric acid, lactic acid, vitamins, antibiotics, etc.

**Use your brain power!**

1. Why is yoghurt mixed in the batter or dough for making *rava-idli*, *bhature*, *naan*?
2. How do preparations like yoghurt, idli, dosa become easy to digest?

If microbes are allowed to grow in batter, dough, fruit juices, etc., they break down these substances producing new compounds as they grow and multiply in them. This microbial process is used in the production of various common foodstuffs.

**Books, my friends!**

Who discovered the process of fermentation?



Sometimes, when you are ill, the doctor prescribes capsules or injections of medicines like penicillin. These types of medicines destroy the pathogens and retard their growth. They are called antibiotics. Antibiotics are produced with the help of specific microbes.

Diseases like tuberculosis, typhoid, cholera, etc. which were previously considered incurable, have now come under control because of antibiotics.

Domestic animals too can be protected from various diseases by mixing antibiotics with their food. Plant diseases can also be controlled with the help of antibiotics.



#### **Always remember –**

Though antibiotics are useful for curing certain diseases, they can be harmful if used without consulting a physician. Hence, a course of antibiotics should be completed strictly following the doctor's prescription. In fact, we should not take any medicines on our own to treat ailments like body-aches, headaches, common colds, etc.



#### **Find out.**

Why are infants vaccinated according to a fixed time schedule?

What is a vaccine?

A vaccine is produced in a laboratory with the help of microbes, that gives immunity against a particular disease. If we have been vaccinated against any disease, our immunity i.e. resistance to that disease, increases, so that the possibility of contracting that disease is greatly reduced.

Microbes are also used in processes like tanning of skin, production of ropes and strings from agave. Some microbes use oil for their growth. Such microbes are used to clear a layer of oil floating on the surface of an ocean or lake formed due to a leak or a spill i.e. to clear an oil slick.

Farm waste, human urine and faeces, wet garbage, etc. is collected and used in a biogas plant to produce biogas and fertilizer.

### **Harmful micro-organisms**



#### **Let's recall.**

What happens to the sweetmeat or bread forgotten in a lunch-box for three or four days?

If jars of pickles, jams (*murabba*), etc. are opened after a long time, a round layer of white scum or black particles may appear to have formed on the surface. In summer, milk and meat get spoilt quickly. Fungus grows quickly on moist and stale food. What do we do with such spoilt food? Why?

#### **Food poisoning**

As they use foodstuffs for their own nutrition, some microbes release toxic materials (enterotoxins), into the food. Such toxins spoil the food. Eating such spoiled food can cause loose motions and vomiting.





### Use your brain power!

1. How will you know that a foodstuff is spoilt?
2. What precautions will you take while purchasing food? Why?
3. Why do food poisoning incidents occur during marriage or other community feasts?

### Pathogens : Disease-producing micro-organisms

Pathogens may be present in water bodies contaminated with sewage and dirt from the surroundings, in food left uncovered in unhygienic conditions with houseflies sitting on it, etc. If such contaminated food or water is consumed, we may fall ill with diseases of the alimentary canal, like amoebiasis, typhoid, cholera, hepatitis, gastro, etc. Pathogens are released in the air when a person having an infection of the respiratory tract sneezes or coughs. A healthy person may get infected with such pathogens on breathing in the same air and contract diseases like common cold, cough, diphtheria, pneumonia, tuberculosis, etc.

Mosquitoes reproduce in places like heaps of garbage, drains, stagnant water, etc. Microbes that cause diseases like malaria, dengue, elephantiasis, yellow fever, chikungunya, Zika fever, etc. gain entry into the human body through the bite of a female mosquito.

### Make sure to check -

1. Is the water tank and the water in it, clean?
2. Are the water tanks and toilets in the school, clean?
3. Is the water that accumulates in pots, tyres, cans, etc. around the house drained promptly?
4. Are the water storage containers cleaned regularly?



### Always remember –

1. Eat fresh and properly covered food.
2. Drink boiled water.
3. Hold a handkerchief over your mouth and nose when you cough or sneeze.
4. Don't allow garbage and water to accumulate around your house.

### Swachha Bharat Abhiyan

Almost 80% of all diseases occur due to uncleanness. Keeping our surroundings clean, avoiding litter and disposing garbage properly, avoiding defecation in the open are some easy ways to stop the spread of diseases.

The Swachha Bharat Abhiyan is a national movement started several years ago to increase awareness about public hygiene along with habits of personal hygiene. Let us participate in this movement by starting a cleanliness drive in our school and neighbourhood.



### Find out.

Which diseases do micro-organisms cause in plants and animals?



### Do you know?

What exactly happens when we have fever?

The body temperature of a healthy human being is about 37°C. If micro-organisms enter our body, our immune system starts acting and body temperature rises. This destroys the micro-organisms. The site of an injury also feels warm for the same reason.



### Use your brain power!

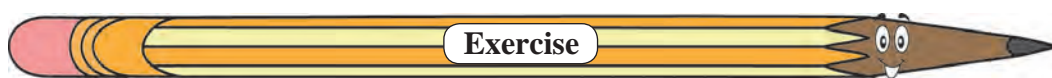
What is the correlation between the normal body temperature of humans which is  $37^{\circ}\text{C}$  and the optimum temperature for the growth of micro-organisms,  $15^{\circ}\text{C}$  to  $35^{\circ}\text{C}$ ?



### Can you tell ?

1. What happens if clothes remain damp in the rainy season?
2. What are the black or white spots sometimes seen on gunny bags?
3. Why are leather articles like purses, wallets, belts, footwear always polished before storing away?
4. What is the powdery material found on old currency notes or old rubber or paper?

All the materials mentioned above i.e. gunny bags, cotton clothes, paper, rubber, etc. are plant products and leather is an animal product. In a humid atmosphere, fungi and some other micro-organisms grow on these articles and spoil or damage them.



### 1. Answer the following questions.

- (a) What is a 'cell'?
- (b) Name the different organelles in a cell?
- (c) What are micro-organisms?
- (d) Which are the different types of micro-organisms?

### 2. Fill in the blanks with the proper word.

- (a) The organelle called the ..... is present in plant cells only.
- (b) Garbage is converted into ..... by micro-organisms.
- (c) In the cell, photosynthesis is carried out with the help of ..... .
- (d) An electron microscope is necessary for the study of ..... .

### 3. What is difference between us?

- (a) Plant cell and animal cell.
- (b) Prokaryotic cell and eukaryotic cell.

### 4. Sketch and describe in your own words, the plant cell and animal cell.

### 5. Explain the uses and the harmful effects of micro-organisms.

### 6. Give reasons.

- (a) Diseases spread on a large scale during periods of heavy rainfall and floods.
- (b) There is a possibility of food poisoning if we eat stale food.
- (c) Soil is turned over during tilling.
- (d) Fungus grows quickly in moist or humid conditions.
- (e) A refrigerator is used in almost every home.
- (f) Bread 'rises' during baking.
- (g) Fodder is soaked in water before offering to cattle.

### 7. When will you use a simple microscope and when, a compound microscope? Explain in detail how you will use them.

**Project :** Visit a bakery in your area, collect information about the process of manufacture of their products and make one of them at home.

