BAL VAIGYANIK

Class 7

an eklavya publication

I heard...
I forgot

I saw...
I remembered

I did...
I understand

BAL VAIGYANIK

Class 7

Dedicated to all the teachers
and students whose participation
in the Hoshangabad Science Teaching
Programme for over 30 years has
made this edition possible.

AN EKLAVYA PUBLICATION

Bal Vaigyanik Class 7

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The content and pedagogy of this book has been developed by a large number of persons associated with the Hoshangabad Science Teaching Programme (HSTP) over the last thirty years.

Originally approved by the Madhya Pradesh government's gazette notification No. F/46-05/2001/20/C-3 dated 23.7.2001 for all the middle schools of Hoshangabad and Harda districts and a few selected schools of Khandwa, Betul, Chhindwara, Narsinghpur, Indore, Dewas, Dhar, Khargone, Jhabua, Ujjain, Ratlam, Mandsaur and Shajapur districts of Madhya Pradesh. The book was later withdrawn as the approved science textbook for these middle schools and allowed to be used as supplementary material by the government order No. 424, Bhopal dt. 8.8.2002.

CONTENTS

Fun with science

A WORD FROM US. . . .

You have before you, the revised edition of the Class 7 *Bal Vaigyanik*. We would like to draw your attention to some important aspects of this revision. However, before doing so, we would also like to point out some general features of the *Bal Vaigyanik* series of textbooks, in particular their overall framework and the way in which they are to be used in the classroom.

For most people, the textbook is more than just a base for instruction and information; it is synonymous with knowledge and education. *Bal Vaigyanik* is certainly a base for learning science but the edifice of learning can only be constructed through the combined efforts of the students and the teacher. So it is essential to see how they can use this book in a learning process.

Let us begin by looking at how the chapters are structured. Each chapter takes up a basic concept in science by first posing a problem that is usually related to the life experiences of the students. The problem is broken down and the students are expected to examine its different aspects in greater detail by performing a series of experiments. They then discuss their experimental results in class.

A series of leading questions are posed in the chapter to focus the discussion and guide the analysis to the required resolution. In some cases, the students are asked to conduct a few more experiments to test and verify their conclusions, with some additional logical questions being posed. Common sense and prior knowledge also contribute to the entire process.

Contrast this with the system of education that is generally followed in our schools in which the emphasis is largely on memorising "final results", without going through any procedure of experiment, discussion and analysis. No doubt, conclusions are important in science, but they are not the sole objective of "learning" science.

Bal Vaigyanik ensures that students go through a process of analysis to arrive at conclusions. It is not enough for them to just write answers in their exercise books to the questions posed. What is required is a written record of everything they do. That is what helps test their understanding later on. Scientific temper develops only if students reflect on these questions and discuss them.

The questions are of different kinds. Some relate to recording the observations of the experiments. Some require the students to give more details of their observations. Yet others help them to combine the observations and results of several experiments into a single general conclusion. Each type of question has its own relevance. So it is important for the teacher to identify and categorise them and decide on a strategy for posing them in the classroom.

But the teacher need not repeat the questions, word for word, from the textbook. The objective should be to help students undertake meaningful discussions and analysis and relate their conclusions to their everyday experiences and knowledge.

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MESSAGE

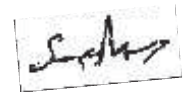
It is a matter of immense satisfaction that the revised edition of Class 7 *Bal Vaigyanik* is being published under the Hoshangabad Science Teaching Programme, which is currently running in 600 middle schools of the state.

It is desirable that educational programmes evolve and progress on the basis of their field experiences. The Hoshangabad Science Teaching Programme has placed a lot of emphasis on analysing its experiences in an organised manner. This new edition of *Bal Vaigyanik* is the collective effort of school teachers, college faculty, educational administrators, scientists and representatives from NGOs.

The *Bal Vaigyanik* workbooks are based on accepted principles of science learning. The strength of the Hoshangabad Science Teaching Programme is that it has successfully implemented these principles in the actual conditions pertaining to government schools. These educational principles are also being adopted by other states and Madhya Pradesh can now be regarded as a pioneer in this respect.

I sincerely hope this initiative in education will progress further.

27 June 2001



(Inderjeet Kumar)

When this happens, we can confidently say that they have internalised new information.

Bal Vaigyanik, thus, serves as a framework for the teaching-learning process in the classroom.

And now, a few words about important aspects of the present revision which, we feel, have enriched the *Bal Vaigyanik* syllabus. Several new elements have been incorporated to strengthen and reinforce the learning process. Study materials and narratives from the history of science have been included in some chapters. Additional scientific information has been given to help the students in the analytical process. Questions for revision have also been included.

The aim is to ensure that studying *Bal Vaigyanik* is both an educative and enjoyable experience. Only then will students be excited about learning science. Only then will they develop the curiousity and ability to learn about the world around them.

With all best wishes. . . .

The Eklavya Group

Two words

It is, indeed, a matter to rejoice that *Bal Vaigyanik* Class 7 is here to initiate a fruitful dialogue between teachers and students.

What exactly is science? It is a subject that was born and evolved through dialogue - a dialogue between humans and nature. Faced with the immense diversity in nature, humans began asking questions - how, when, where, why? Humans sought to unravel the mysteries hidden behind events occurring in nature - Why does the sun shine? Where does it hide between sunset and sunrise? Where does water come from when it rains? Why does lightning strike? Why do the tides in the seas ebb and flow? Why are leaves green? Why don't fish die when they are immersed in water? And so on.

Humans became scientists in the process of searching for answers to such questions. This process did not evolve in a few days. Information was gleaned, little by little, over years, over centuries. Sometimes scientists arrived at wrong answers, but they kept moving ahead in their quest till they found the correct path .

The beauty of science is that the subject keeps developing and adding to its storehouse of knowledge. It keeps fine-tuning and embellishing this knowledge. Earlier beliefs are discarded when they are proved wrong by newer information. This process of constant renewal is what brings a feeling of freshness to science.

This renewal is achieved in two ways - through theoretical discussions and mental churnings and through experimentation and testing.

For example, Aristotle (384-322 BCE) believed the earth was stationary and the planets and stars revolved around it. Five centuries ago, Copernicus put forward a new theory in which he stated that the sun was stationary at the centre of the solar system, which included the planet earth. It was through a process of actual observations that the Copernican theory was eventually accepted as a better interpretation of the reality than the Aristotlean theory. Galileo furthered this tradition of experiment and verification in science, while Newton gave an impetus to the theorising aspect. Both scientists lived and worked during the 17th century.

During Galileo's time, people indulged in verbal debates only, to settle contentious scientific issues. Galileo questioned this approach, saying, "What can we discover by discourse alone .... come, let us do an experiment and find out."

So science is a subject that arises from an inherent curiousity; asks questions about contentious issues; and then finds answers to these questions through a process of hypothesising, experimentation and observation.

It is, indeed, a matter of great appreciation that the *Bal Vaigyanik* textbooks have adopted this path of science. However, the *Bal Vaigyanik* experiment can be considered successful only when the teacher encourages the student to ask questions and look for answers. It doesn't matter whether the questions appear strange, or if their answers cannot be found in the textbook. It is the duty of the teacher to ensure that the doubts of the students are resolved, even if it means referring to books from outside the syllabus.

I sincerely hope that this project of the Madhya Pradesh government and Eklavya is successful in bringing science closer to children.

जयंत नार्लीकर

Jayant Narlikar

June 2001
Inter-University Centre for
Astronomy and Astrophysics (IUCAA)
Pune

Jayant Narlikar was the director of the Inter-University Centre for Astronomy and Astrophysics (IUCAA) and played a key role in setting up the centre. His research interests include working on a hypothesis related to the birth and evolution of the universe. He has written popular articles on astronomy in Marathi and Hindi and written several science stories, including a collection titled *Comets*. He has also written *Aagantuk*, a science novel.

Dear friends,

Congratulations on reaching Class 7!

You must have conducted a lot of experiments in Class 6 and continued that process during your summer vacation in your home laboratory, fields and playgrounds. You also must have gone on several field trips in the course of the past year. Were you able to complete all the experiments in Class 6? If you haven't, try and find the time to do them this year.

Before embarking on the experiments in Class 7, take a second look at your Class 6 *Bal Vaigyanik* and exercise book. We hope you haven't thrown them both in the dustbin. That would cause a real problem because the chapters you will be taught in Class 7, are based on what you learned in Class 6. In the same way, what you learn in Class 7, will form the basis of what you learn in Class 8. So preserve your Class 6 textbook and workbook and also your Class 7 textbook and workbook.

After having performed all those experiments in Class 6, you must be quite familiar with the items in your science kit. By now, you also must have realised the importance of maintaining your kit. Continue that process this year and look after your kit well.

The chapters in this textbook have been arranged in a particular sequence. We spent a lot of time in discussing this issue in depth before arriving at the final sequence. What you learn in one chapter will help you to understand subsequent chapters better. For example, you will find it difficult to understand the chapter "Reproduction in plants" if you haven't first gone through the chapter

"Recognising flowers". Similarly, it is essential to not only do the chapter "Gases" before attempting to understand the chapter "Respiration", but also to first complete the chapters "Some games with air" and "Volume". They are all linked, so try and do the chapters in the given sequence.

You must be aware that your *Bal Vaigyanik* is constantly going through a process of revision. Have you ever wondered what the basis of each revision is? The revisions are mainly based on the experience of teaching each chapter in the classroom. We learn about this experience in many different ways. For example, while you are doing a chapter, your teacher notes down where you are experiencing problems, which experiments are difficult to do, what improvements need to be made in the experiments, etc. All the teachers then discuss their observations at the regular monthly feedback meetings they attend. Apart from this, you must be familiar with the person who visits your school regularly to follow-up and observe what is being done in the classroom. S(He) also helps you and your teacher in many ways, by explaining your doubts and giving new information. Also, there are the questions you ask Sawaliram, to help you prepare for your examinations.

We learn about the problems you face in studying *Bal Vaigyanik* through all these different methods - where it is necessary to make changes and revise the chapters, what additional information needs to be given, what unnecessary information needs to be removed, what information needs to be further simplified, etc. It is on this basis that we revise the book from time to time. Just think about it. Would we be able to improve this book if you did not perform the experiments and did not ask questions?

There is one more thing you need to bear in mind. Your book has several long-duration experiments that have to be conducted over several days. Take special care while performing these experiments. You will need

to make detailed observations at specific intervals, so you must have the patience to wait till the end of the experiment before reaching the desired conclusions. You shouldn't fall into a situation where you begin the experiment and lose track of what you had done earlier.

The number of letters I receive from you and your teachers, makes it obvious that you have a lot of questions to ask. Probably, your list of questions will get longer in Class 7. Don't ask only those questions related to your problems in the classroom. Ask questions about things that puzzle you outside your classroom as well. After all, science means inculcating the habit of looking attentively at things, observing them carefully, asking questions about whatever puzzles you and finding answers to these questions. Also remember - no question is stupid or useless. If anything comes to your mind, ask your teacher. You may not receive an answer immediately. If you can't get an immediate answer, don't lose heart. Just keep searching. And send your question to me as well. Write me a letter. I shall also try and help out in your search for an answer. My address is:

SAWALIRAM
C/o Eklavya, Chakkar Road,
Malakhedi, Hoshangabad - 461 001

Yours,
Sawaliram

FUN AND GAMES

Chapter 1

Scrape the powder off a few matchsticks. Cut several 1.5 cm pieces from a cycle valve tube.

JOINT OF TWO

Fit matchsticks into the two ends of a valve tube. The two matchsticks should meet end-to-end inside the valve tube as shown in Figure 1.

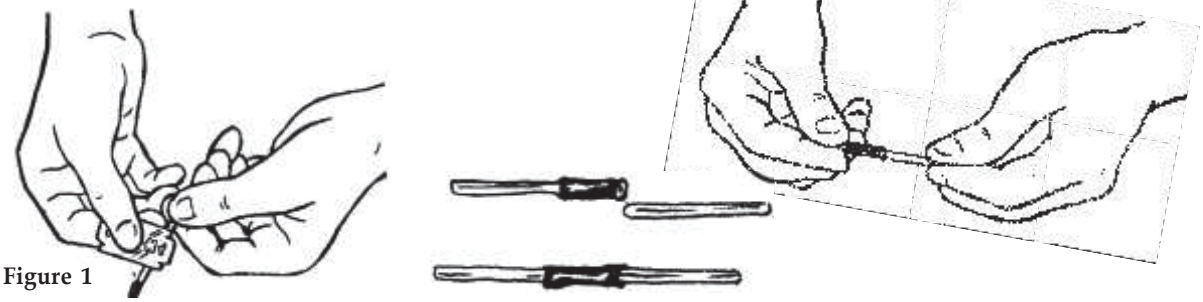


Figure 1

Make a few more such joints and use them to form the simple shapes shown in Figure 2.

A triangle is a strong and stable shape. It is used in many ways, for example in the construction of buildings and bridges. The roofs of houses in the village are supported by triangular frames made of bamboo and wood. You can see for yourself which of the different shapes you have made are stable and firm and which are not by pressing them between your finger and thumb.

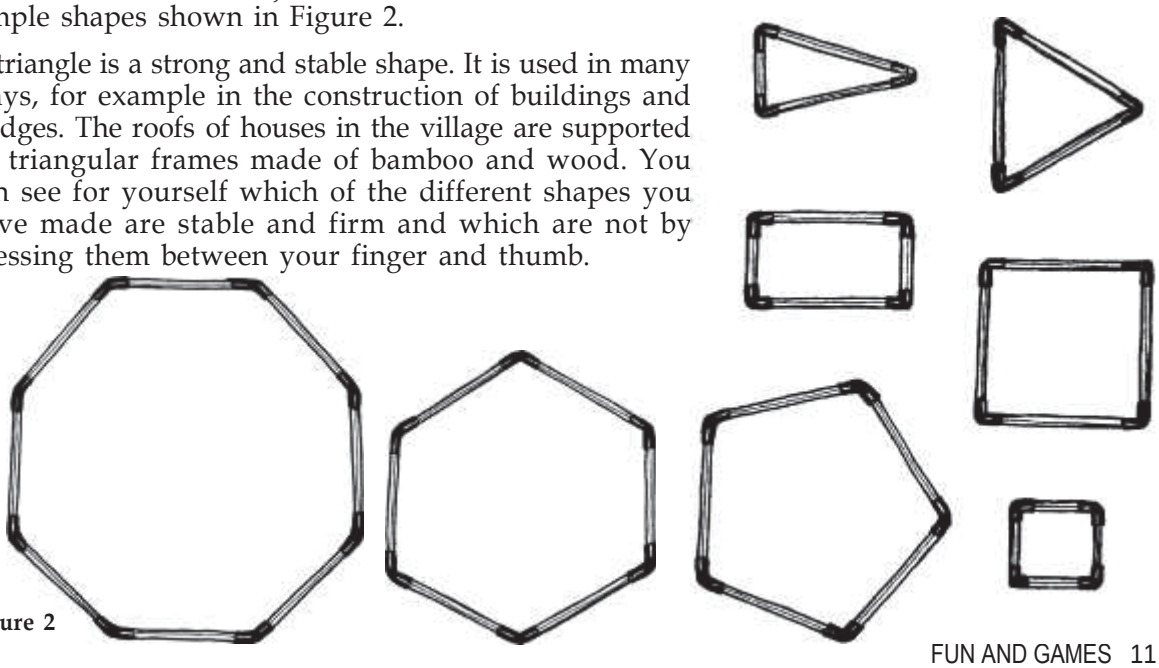


Figure 2

You can also arrange these shapes in different decorative designs (Figure 3).

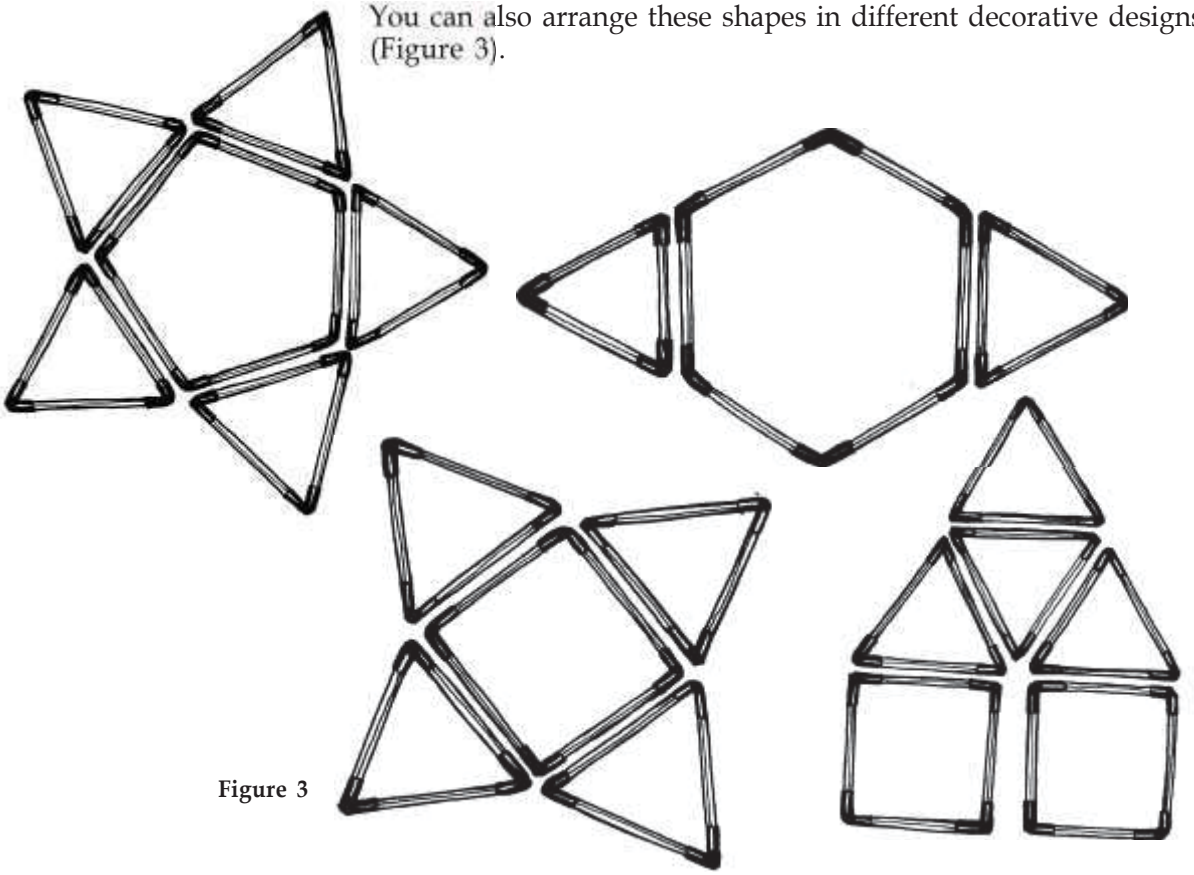


Figure 3

JOINT OF THREE

Take your joint of two match sticks and pierce a hole in the valve tube at the spot where the match sticks meet end-to-end. Use something sharp like a babool thorn or pin to pierce a hole (Figure 4).

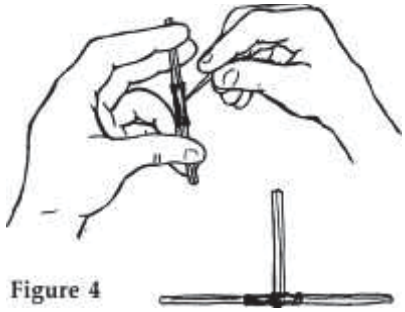
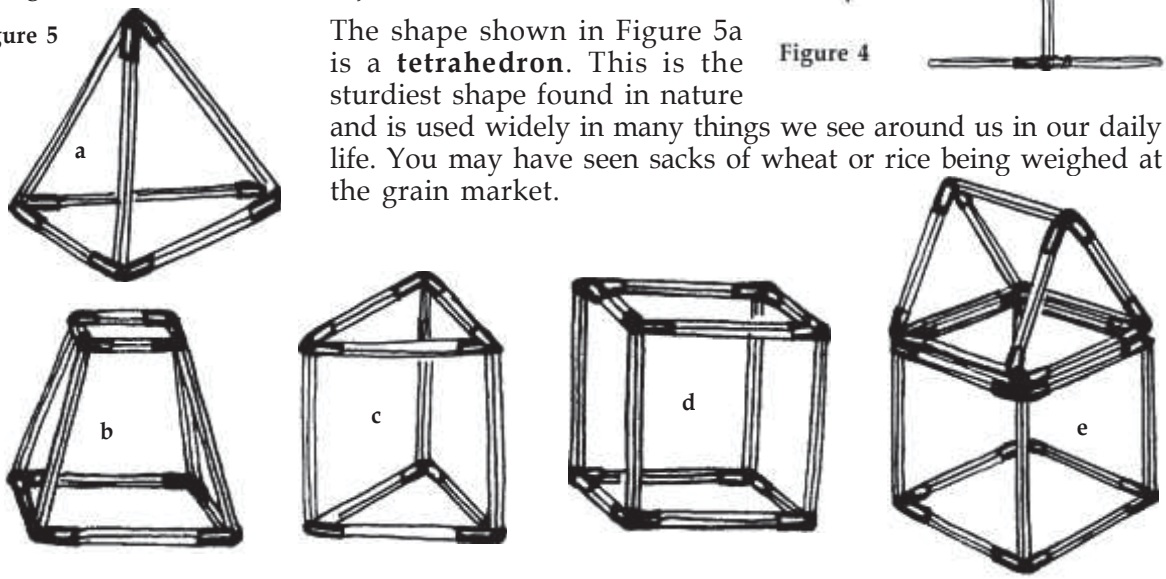


Figure 4

Insert a third match stick into this hole. You now have a joint of three match sticks. You can make the shapes shown in Figure 5 with several such joints.

Figure 5



The shape shown in Figure 5a is a **tetrahedron**. This is the sturdiest shape found in nature and is used widely in many things we see around us in our daily life. You may have seen sacks of wheat or rice being weighed at the grain market.

The weighing scale is suspended from a stand made of three bamboo sticks. This stand is in the shape of a tetrahedron.

JOINT OF FOUR

Cut a few 2 cm-long pieces of a valve tube. Insert a babool thorn or pin through one piece. Now pierce another valve tube through the middle with this thorn or pin. Hold the second valve tube at both ends and pull it down so that it slips over the first valve tube (Figure 6).

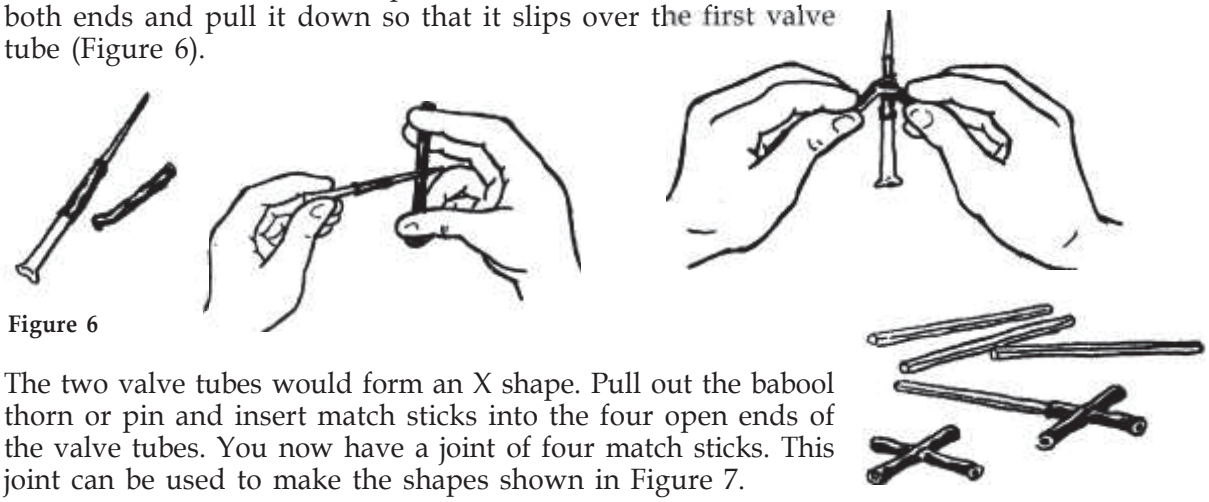


Figure 6

The two valve tubes would form an X shape. Pull out the babool thorn or pin and insert match sticks into the four open ends of the valve tubes. You now have a joint of four match sticks. This joint can be used to make the shapes shown in Figure 7.

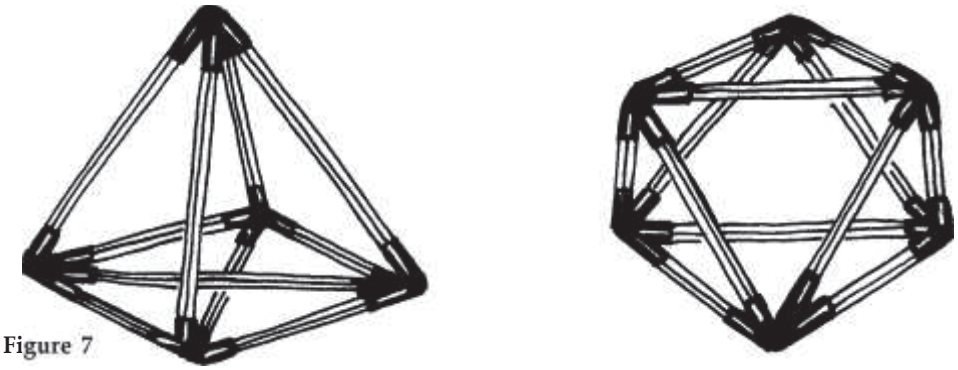


Figure 7

JOINT OF MANY

Make the X shape with two valve tubes like you did earlier, but do not remove the babool thorn or pin.

Take a third valve tube and slide it over the first one on the thorn or pin. The three valve tubes form an H shape.

Take the open end of your second valve tube and slip it through the hole in the third valve tube. Use a match stick to push the valve tube through, if necessary. Now insert six match sticks in all the open ends of the three valve tubes to get a joint of six. If you leave one of the six ends without a match stick you get a joint of five (Figure 8). Figure 9 shows some shapes you can make by using a joint of five match sticks.

You can go on in this fashion to make joints of 8, 10 and 12 match sticks.

Figure 8

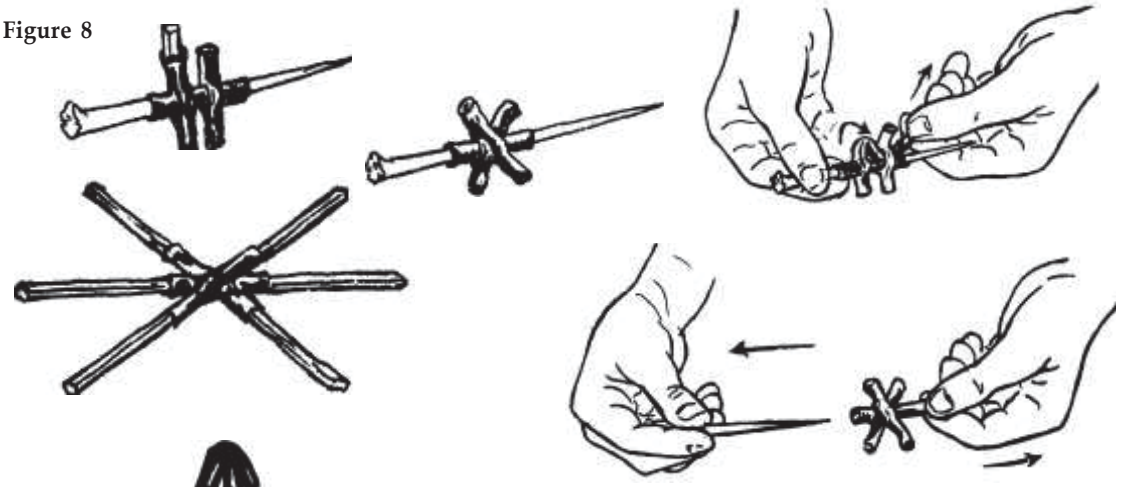
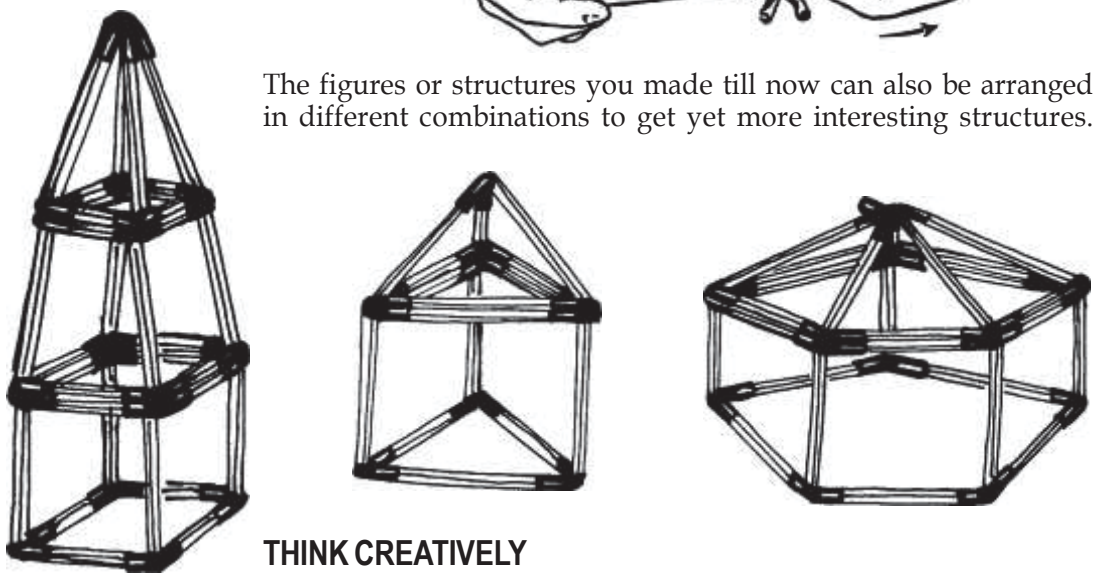


Figure 9



The figures or structures you made till now can also be arranged in different combinations to get yet more interesting structures.

THINK CREATIVELY

You can fashion many interesting and useful things and toys with match sticks and valve tubes. For example look at the divider in Figure 10. It has been made by joining babool thorns with valve tubes.

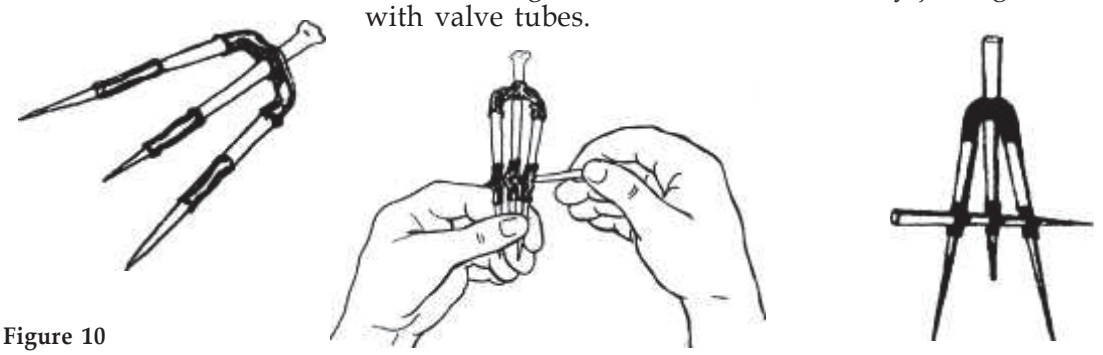


Figure 10

See if you can make tables, chairs and other things in this way.

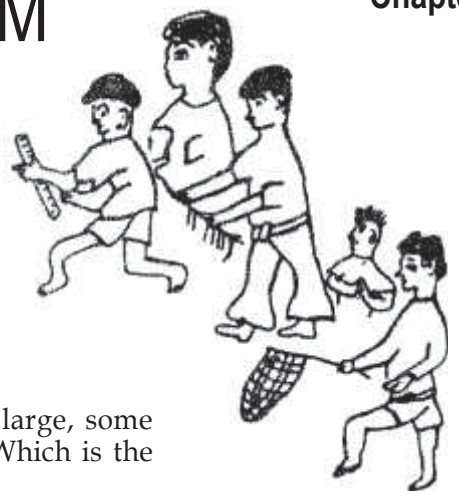
With just a little extra effort you could also make things like cycles, bullock carts, ploughs etc. Just give it a try.

NEW WORDS

Tetrahedron

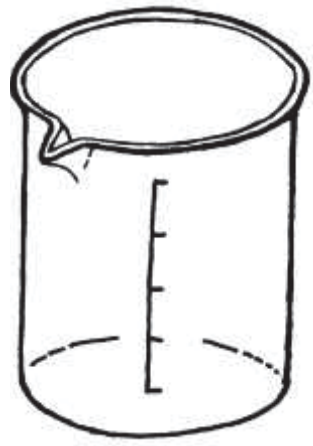
THE ANIMAL KINGDOM

Chapter 2



There are many living creatures around us - some large, some small. Which is the largest animal you have seen? Which is the smallest?

In this chapter we shall study some animals that are easy to capture and bring to the class. The aim is to learn more about how to observe and study animals. We shall also look at the different parts of their bodies and study their structure.



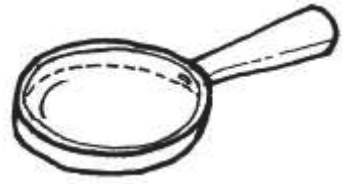
We have chosen three animals for observation and study - earthworms, grasshoppers and fish. You could study other animals on your own using the methods you learn in this chapter. We shall also go on a field trip to see where these animals live, what they eat and how they behave in their natural surroundings.

A day before you begin this chapter, your teacher will ask you to bring an earthworm, a grasshopper and a fish to school. It is best if you bring these animals alive to the classroom.

Where would you look for earthworms, grasshoppers and fish? How would you catch them and bring them to school? (1)

Studying an earthworm

The earthworm you bring should be as large as possible. Examine it carefully and answer the following questions:



Touch its skin. Is it dry or wet? (2)

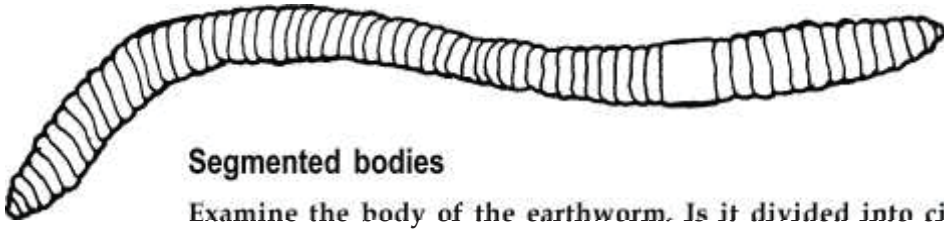
What is its colour? (3)

Is the skin on different parts of its body of different colours? Is the part which is usually in contact with the ground any different in colour from the rest? Try to explain any differences you see. (4)

Think of other animals. Is there a difference in colour between their upper and lower surfaces as well? (5)

Watch the earthworm carefully as it moves. It does not have legs. How does it move? (6)

If you find it difficult to answer Question 6, go to the end of this chapter. Three ways in which animals without legs crawl forward are shown. Observe how the earthworm moves and check which of these three methods it uses.



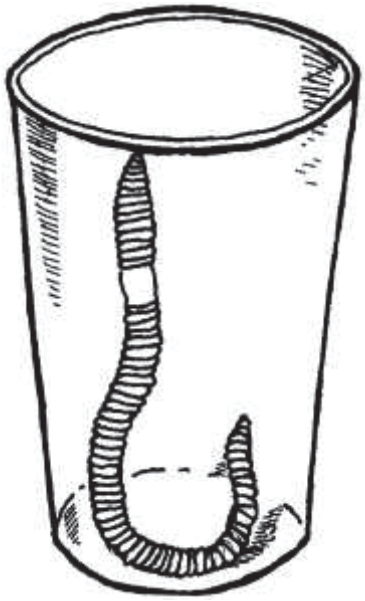
Segmented bodies

Examine the body of the earthworm. Is it divided into circular bands? (7)

A body that is divided into bands or rings is called a **segmented body**.

Make a special effort

To study your earthworm more closely, place it in a transparent glass bottle, plastic jar or beaker. Use a magnifying glass to carry out the following observations:



1. Find the circular bands on the body of the earthworm that are slightly different in colour to the other bands. It is easy to see this with a large earthworm.

How many segments are there from the mouth of the earthworm to this darker band-like structure? (8)

The position of this structure - i.e. the number of segments between it and the mouth of the earthworm - is always the same.

This darker coloured band is related to the reproductive system of the earthworm.

2. Examine the mouth of the earthworm.

Can you see its mouth opening and closing? (9)

3. Hold the bottle or beaker in which the earthworm is kept towards the light. Look at the earthworm's body. You will see a long tube inside containing small balls of earth in some places. This long tube is the alimentary canal or food tube of the earthworm and the small balls are the food it has eaten.

Draw a diagram of the earthworm in your exercise book showing all the structures you have seen. (10)

Some interesting information about earthworms

Experiments have shown that an earthworm shies away from light. If a bright light is shone on the front part of its body, it moves away from the light. The earthworm does not have eyes. So how does it know if light is shining on it or not?

Actually, the earthworm has some cells in its skin that are sensitive to light. These cells are concentrated in the upper part of its body. There are no such cells in the lower part of its body.

Studying grasshoppers

What is the colour of the grasshopper you have brought to class? (11)

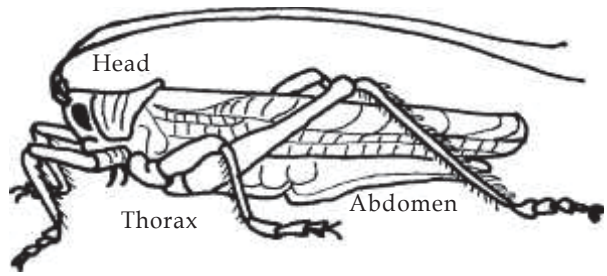
Is there a difference in colour between the upper and lower surfaces of its body? (12)

Look at the picture of the grasshopper given below and count the number of segments its body is divided into. (13)

Draw a picture of your grasshopper in your exercise book. Compare your diagram with the one given here and then label the parts of the body in your diagram. (14)

Is the body of the earthworm also segmented like this? (15)

Name two other insects whose bodies are segmented like the body of the grasshopper. (16)



The first segment : The head

Examine the head of the grasshopper with a magnifying glass. You will see two long **antennae** emerging from the front of its head. These antennae are sensitive to changes in temperature and the smells that occur around the grasshopper.

Identify the antennae in the picture you have drawn. (17)

Do the antennae move or are they rigid? (18)

Do the antennae have joints? (19)

Touch an antenna with a twig. What does the grasshopper do when its antenna is touched? (20)

Which other animals have antennae? (21)

Examine the eyes of the grasshopper with a magnifying glass. Do they have eyelashes? (22)

The second segment : The thorax

The part of the body from which the legs and wings of the grasshopper emerge is called the thorax.

How many legs does a grasshopper have? (23)

Are all the legs the same length or are some longer than the others? (24)

Is there hair growing on the legs? (25)

Do the legs have joints? (26)

Have you ever seen an insect that does not have joints in its legs? (27)

If an insect did not have joints in its legs, what problems would it face? Discuss this in class before writing your answer. (28)

Make the following observations about the wings of the grasshopper:

1. How many wings does a grasshopper have?

2. Are the wings transparent or opaque?

3. Are the wings coloured or colourless?

4. Is there any pattern visible on the wings? (29)

The third part : The abdomen

The entire portion behind the breast is called the abdomen.

Examine the stomach of the grasshopper with a lens.

Does any organ emerge from this portion? (30)

Is the abdomen segmented or not? (31)

Studying a fish

Each group should bring a fish. Sit with your group and study your fish.

First draw a picture of the fish in your exercise book. (32)

Touch the fish.

Is the skin smooth and slippery? (33)

Run your finger down the fish from its head to its tail. Then run your finger from its tail to its head.

Does it feel the same in both directions? (34)

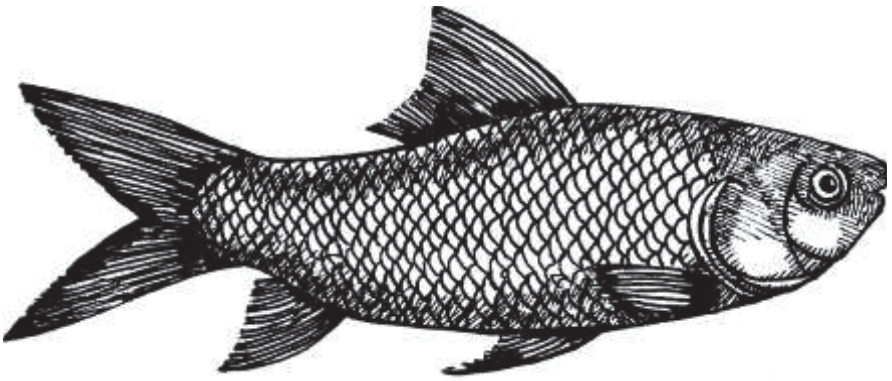
Which structures on the skin could you identify by running your finger up and down the body of the fish? (35)

If you did not feel anything, use your lens to look closely at the skin.

The structures that you see are called **scales**.

Is the entire body of the fish covered with scales? Draw the scales in your picture of the fish. (37)

Examine the eyes of the fish. Do they have any eyelashes? (38)



Open the mouth of the fish and see whether it has teeth or a tongue. (39)

Are there nostrils near its mouth? (40)

A special structure

Open the lid-like structure near the mouth of the fish. You will see red-coloured structures inside. These are the **gills** of the fish. The fish breathes through its gills. In a live fish, the gills are red in colour. The gills of a freshly caught fish are also red. But once a fish dies, its gills slowly become darker and duller. A person

who buys fish can tell whether the fish is fresh or not by looking at its gills.

Discuss the similarities and differences between the fishes brought to class by the different groups. List these similarities and differences in your exercise book. (41)

A field trip

You learned how to study animals by looking at three different kinds of animals. To know more about the animal kingdom you should go on a field trip with your teacher and classmates. You will be able to learn more about animals by observing them in their natural habitat. You could catch these animals and if they are small enough, you could put them in a broad-mouthed jar for some time so that you can observe them more closely. After you have studied them you should return the animals to their habitats.

Preparing for the field trip

1. Before leaving on your field trip, copy Table 1 in your exercise book. Take it with you on your trip.

2. Each group should take a magnifying glass, polythene bags and a broad-mouthed glass bottle.

A WORD OF CAUTION

1. Don't catch creatures like snakes and scorpions during your field trip. Don't put your hand in any hole you see in the ground.
2. It is not necessary to kill an animal to study it.

Students should observe different animals. For example, one could study a bird and another, an insect. In this way, the class can collect observations on many different animals. Record your observations in the table. If you notice something unusual about any animal, make a note in your exercise book. Thus, you can gather a lot of information about animals.

Where should you go on a field trip? You could choose a field, orchard/garden or river/pond near your school. Your aim should be to observe as many animals as possible.

Table 1

Name of animal	Where it lives	Lives alone or in a group	What it eats	Number of legs it has	Number of wings it has	How it moves	The sound it makes

After you return to the classroom

Arrange the information you have collected in the following groups:

1. Animals with wings

2. Animals that crawl (42)

Did you come across any animal that does not have joints in its legs? (43)

What animals eat

Study the entries in your table and state whether all animals eat the same kind of food. (44)

Which are the animals in your list that eat only plants, trees or their products (fruit, flower, grain, the nectar of flowers, etc.)? (45)

Such animals are called **herbivores**.

Which are the animals that eat other animals or their eggs? (46)

Such animals are called **carnivores**.

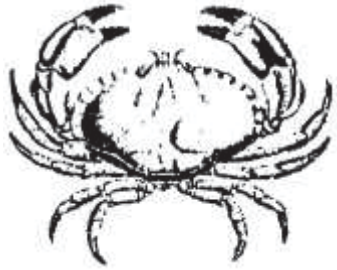
Name those animals that eat plants, trees or things obtained from them as well as other animals. (47)

Such animals are called **omnivores**.

Are there some animals in your list that get their food from the bodies of other animals without killing them?

Such animals are called **parasites**.

List the names of some parasites. (48)



If your table doesn't contain any such animal, ask your teacher and add some examples. (49)

What are the differences between carnivores and herbivores? (50)

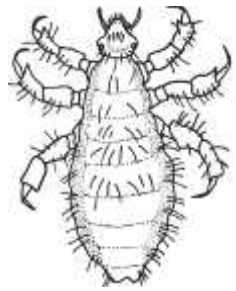
There are some animals that eat the flesh of dead animals.

These animals are called **saprophytes**.

Give two examples of such animals. (51)

Use the information in your table to make a large chart. Draw pictures of each animal, giving its name, what it eats and where it lives. Display the chart in your classroom. (52)

Our body : An abode for animals



Lice

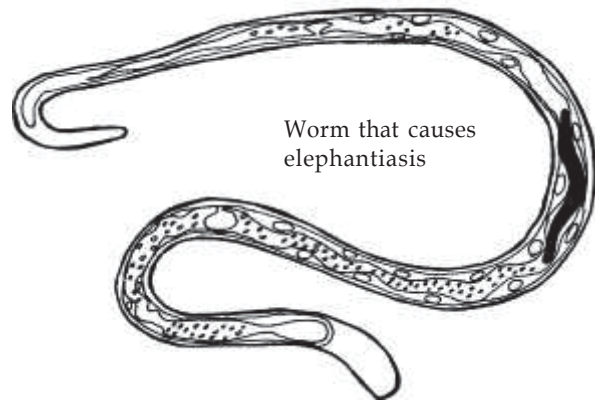
We see many animals around us. But do you know that several animals use our body as their home? Some live on our body while others live inside it. Some harm our body, some just live there while some others actually help our body in different ways.

You may be familiar with lice. They live in the hair on our head. They move from the head of one person to another. They suck our blood. Other lice-like animals live in other parts of our body - like the hair on the chest of males.

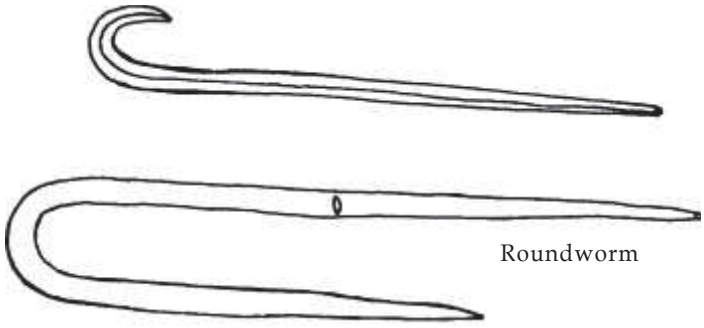
Many people suffer from dandruff. Dandruff is caused by a fungus. This fungus is a saprophyte. It causes the upper layer of the scalp to become dry and flake off. These flakes are called dandruff.

Some **microorganisms** also live on our skin. They are so small you cannot see them. You find them under your nails, in the pits (follicles) of the hair on your body, under your eyelashes and in several other places. If you suffer a wound, these microorganisms flourish in it. They form the pus in the wound.

Some animals live inside our body. It is said that there are hundreds of thousands of microorganisms in our intestines. They do not harm us. In fact, some of them produce vitamins for the body. But some harmful microorganisms do enter our body. You may have heard of children suffering from worms in their stomach. The roundworm is one such worm. Other similar worms also find their way into our alimentary canal. They consume the digested food there.


Worm that causes elephantiasis

Some microorganisms cause diseases when they enter our body. Some examples include the malaria parasite, TB **bacteria**, pneumonia (pneumococcus) bacteria, polio **virus**, etc. These microorganisms reside in different parts of our body and make it their home. For instance, the TB bacteria resides in our lungs.


Roundworm

Some questions for revision

1. Which of the following is true or false? Mark them accordingly.

a) The cockroach senses changes in its environment such as smell, temperature etc. with its antennae.

b) Fish have scales on their heads.

c) Herbivores and carnivores are together called omnivores.

d) Fish have eyelashes.

e) The silverfish does not have joints in its legs.

2. Make a list of insects that live in our homes. Examine these

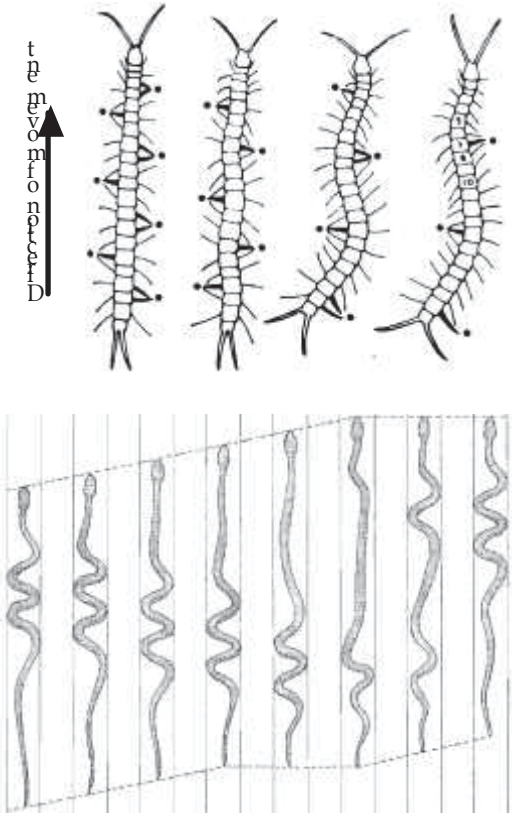
insects with a magnifying glass. Group them according to the number of legs they have.

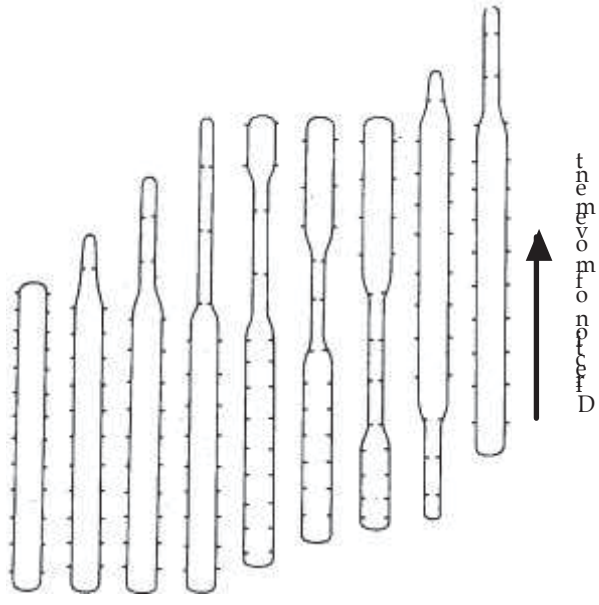
3. **List 10 omnivores, 10 carnivores and 10 herbivores that live in your vicinity.**
4. **Observe the way frogs, wall lizards and squirrels eat their food and describe in your own words what you see.**
5. **You may have noticed that some animals live in association with other animals. For example, the crane is always seen near the buffalo. Make a list of such animals which are always seen together.**
6. **The population of vultures has fallen dramatically these days. If vultures become extinct, what effect would it have on our environment? Discuss the matter in class and write your answer in your own words.**

New words

Parasite	Saprophyte	Herbivore
Scales	Gills	Omnivore
Carnivore	Segmented body	Antenna
Microorganism	Bacteria	Virus

Three ways of crawling





GETTING TO KNOW FLOWERS

Chapter 3

Mention the word flower and the picture that leaps to one's mind is of roses, marigold, jasmine and lilies. All beautiful, colourful and fragrant. But is every flower attractive? There are many flowers that don't look like flowers. You may not even recognise them as flowers. Which of the following plants do you think bear flowers?

wheat, millet (*jowar*), maize, rice, teak (*sagaun*), *mahua, tulsi*, grass, *peepal*, banyan.

In this chapter, we shall study the structure of different types of flowers and make our own album of flowers.

Identifying the parts of a flower

Bring two flowers each of *besharam* (Ipomea), *dhatura* or brinjal to class. Choose one of these flowers to study its different parts. If you chose *besharam* or *dhatura* you will have to cut the flower open to see its internal parts. So first study its external parts carefully before you dissect it. The way to dissect a flower is shown in Figure 1. You will not face this problem if you choose a brinjal flower.

Figure 1
Dissecting a *besharam* flower with a blade

Draw a diagram of the flower you have dissected, showing all its internal parts. (1)

Observe the parts carefully and identify their names with the help of Figure 2.

If you cannot see the male reproductive parts **(androecium)** and female reproductive parts **(gynaecium)** clearly, pluck off the sepals and petals.

Could you locate all the parts shown in Figure 2? (2)
Label these parts in your diagram. (3)

The swollen end of the stalk where all these parts are joined is called the **thalamus**.

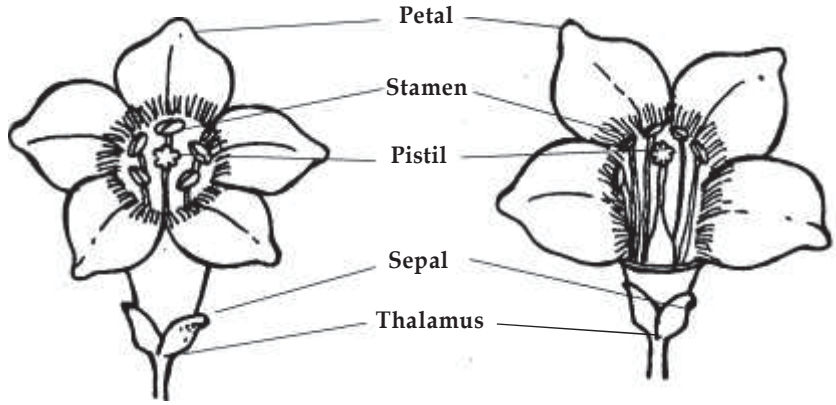


Figure 2 External and internal parts of a flower

Identify the thalamus in your flower and label it in your diagram.

Compare the **stamens** of your flower with the ones in Figure 3.

How many stamens are there in your flower? (4)
Draw a diagram of one stamen and label its different parts. (5)

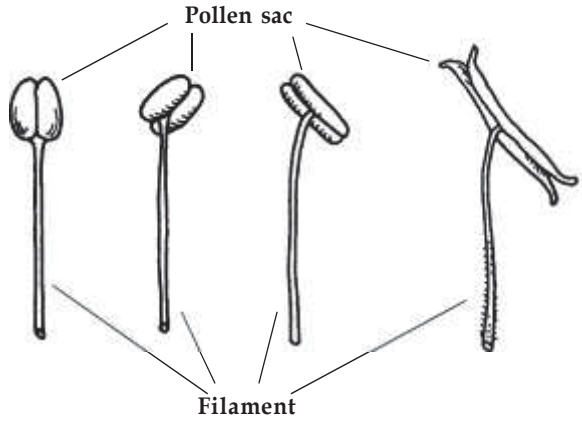


Figure 3

Look at pollen through a microscope

Pluck a stamen from your flower and tap it gently on a glass slide. Do you see some grains falling off?

From which part of the stamen did the grains fall? Write the name of this part. (6)

Observe these grains through a microscope. They are called **pollen grains**.

What is the importance of pollen grains in the life of plants? We shall study the answer to this question in the chapter "Reproduction in plants".

Let us now study the gynaecium or **pistil**. You will have to pluck off the other parts of the flower attached to the thalamus to see the pistil. Pluck off the sepals, petals and stamens one by one.

You will be left with only the pistil attached to the thalamus. Observe its outer structure carefully.

Can you see the different parts of the pistil? Identify their names with the help of Figure 4.

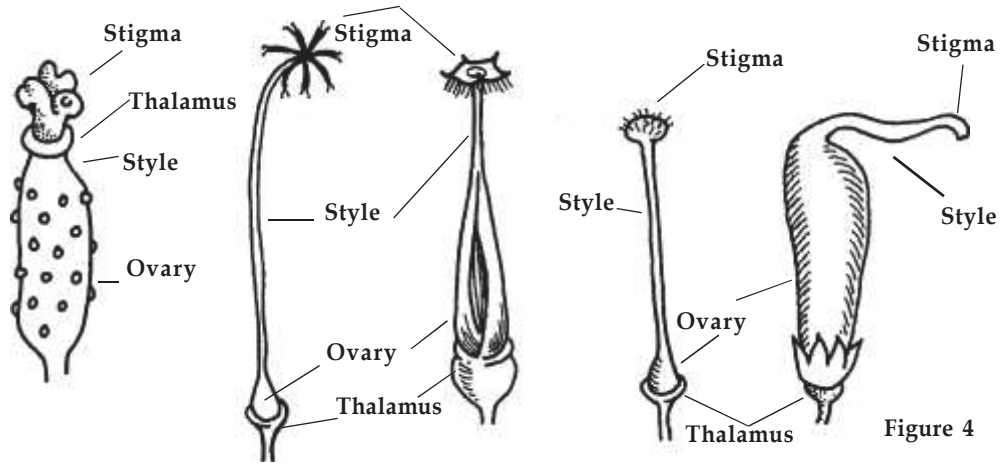


Figure 4

Draw a diagram of the pistil of your flower showing its different parts and label them. (7)

Look carefully at Figure 5. It shows how to cut a **transverse section** of the **ovary** of a flower. To get a good transverse section you should use a blade to cut through the swollen middle part of the ovary, as shown in the figure.

Cut a transverse section of the ovary of your flower and sprinkle a few drops of water on it to prevent it from drying up. The ovaries of brinjal and *dhatura* are fairly big. Their internal structure can be clearly seen in the sections.

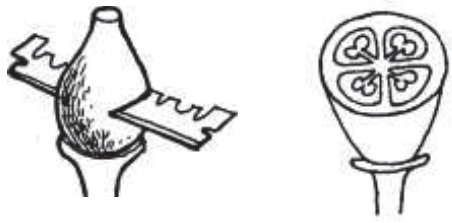


Figure 5 Transverse Section

Study the internal structure with the help of a magnifying glass. Ask your teacher to point out the **ovules** and **chambers** in the sections and draw a diagram of whatever you see.

Going on a field trip

You have studied a flower and its internal parts. Do all flowers have similar structures or do different flowers have differences? To answer this question, you will need to go on a field trip to collect different types of flowers.

Preparing for the field trip

Each group will have to take a magnifying glass, some large envelopes or polythene bags and a wet cloth for the field trip.

Go with your teacher to farms, gardens and forests.

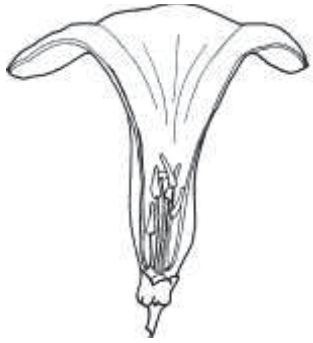
During the field trip try to collect flowers that you have not seen before, for example, flowers of grass, wheat, maize, *tulsi*, etc. Also, try to collect the following flowers: *besharam*, brinjal,

china rose, *bhindi*, *dhatura*, pumpkin, *gilki*, cow pea (*chaola* or *barbati*) and tomato.

Pluck the flowers with their stalks and cover them with the wet cloth, or place them inside the envelop or polythene bag. Ensure that the flowers are not crushed and that they do not dry up.

It is important to bear one thing in mind when going on a field trip - our aim is to collect only as many flowers as we need for our observation and study. Do not pluck flowers unnecessarily. Plucking flowers is harmful for plants.

When you come back to school



Arrange the flowers you have collected in separate groups. You are free to choose the characteristics for each group. For example, you could have groups of bell-shaped flowers, flowers that are fragrant, colourful, thorny, etc.

Choose a flower from each group and draw its diagram. (8)

Make a table and record the names of the groups, the list of flowers in each group and the important characteristics of the group. (9)

How the parts of a flower are arranged

Observe the brinjal, *besharam* or *dhatura* flower carefully.

Are the different parts of the flower arranged in circles or whorls? (10)

If they are arranged in whorls, then begin from the outermost whorl, the sepals, and see which parts are located in each whorl. In this manner, proceed right up to the innermost whorl. (11)

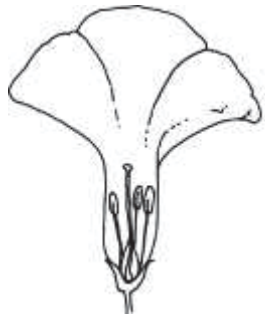
Study the structure of the other flowers you have collected. Note the order in which the different parts are arranged and see whether they are attached to each other.

Draw the following table in your exercise book to record your observations. (12)

Answer the following questions on the basis of your entries in Table 1.

Table 1

S.No	Name of flower	Stalk present or absent	Sepals		Petals		Stamens		Carpels
			No.	Attached to each other or separate	No.	Attached to each other or separate	No.	Attached to petals or separate	Present or absent
1									
2									
3									
4									
5									



Do all the flowers have their parts arranged in different whorls? (13)

Did you find any flower in which the parts were in the following order: sepals, stamens, petals, pistil? (14)

Do the flowers which have petals attached to each other also have sepals that are attached together? (15)

Did you come across any flower with colourful sepals? (16)

Did you come across any flower which has free petals, but has stamens attached to the petals? (17)

If you come across any flower that has sepals and petals that look alike, note its name. (18)

Did you find any flower which has a different number of sepals and petals? (19)

Did you find any flower with parts arranged in more than four whorls? Make sure to note its name. (20)

Some important terms

Before we proceed further it would be useful to learn some scientific terms. Once we are familiar with these terms it becomes easier to talk about flowers.

Complete flower: A flower that has four whorls - one each of sepals, petals, stamens and pistil - is called a complete flower.

Incomplete flower: A flower in which any of these four whorls is missing is an incomplete flower.

Unisexual flower: A flower that has either the androecium or the gynaecium, but not both, is called unisexual. Unisexual flowers are of two types:

a) Male – if it has an androecium, but no gynaecium.

b) Female - if it has a gynaecium, but no androecium.

Bisexual flower: A flower that has both an androecium and a gynaecium.

Asexual flower: A flower that does not have either an androecium or a gynaecium.

Draw Table 2 in your exercise book and fill it in on the basis of your entries in Table 1. (21)

Table 2

S.No	Name of the flower	Complete/ incomplete	Unisexual/ bisexual/asexual	If unisexual, male or female

Some students may have brought a sunflower or marigold (*genda*) to class. You may think the sunflower or marigold is a single flower but they are actually bunches of flowers. The flowers in the centre and those along the rim may not be alike. You will learn more about such special flowers in the higher classes.

Make an album of flowers

Press the flowers you have collected between the pages of old newspapers or magazines, put these pages between two cardboard sheets and place a brick on top. Turn the newspapers over every two to three days. Allow the flowers to become completely dry. Now paste or stitch them on to card sheets and your flower album is ready.

Questions for revision

1. Which of the following flowers are complete and which are incomplete: *dhatura*, brinjal, *louki*, *gilki*?

Write their names in separate columns, giving reasons for your answers.

2. Are the following statements true or false?

a) All bisexual flowers are complete flowers.

b) All complete flowers are bisexual.

c) If the sepals of a flower are attached to each other, then the petals are also attached to each other.

3. Have you seen flowers of *peepal*, banyan or *goolar*? If not, look for them.

4. Different types of stamens and pistils are shown in Figures 3 and 4. Find one example of each type of stamen and pistil and show it to your classmates.

New words

Stamen
Transverse section
Filament
Labelled diagram
Chamber
Asexual flower
Ovary
Thalamus
Gynaecium
Stigma
Ovule
Bisexual flower
Complete flower
Style
Androecium
Pollen sac
Pollen grain
Unisexual flower
Incomplete flower

SOUND

Chapter 4

After a scorching summer, the sound of thunder and the black monsoon clouds bring joy to the heart. The delightful chirping of birds in the early morning brightens our day. The sweet, lilting notes of a flute are soothing and peaceful. But not all sounds are enjoyable. A loud grating noise irritates you and gives you a headache. You hear different sounds every day. Some are shrill and some are deep. You may like some sounds and dislike others.

Have you ever wondered how sound is produced? Why are some sounds high pitched and others low pitched? Let us do some experiments to find answers to these and other questions.

Experiment 1

How is sound produced? :

Make sure that your school bell hangs freely and does not touch anything else. Strike the bell with a hammer.

Did the bell stop ringing soon after it was struck by the hammer? (1)

Gently touch the bell with a finger while it is ringing.

Did you feel it vibrating? (2)

Ring the bell again and grasp it tightly with both hands.

When you held it firmly, did the bell continue to ring as before? (3)

Touch the bell again after it has stopped ringing.

Did you still feel it vibrating like it did earlier? (4)

Experiment 2

Strike the rim of a plate lightly with a spoon or stick.

Did you hear a sound? (5)

Strike the plate again, touch its rim gently and observe what happens.

Did you feel the same sensation you felt when you touched the ringing bell?

Strike the plate and then clutch it tightly so that the sound stops. Now touch the plate gently again.

Do you still feel any vibrations? (6)

How were the vibrations affected when you clutched the plate tightly? (7)

Under what conditions does a plate produce a sound? Think carefully before answering. (8)

Experiment 3

Buy a bamboo whistle (Figure 1) from a vendor and examine its parts.

Figure 1

Blow the whistle. Touch it gently while you blow.

What did you feel? (9)

Which part of the whistle vibrates? (10)

Make your own whistle

Take a strip of paper about 13 cm long and 7 cm wide. Fold it as shown in Figure 2a and make a hole in its centre. On opening the folds, the paper strip should look like Figure 2b.

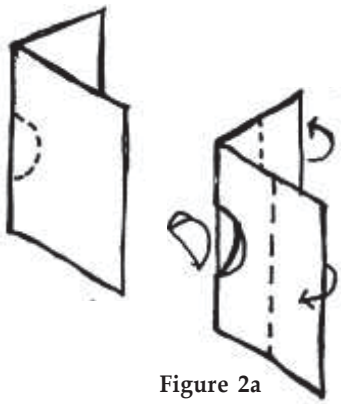


Figure 2a

Figure 2b

Figure 2c

Hold the strip as shown in Figure 2c and blow into the hole. What happens?

The vibrations of your voice

Ask a friend to say aaaaah and place your fingers gently against his throat.

Did you feel his throat vibrating? (11)

Our throats have special muscles called vocal chords. When we speak, they vibrate.

You observed several methods of producing sound in the experiments you have done till now.

Figure 3

In each method, sound was produced by a specific process. What is this process? (12)

In which methods did you actually see this process? In which methods did you only feel it by touch? Record your observations in a table. (13)

You may have seen many different instruments that produce sound - harmonium, *tabla*, *dholak,* cow bell, etc.

Play these instruments and carefully observe what happens. Touch them while they are producing a sound.

On the basis of your answers to Question 13, divide these instruments into two groups and list their names in the table. (14)

You may have blown into a pen cap or a small bottle to produce a whistling sound. Did you notice any of its parts vibrating?

Whistles produce vibrations in the air and these vibrations are the sound we hear. There are many instruments in which sound is produced by the vibration of air. Some examples are a flute, scout's whistle, *shehnai*, etc.

You hear many sounds every day - the drone of a mosquito, the buzz of a fly, the beat of a drum, birds singing, frogs croaking, the rustle of leaves, the chirping of crickets, etc. These sounds are produced by making something vibrate. Try and find out which part vibrates in each case to produce these sounds.

Low and high pitched sounds

A woman's voice is generally pitched higher than a man's. The mooing of a cow is low pitched while the bleating of a goat is high pitched. A *dholak* gives out a higher pitched sound from one side and a lower pitched sound from the other. In a harmonium, the keys on the right side produce high pitched notes while the ones on the left produce low pitched notes.

Let us find out how high and low pitched sounds are produced.

Bear one thing in mind while performing the following experiments. People often confuse high and low **pitch** with how loud or soft a sound is. A low pitched sound can either be loud or soft. Similarly, a high pitched sound can also be loud or soft.

Experiment 4

Take a narrow wooden plank. It should be 80 cm to 90 cm long and at least 5 cm wide. Hammer a nail at each end of the plank, a little distance inside from the edge. Tie a thin steel wire tautly between the two nails. Slide two plastic boxes under the wire at either end as shown in Figure 4. Pluck the wire with your finger.

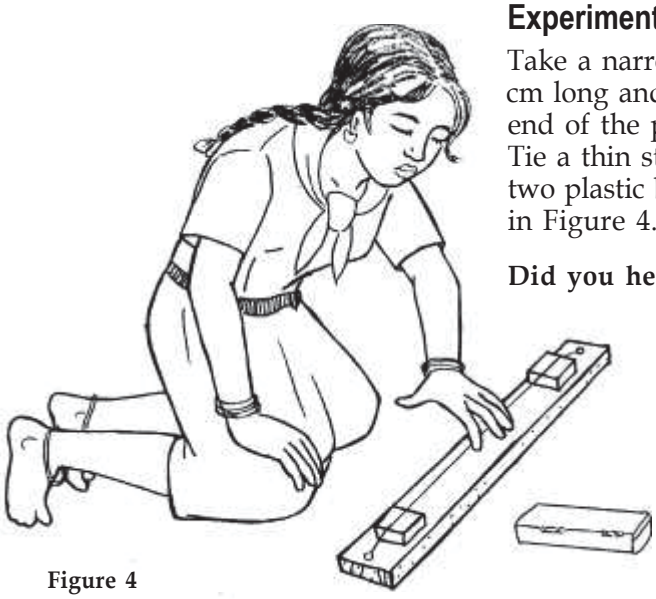


Figure 4

Did you hear any sound? (15)

Could you see the wire vibrating? (16)

Slide a small wooden block over one of the plastic boxes (Figure 5). Ensure that the wire does not become loose and that its length between the two blocks does not change.

How did the block affect the tension of the wire? (17)

Pluck the wire again with your finger. Watch it carefully and listen to the sound it produces.

What effect did the block have on the vibrations produced in the wire? (18)

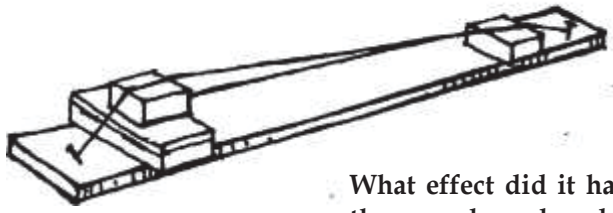


Figure 5

What effect did it have on the sound produced? Was the pitch of the sound produced higher or lower than before? (19)

Can you now suggest a relationship between the tension of the wire, the rate at which it vibrates and the sound it produces? (20)

Experiment 5

Length and frequency :

Place a metre scale on the edge of a table as shown in Figure 6. About 95 cm of the scale should project out beyond the table's edge. With both hands, press down on the end of the scale which is on the table. It would be even better if you can clamp this end down.

Ask a friend to gently press the projecting end of the scale and release it.

Does it make a rattling sound?

If it does, that means you are not pressing it down at the correct point. Adjust your hands to the point where the rattling stops.

When you get the right position, ask your friend to press the scale down again and release it.

Did the scale vibrate? (21)

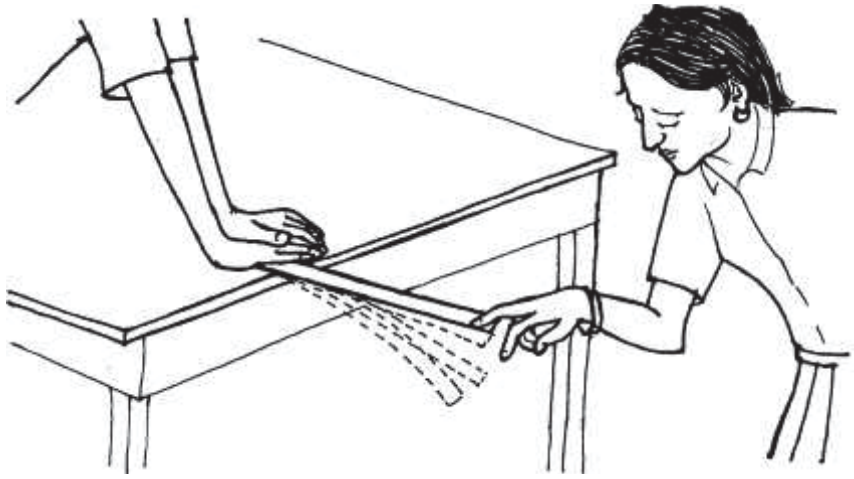


Figure 6

The **frequency** of any object is related to the number of vibrations it makes in a given interval of time. More precisely, the frequency of any vibrating object is defined as the number of oscillations it makes in one second. By one **oscillation** we mean one complete to and fro motion of the vibrating object.

Touch the vibrating scale at a point near the edge of the table.

What did you feel? (22)

Now move the scale 10 cm inwards onto the table.

Set the scale vibrating again and see if there is any difference in the vibrations this time.

What difference is there in the vibrations compared to the previous position? (23)

Keep reducing the length of the vibrating part of the scale 10 cm at a time. Vibrate the scale at each length and observe the vibrations carefully. Also, get a feel of the frequency of oscillations by gently touching the scale near the edge of the table. As the length of the vibrating part decreases, your friend will have to apply more pressure to make the scale vibrate.

When the length of the vibrating portion of the scale is reduced, what effect does it have on the vibrations produced? (24)

Was any sound produced in any of the positions of the scale you experimented with? (25)

You may have to place your ear close to the scale to make out whether it is producing a sound or not.

If you did hear a sound, what was the length of the vibrating portion of the scale? (26)

Were you able to see the vibrations when the length of the scale projecting from the table was about 15 cm? (27)

If you could not, what could be the reason? (28)

Experiment 6

In Experiment 4 you drove nails into a wooden plank and stretched a steel wire tautly between them. Take the same plank and slide one or two blocks under one end of the wire to make it more taut. At the other end, slide a strong hollow cardboard box with a wooden block over it (Figure 7).

In this experiment we shall vibrate different lengths of the wire to see how length affects the sound produced.

Pluck the wire with your finger and listen carefully to the sound produced.

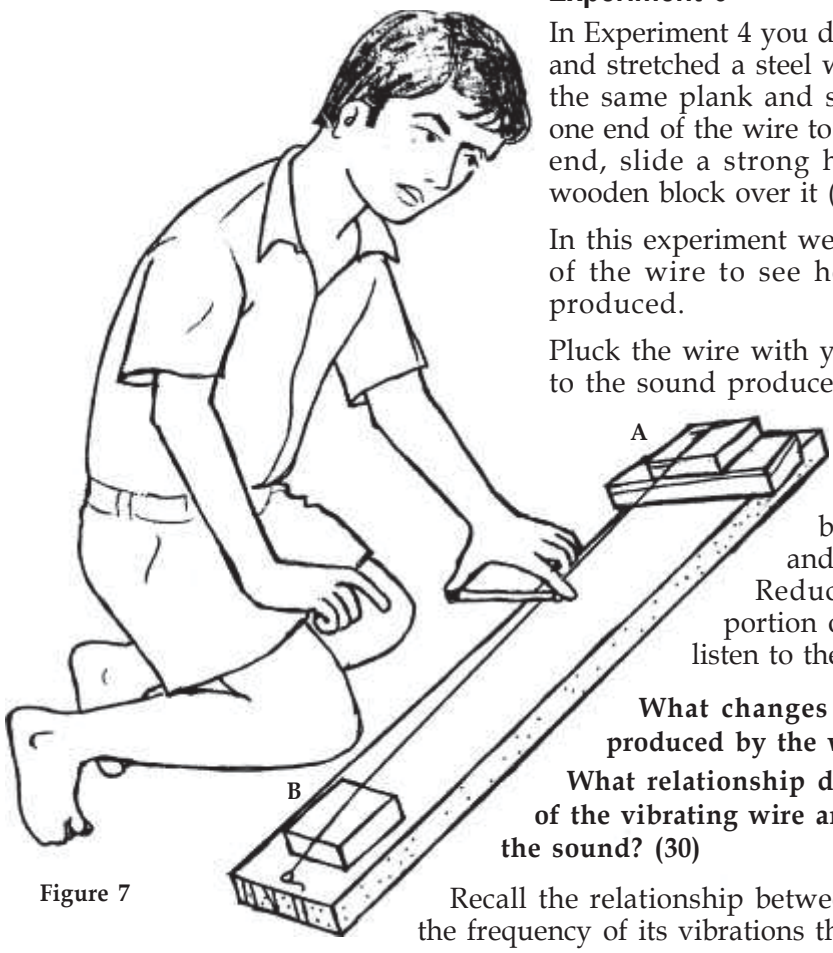


Figure 7

Press the wire with a nail at a distance of about 5 cm from point A. Pluck the wire between the nail and point B and listen to the sound produced. Reduce the length of the vibrating portion of the wire 5 cm at a time and listen to the sound produced in each case.

What changes did you notice in the sound produced by the wire? (29)

What relationship do you see between the length of the vibrating wire and the pitch - low or high - of the sound? (30)

Recall the relationship between the length of the scale and the frequency of its vibrations that you noted in Experiment 5.

Based on your observations so far, what is the relationship between the length of the wire, the frequency of oscillations and the pitch, low or high, of the sound produced? (31)

An object must vibrate to produce sound. These vibrations cause the surrounding air particles to vibrate, which in turn causes our eardrums to vibrate. That is how we hear sound. There must be something to carry the vibrations of an object to our ears. This something is called a medium. When we talk to each other or listen to the radio or hear the school bell, it is air which acts

as the medium between our ears and the vibrating object. But sounds can reach us through other mediums as well. Let us do some experiments with different mediums.

Experiment 7

Sound and the medium

Put your ear close to the surface of a table. Tap the table gently with your finger at a distance of about 30 cm to 40 cm from your ear. Listen carefully.

Did you hear a sound? (32)

Through which medium did the sound reach you? (33)

Raise your ear a little from the table. Tap the table again, like you did before, and listen to the sound.

Through which medium did the sound travel this time? (34)

In which case was the sound louder - when your ear was on the table or when it was lifted a little from the table? (35)

In what way did the change in medium affect the sound? (36)

Experiment 8

Take the inner trays of two matchboxes. Pierce holes in their base and, using matchsticks and a long piece of thread, make the toy telephone shown in Figure 8.

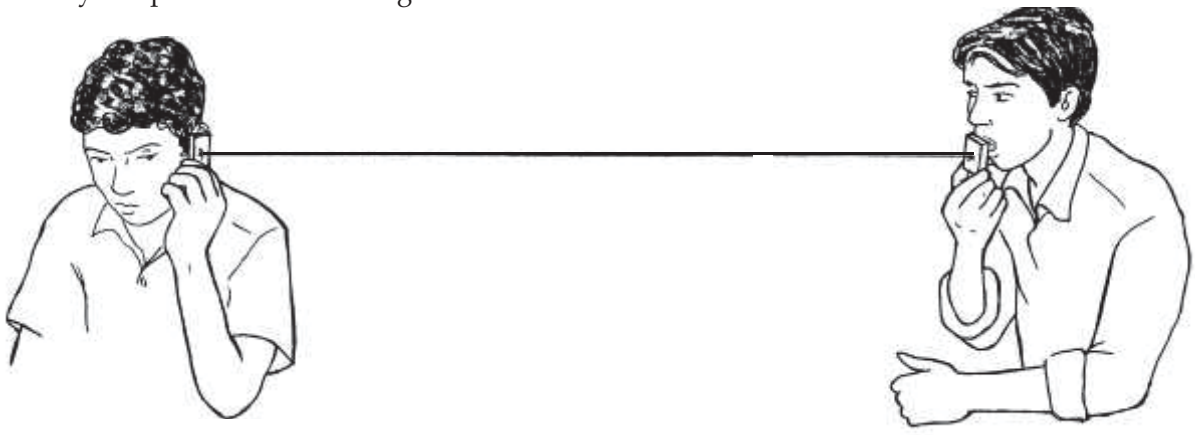


Figure 8

Two students should hold the trays with the thread stretched taut between them. One should say something softly into his tray while the other holds his tray close to his ear and tries to listen to what is being said. A third student should stand nearby and try to hear what is being said without the help of the toy telephone.

Did both students hear what was said?

If not, then who heard what was said?

Why did this happen? (37)

What arrangement can you make if more than one student wishes to hear what is being said on the matchbox telephone?

Devise an experiment

Try to devise an experiment to hear sound that travels through water. If possible, perform the experiment and discuss your results in class.

Write a summary of your discussion in your exercise book. (38)

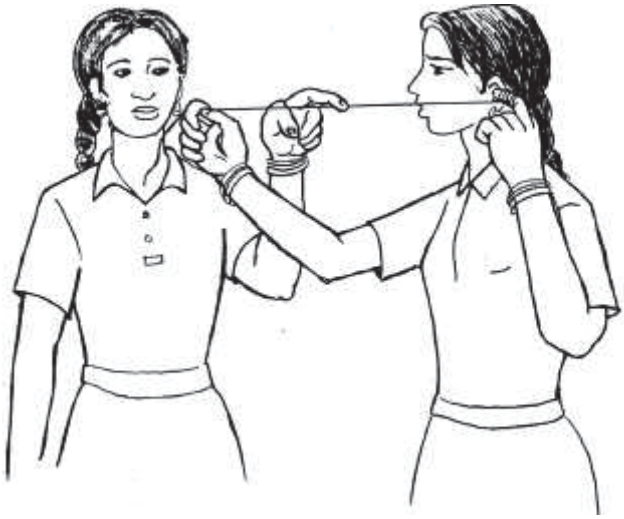
Experiment 9

Take two metal spoons. Tie them in the middle of a 2-metre-long thread. Keep a distance of about 2 cm between the two spoons. Wrap the ends of the thread around your index fingers and insert your fingers in your ears. Swing the thread so that the spoons bang against each other.

Did you hear anything? (39)

Remove your fingers from your ears and swing the spoons again so that they strike each other.

Was the sound the same as before? If not, why was it different? (40)



You can perform this experiment with a tumbler, bowl or other utensil. You will have to strike the utensil with something to produce a sound.

Experiment 10

Take a thread and wrap it around your index finger. Hold the other end in your other hand and pull the thread taut.

Ask your friend to pluck the taut thread.

Insert the finger with the thread wrapped around it in your ear and, keeping the thread taut, ask your friend to pluck it again.

What was the difference in the sound produced in both cases? (41)

You have learned many things about sound in this chapter - how sound is produced, the relationship between frequency and pitch, the role a medium plays in transmitting sound, etc.

We hear sounds only because of our ears. They are sensitive organs so we can hear even soft sounds. But people who live in a noisy environment, like those living in big cities or working in a factory, become less sensitive to sound over a period of time. When we are surrounded by loud noises all the time they affect our ears and also cause other physical and mental problems.

Extremely loud noises, such as exploding crackers, can damage

your eardrums. You could also damage your eardrum if you insert a pointed or sharp object into your ear. You should be careful and avoid doing such things.

Questions for revision

1. **When a utensil falls down it makes a loud clanging noise. But the moment you pick it up and hold it in your hands, the sound stops. Why?**
2. **Why doesn't a cycle bell ring properly if you cover it with your palm?**
3. **Two wires are stretched taut on a wooden plank. They are of different lengths but the tension of both wires is the same. If they are plucked, can you identify which is the longer and which is the shorter wire by the sounds they produce?**
4. **A steel wire is fixed to a nail. It has a 10 kg weight attached to it. The wire produces a sound when it is made to vibrate. What must you do to produce a sound of a higher pitch?**
5. **Take an empty test tube. Blow across its mouth to produce a whistling sound. Add 2 ml of water to the test tube and blow again. Keep adding 2 ml of water each time and blowing. What difference does the level of water make to the sound produced? Can you explain why this happens?**

New words

Vibration Oscillation Frequency Pitch Tension Medium

3 SOUND

34 SOUND

38 SOUND

32 SOUND

36 SOUND

4 WATER - HARD & SOFT

WATER - HARD & SOFT 3

42 WATER - HARD & SOFT

WATER - HARD & SOFT 4

44 WATER - HARD & SOFT

WATER - HARD & SOFT 43

46 REPRODUCTION IN PLANTS

REPRODUCTION IN PLANTS 45

48 REPRODUCTION IN PLANTS

REPRODUCTION IN PLANTS 47

5 REPRODUCTION IN PLANTS

REPRODUCTION IN PLANTS 4

52 REPRODUCTION IN PLANTS

REPRODUCTION IN PLANTS 5

54 AREA

AREA 53

56 AREA

AREA 55

58 AREA

AREA 57

6 AREA

AREA 5

62 AREA

AREA 6

64 HOW TO DRAW A MAP

HOW TO DRAW A MAP 63

66 HOW TO DRAW A MAP

HOW TO DRAW A MAP 65

68 HOW TO DRAW A MAP

HOW TO DRAW A MAP 67

7 HOW TO DRAW A MAP

HOW TO DRAW A MAP 6

72 HOW TO DRAW A MAP

HOW TO DRAW A MAP 7

74 INTERNAL ORGANS OF THE BODY - 1

INTERNAL ORGANS OF THE BODY - 1 73

76 INTERNAL ORGANS OF THE BODY - 1

INTERNAL ORGANS OF THE BODY - 1 75

78 INTERNAL ORGANS OF THE BODY - 1

INTERNAL ORGANS OF THE BODY - 1 77

8 INTERNAL ORGANS OF THE BODY - 1

INTERNAL ORGANS OF THE BODY - 1 7

82 INTERNAL ORGANS OF THE BODY - 1

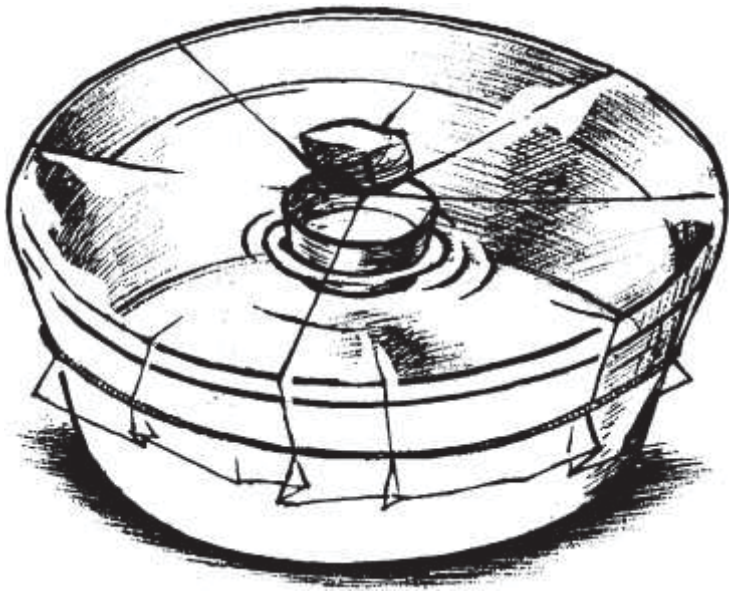
INTERNAL ORGANS OF THE BODY - 1 8

84 INTERNAL ORGANS OF THE BODY - 1

INTERNAL ORGANS OF THE BODY - 1 83

GET DISTILLED WATER, DROP BY DROP

Take a large bowl or tub. Place a small heavy bowl in its centre. Fill the large bowl with water. Pour just enough water to ensure that the small bowl does not float. Cover the mouth of the large bowl with a transparent plastic sheet. Tie the tightly stretched plastic cover in place with thread. Place a small pebble at the centre of the plastic sheet, directly above the small bowl. The plastic cover will dip slightly in the middle because of the weight of the pebble.



Place this apparatus in the sun. After some time, you will see drops of water forming on the under-surface of the plastic cover. The drops of water will drain into the small bowl. This is your distilled water. Do you see any similarity between what happens in your apparatus and the process by which we get rain?

WATER - HARD AND SOFT

Chapter 5

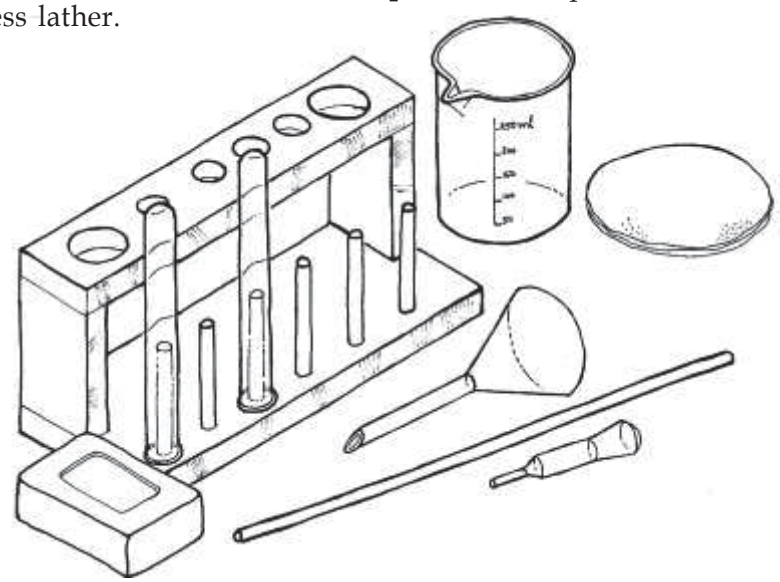
We use water all the time. Water is so important for us that we cannot imagine life without it. It is important because of its properties.

You have studied many properties of water. Since you use water daily, you must have also observed many of its properties. Make a list of these properties.

In this chapter we shall study a special property of water. Do you recall ever having used water in which soap does not lather? Can you remember where this water came from?

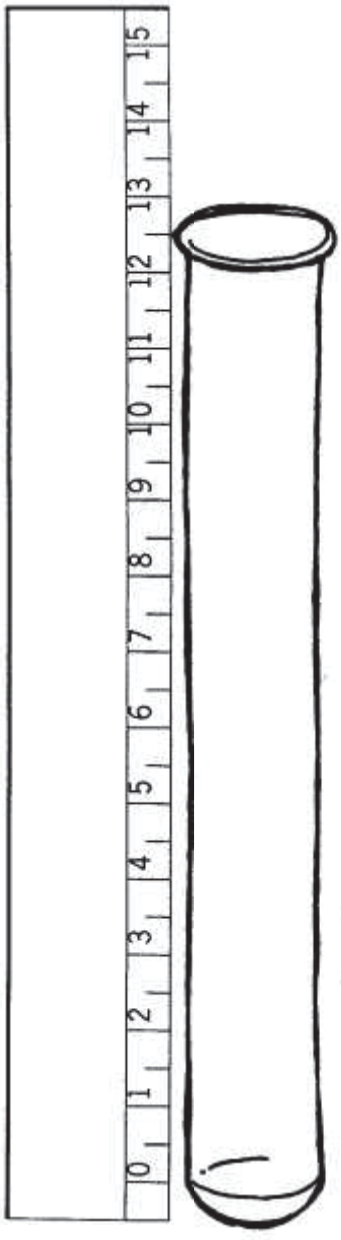
We shall try to understand why soap does not produce a rich lather in water collected from some sources and how we can change the quality of this water so that it can produce a better lather. To do this, you will have to collect water from different sources - well, tap, river, pond, etc.

However, before we begin our experiments, we need to answer one question. When we say water from a certain source produces less lather, what are we comparing it with? Less than what? We must have some **standard** with which to compare before we can decide whether a **sample** of water produces more or less lather.



The standard we shall use for comparison is rain water and the lather it forms.

Distilled water from rain



The experiments we shall now perform require a supply of **distilled water**. Each group will need at least one glucose bottle full of distilled water. To collect distilled water, place a utensil with a wide mouth in the rain. The utensil should be kept in the open so that water running off a roof or nearby trees cannot fall in it. Also, take care that mud doesn't splatter into the utensil. Store the rain water you collect in a clean glucose bottle and plug its mouth with a cork. This is your distilled water.

There is another way of collecting distilled water. This method has been explained in an interesting experiment given just before this chapter on Page 38.

Preparing a soap solution

We need soap solution for our experiments. We shall prepare enough soap solution for the whole class. But remember one thing - use bathing soap, not **detergent**, to prepare the solution. Take a beaker and fill it halfway with distilled water. Add a few pieces of bathing soap to the water. Let the soap soak and dissolve in the water and then shake the beaker well to make a solution. The solution should be so concentrated that 5 to 10 drops should produce a lot of lather when poured into a test tube which is filled a third with water.

You now have all the things you will need for your experiments.

Experiment 1

In this experiment you will compare the lather produced in different samples of water with the lather produced in distilled water. But you must observe three precautions while doing this experiment:

1. Take equal amounts of water from each sample for comparison.
2. Add an equal number of drops of soap solution to each sample.
3. After adding the soap solution, shake each sample an equal number of times.

Why is it necessary to take these precautions? (1)

HOW MUCH IS ONE THIRD?

A diagram of a test tube is given above. A scale has been drawn alongside it. Mark the length of the test tube on the scale and measure one-third (1/3) of this length. Mark the test tube at this point with a pen.

Mark two test tubes in this way. Every time you need a 1/3 test tube of water, fill the test tube to this mark.

Fill one-third of a test tube with distilled water. Add 8 drops of soap solution and shake well for a measured interval of time. We shall use this test tube as the standard for comparison. Label it and place it on the test tube stand.

Now take a fresh test tube. Pour your sample of river water into it.

How much water did you take?

Put as many drops of soap solution into this water sample as you did in the distilled water. Shake it well for the same interval of time as before. See how much lather is formed. Compare it with the lather in the standard test tube. If the lather in the standard test tube has settled, shake the test tube again before comparing.

Make a note of whether the lather formed with river water is less, equal to or more than the lather formed with distilled water.

Use the following signs to record your observations in Table 1:

(+) sign for equal or more lather than distilled water.

(-) sign for less lather than distilled water.

Table 1

No.	Source of sample	Amount of lather compared to distilled water	Precipitate formed or not
1.	River		
2.			
3.			
4.			

Check if any insoluble substance **(precipitate)** is produced after you shake the test tube. Fill in this column of the table as well.

Repeat the experiment with the samples of tap and well water. Don't forget to wash your test tube with distilled water every time you test a new sample.

Record your results in Table 1. (2)

Did all the water samples produce an equal amount of lather? (3)

Water that produces plenty of lather with soap (equal to or more than the lather produced with distilled water) is called **soft water**.

Water that produces less lather than distilled water is called **hard water**.

Should one consider distilled water to be soft or hard?

Experiment 2

We shall repeat Experiment 1 with some more samples of water. But we shall prepare these samples ourselves by mixing several different **salts** in water.

These salts are listed in Table 2. Use them one by one for your experiment.

Wash a test tube with distilled water and fill 1/3 of it with distilled water. Add a tiny bit of calcium chloride - the size of a grain of rice - to the water and shake well.

Add soap solution to the water and shake well.

How many drops of soap solution should you add?

Compare the lather formed with that of the standard test tube of distilled water and record your result in Table 2, using the same method you did in Experiment 1. (4)

Table 2

No.	Salt mixed with distilled water	Amount of lather compared with distilled water	Precipitate formed or not
1.	Calcium chloride		
2.	Sodium chloride		
3.	Calcium sulphate		
4.	Magnesium sulphate		
5.	Sodium carbonate		
6.	Sodium bicarbonate		

Repeat this experiment with each salt listed in the table. Answer the following questions on the basis of your observations.

Did all the salt solutions produce the same amount of lather with soap? (5)

List the names of the salts you used in your experiments in the appropriate columns of Table 3. (6)

Table 3

Salts that do not make water hard	Salts that make water hard	Salts that produce a precipitate with soap

Which salts, when dissolved in water, make the water hard? (7)

Are there any salts which, when dissolved in water, do not affect the softness of water? (8)

Which salts, when dissolved in water, leave a precipitate on adding soap? (9)

Do you see any relationship between salts that form a precipitate and salts that make water hard? If you do, explain what this relationship is. (10)

Are the salts that produce a precipitate the same as the salts that make water hard? (11)

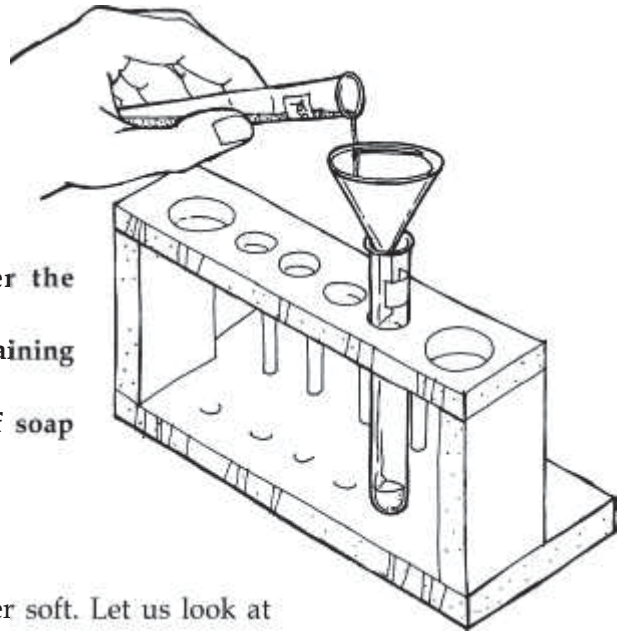
If we repeat this experiment with detergent instead of soap, would the results be the same? (12)

If you cannot answer this question, do the following experiment.

Experiment 3

You saw in Experiment 1 that some samples of water, when mixed with soap, gave less lather than distilled water. We labelled them samples of hard water. In Experiment 2 you saw that there are some salts that make distilled water hard if they are mixed in it.

You can use any sample of hard water from your previous two experiments for this experiment. Take two test tubes. Fill one test tube 1/3 with distilled water. Pour an equal amount of hard water in the second test tube. Add 2 to 3 drops of concentrated detergent solution to both the test tubes and shake well.



Did the hard water produce lather after the detergent solution was added? (13)

Did a precipitate form in the test tube containing hard water? (14)

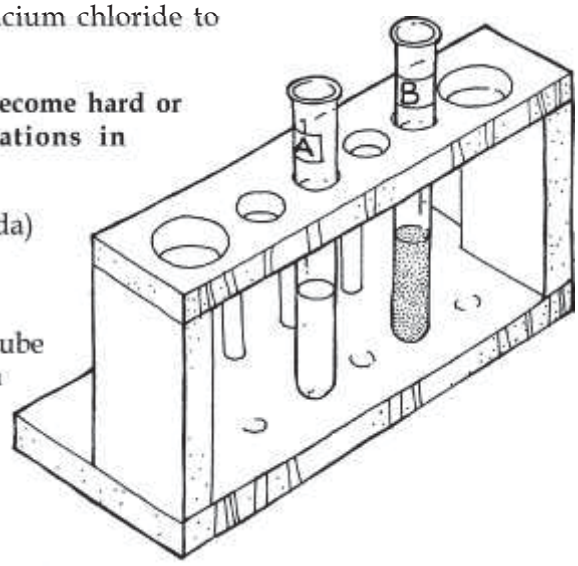
Is there a difference between the action of soap and detergent on hard water? (15)

Experiment 4

Making hard water soft

There are many ways of making hard water soft. Let us look at one of these methods.

Take two test tubes A and B. Fill both 1/3 with distilled water. Add a pinch (the size of a grain of rice) of calcium chloride to each.



Did the distilled water in test tubes A and B become hard or soft? Answer on the basis of your observations in Experiment 2. (16)

Now add a little sodium carbonate (washing soda) to test tube B and shake well.

Did a clear solution form in the test tube? (17)
If it did not, filter the solution into another test tube and mark it B. Now add 8 drops of soap solution each to test tubes A and B. Shake them well. Observe the lather produced and compare the amount in both test tubes.

Is the amount of lather produced in test tube A the same as that in test tube B? (18)

If not, which test tube has more lather? (19)

Why did more lather form in this test tube? (20)

What conclusions can you draw from these observations? (21)

If you find you are using too much soap while washing clothes, what should you do? (22)

Why is sodium carbonate called washing soda? (23)

On the basis of the experiments that you have performed, can you suggest some other ways of making hard water soft? (24)

Hardness is of two types. One type of hardness disappears after the water is boiled.

Test the water from wells or lakes near your home and find out whether the water loses its hardness after it is boiled. (25)

You have learned to test the hardness of water.

Find out whether the items/substances listed below make water hard.

1. Chalk dust

2. Ash

3. Sugar

4. Black tea. (26)

Some questions for revision

1. Based on the experiments performed in this chapter would you say that soft water always remains soft?

2. The chemical name of the common salt we use to cook food is sodium chloride. Does water become hard if common salt is added to it?

3. Why did we use distilled water to make solutions of different salts in Experiment 2? Could we have used tap water? Give reasons for your answer.

New words

Standard	Distilled water	Process	Soft water
Detergent	Sample	Hard water	Precipitate
Salt			

Chapter 6

REPRODUCTION IN PLANTS

In the chapter 'Seeds and their germination' in Class 6, you learned how a plant develops from a seed. But is it true that all plants germinate from seeds?

How do the following plants grow? Discuss with your classmates and write your answer in your exercise book:

mango, potato, banana, tamarind, rose, wheat, rice, *besharam*, watermelon, *doob* and radish. (1)

The process by which plants and animals produce young ones and increase their numbers is known as **reproduction**.

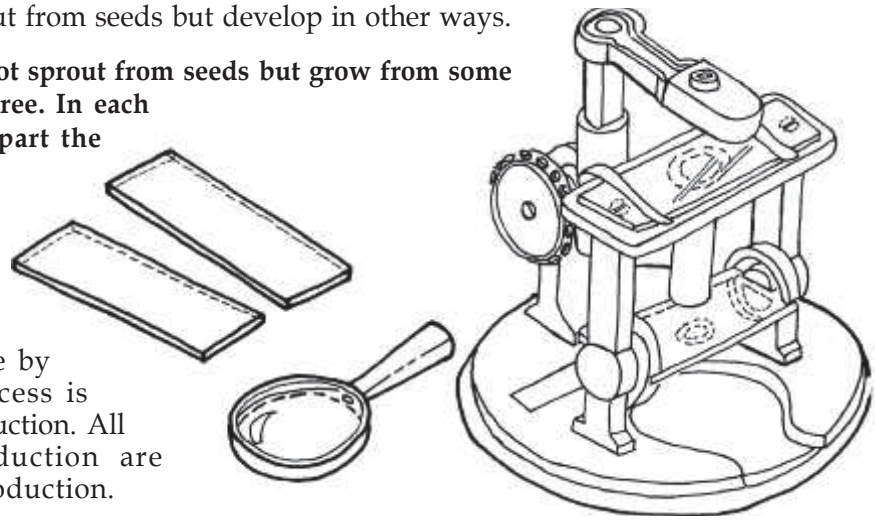
As we saw earlier, different plants reproduce in different ways. Some trees and plants sprout from seeds.

Name 10 plants that sprout from seeds. (2)

Some plants do not sprout from seeds but develop in other ways.

Name 10 plants that do not sprout from seeds but grow from some other part of a plant or tree. In each case, write from which part the new plant develops. (3)

Can you name some plants that develop from seeds as well as in other ways? (4)



When plants reproduce by forming seeds the process is known as **sexual** reproduction. All other ways of reproduction are known as **asexual** reproduction.

Sexual reproduction

The formation of a seed is essential for sexual reproduction. You studied seeds in Class 6. You know that they are found inside the fruit. We shall now try and understand how fruits are produced.

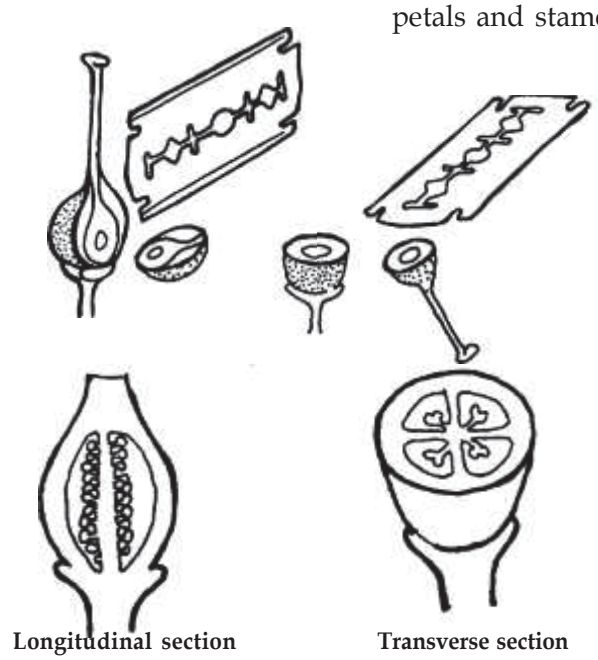
On the basis of your previous experience and knowledge can you say from which part of the plant the fruit develops? (5)

Experiment 1

Comparison of the fruit and flower

In this experiment, we shall compare flowers with fruits and try to understand the relationship between them. To do this, you should first collect flowers and fruits from five different species of plants. For example, if you collect a flower from a ladyfinger (*bhindi*) plant, you must bring a fruit of the plant as well. Get two flowers and two fruits of each species.

Choose the flowers and fruits of any one species. Pluck the sepals, petals and stamen of one flower. Pluck them one by one, taking care not to damage the pistil. Finally, only the pistil remains on the thalamus. You can easily recognise the ovary, style and stigma in the pistil.



Longitudinal section **Transverse section**

Figure 1

Compare the shape and structure of the ovary with the shape and structure of the fruit.

Do you see any similarity between their shape and structure? (6)

Let us first compare their internal structures. Slice the ovary of one flower horizontally and that of the second flower of the same species vertically. You learned how to make a horizontal section in the chapter 'The structure of flowers'. To help you, Figure 1 shows how this is done. The figure also shows you how to make a vertical section.

In the same way, slice one fruit vertically and the second horizontally.

Study the internal structure of the ovary and the fruit using the horizontal and vertical sections. Use a magnifying glass, if necessary.

Draw diagrams of the horizontal and vertical sections of the ovary. (7)

Show the arrangement of ovules in the ovary. (8)

Similarly, draw diagrams of the horizontal and vertical sections of the fruit, showing the arrangement of seeds in them. (9)

Slice all the remaining samples of flowers and fruits and draw diagrams of their horizontal and vertical sections. (10)

Answer the questions given below:

What similarity do you see between the ovary and fruit of the same species? (11)

On the basis of the similarity you observe, would it be reasonable to conclude that the fruit develops from the ovary? (12)

From which part of the ovary do you think the seeds develop? (13)

On the basis of your comparison, can you state whether a plant can produce fruit if it bears no flowers? (14)

Before we proceed further

In the chapter "The structure of flowers" you had seen that some plants have two types of flowers. One type has sepals, petals and stamens. These are the **male flowers**. The other type has sepals, petals and a pistil. These are the **female flowers**.

Flowers which only have either the male or the female parts are known as **unisexual flowers**.

Find five plants with unisexual flowers. (15)

On the basis of your observation in Experiment 1, say which kind of flower develops into fruit. (16)

From flower to fruit

You have compared the structure of an ovary and a fruit of the same species and seen that it is reasonable to conclude that an ovary develops into a fruit while the ovules develop into seeds. How can we confirm this?

Can you suggest an experiment for the purpose? Describe your experiment. (17)

Let us accept for the moment that the fruit develops from the ovary and the seeds from the ovules.

Did you notice any difference between the horizontal sections of the ovary and fruit?

Some features are listed in Table 1. Based on these features, compare the ovary of each species of flower with the fruit of the same species. (18)

Table 1

	Ovary	Fruit
Thickness of wall		
Number of chambers		
Arrangement of ovules/seeds		
Size of ovules/seeds		
Number of ovules/seeds		

You will notice that many changes occur during the process of an ovary developing into a fruit.

Can we assume that an ovary develops into a fruit on its own? (19)

The experiment described below might help you answer this question. If possible, try doing the experiment yourself. If you cannot, then read the details of the experiment and then try answering Question 19.

Experiment 2

This experiment can be performed with any flower. But it is easier to do it with unisexual flowers. You know that flowers of the gourd (*lauki*) plant are unisexual, i.e. they are either male or female.

Interestingly, this experiment was actually performed by some school students. They first learned to identify male and female *lauki* flowers.

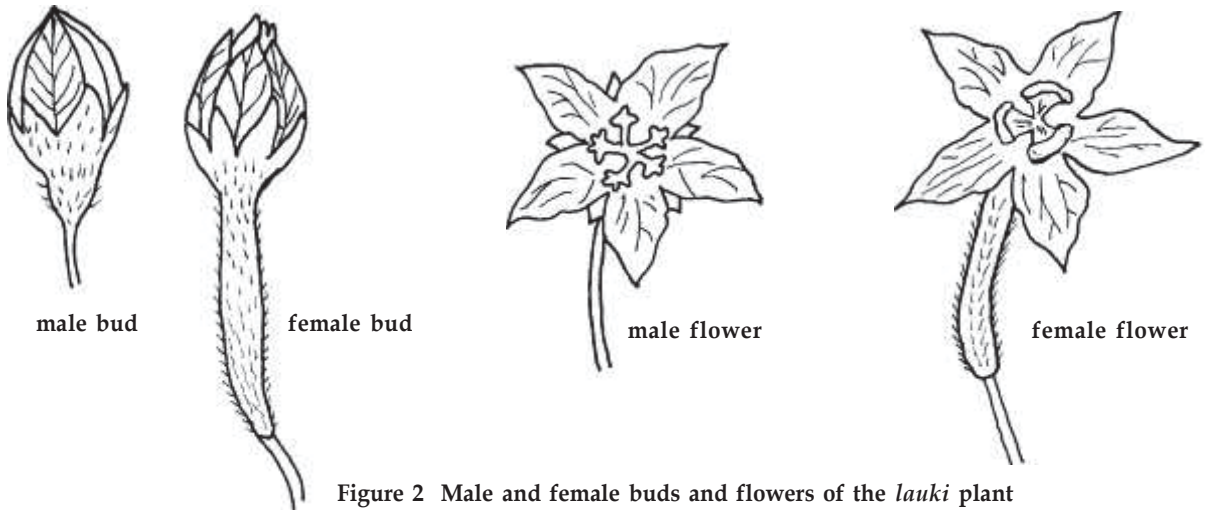


Figure 2 Male and female buds and flowers of the *lauki* plant

Can you identify the male and female *lauki* flowers after having looked at the diagrams in Figure 2. What differences do you see between them? (20)

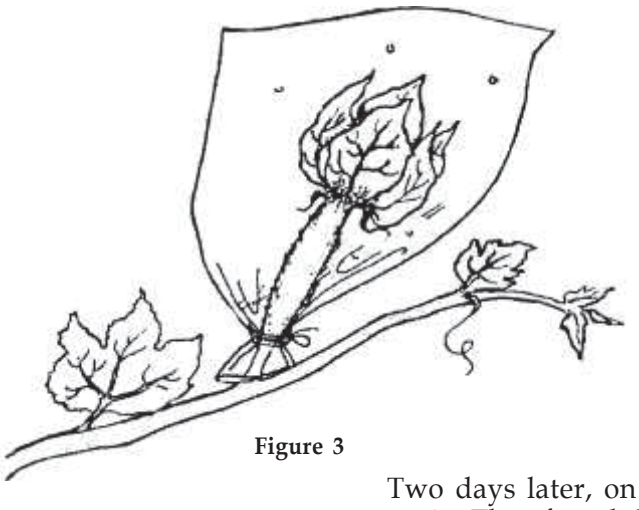


Figure 3

The students went to a garden and selected 10 female buds that they felt would bloom in a day or two. The petals of these buds were closed when the experiment began. The students covered each bud with a polythene bag, loosely tying the bag on the stalk (Figure 3). They noted the date the experiment began (August 2, 2002) on slips of paper and put a slip inside each bag. The teacher instructed them to make tiny holes in the bags with the help of a pin.

Why did the teacher ask them to make holes in the bags? (21)

Two days later, on August 4, the students observed the plants again. They found that most of the female buds they had covered with bags were blooming. Their teacher told them to collect and brush pollen grains on the stigma of five of these female flowers.

The students chose four or five male flowers to collect pollen.

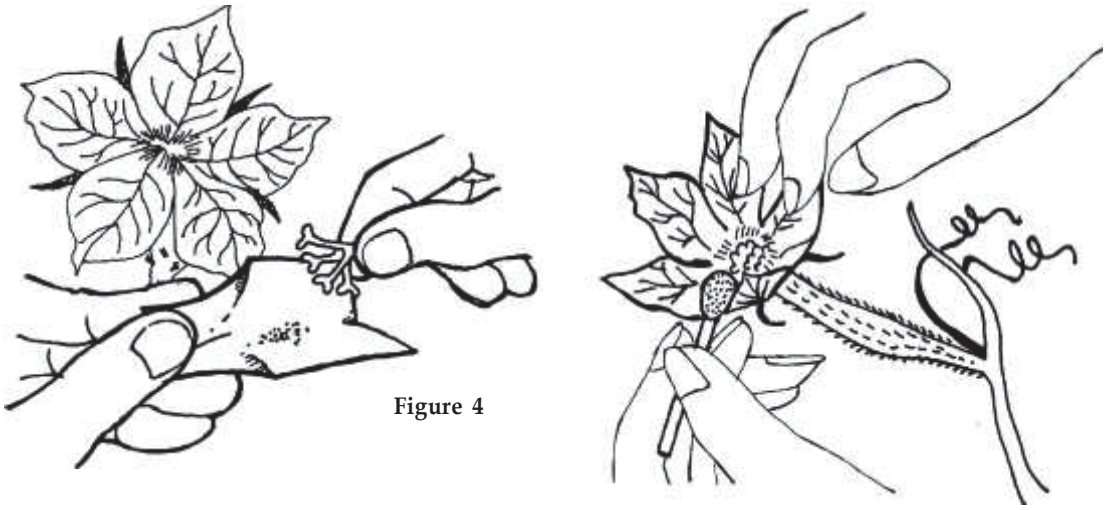


Figure 4

They plucked the stamens of these flowers and shook loose the pollen grains onto a sheet of paper. They made a brush by twisting cottonwool over the tip of a matchstick and used this brush to collect the pollen grains.

They removed the bags from five of the ten female flowers. They applied pollen to the stigma of these flowers with the brush (Figure 4). The pollen grains stuck to the stigma. They noted the date on which they had applied the pollen (August 4, 2002) on slips of paper, put a slip into each bag and covered the flowers again.

Their teacher told them that the process of pollen grains reaching the stigma is known as **pollination**. A flower that receives pollen is called a **pollinated flower**. Flowers that are not pollinated are called **unpollinated flowers**.

Did the students pollinate all the female flowers? (22)

The students returned to the garden on August 10 and checked all the 10 covered flowers. They made the following observations:

Table 2

	Number of flowers	Number that survived	Number that bore fruit
Pollinated flowers	5	4	4
Unpollinated flowers	5	5	0

Answer the following questions:

Why was it necessary to begin this experiment with buds in which the petals are closed? (23)

Why were the buds enclosed in polythene bags? (24)

Why were 4 or 5 buds selected? Couldn't the experiment have been done with a single bud? (25)

Why were the unpollinated flowers also covered with polythene bags? (26)

Which of the flowers bore fruit? Study the table before you answer. (27)

On the basis of this experiment, describe the role of male flowers in the formation of fruit. (28)

Pollination in nature

In the experiment we have just described, a brush was used to transfer pollen to the female flower. This is known as **artificial pollination**. We know that pollination is essential for a flower to develop into a fruit and for seeds to form. So how does this process take place in nature?

There are many ways in which pollen grains from the stamens reach the stigma.

When the stamens ripen, they begin to shed pollen grains. The pollen grains are light. They are carried by the wind in all directions. Some pollen grains are carried to the stigma of other flowers by the wind.

Insects and birds are other agents of pollination. You may have seen honeybees, beetles and a variety of birds hovering over flowers. They usually suck the nectar from flowers. But while doing so, pollen grains from the stamen stick to their wings, legs, stomach, etc. When they go to another flower these pollen grains are transferred to the stigma of that flower. Thus pollination takes place.

Name some flowers on which you have seen insects hovering or sitting? (29)

Do these flowers have any special features that attract insects? (30)

After pollination

Pollen grains reach the stigma by pollination. What happens to them after this? Let us perform an experiment to find out.

Experiment 3

Do this experiment with the pollen grains of *besharam* or periwinkle (*sada bahar*) flowers. Take two glass slides. Put 2 to 4 drops of water on each slide. Add 1 or 2 grains of sugar to the water on one slide.

Sprinkle a few pollen grains from the stamen of the flower you have selected in the water on both the slides. Let the slides stand for 30 minutes.

Observe both slides through a microscope. Cover the drops of water on the slides with a piece of polythene before placing them under the microscope. This will prevent the water from touching the lens.

Draw diagrams of the pollen grains placed on each of the two slides. (31)

Do you see any difference between the pollen grains on the two slides? If so, what is the difference? (32)

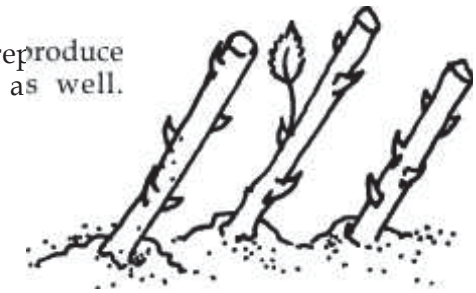
Pollen grains undergo the same process when placed on a stigma. There are substances present on the stigma which cause pollen grains to germinate. During germination a tube develops from the pollen grain. This tube ultimately reaches the ovary through the style.

The experiment described above can also be done with the juice of a crushed style instead of sugar grains.

Describe in your own words what you have learnt about the process by which a flower develops into a fruit. (33)

The flowering of a plant, the formation of fruit and seed from the flower, the development of a new plant from a germinating seed – this is the life cycle of a plant. This cycle is completed through sexual reproduction.

Asexual reproduction



In the beginning of the chapter you saw that plants reproduce not only through seeds but by other processes as well. Reproduction by any process other than seed formation is known as asexual reproduction. We shall now examine the different ways in which asexual reproduction takes place in plants.

In the chapter "Getting to know leaves" in Class 6, you learned about the leaves of the bryophyllum plant (*patharchatta*, *ajooba* or *khatumara*). You may have also seen this plant.

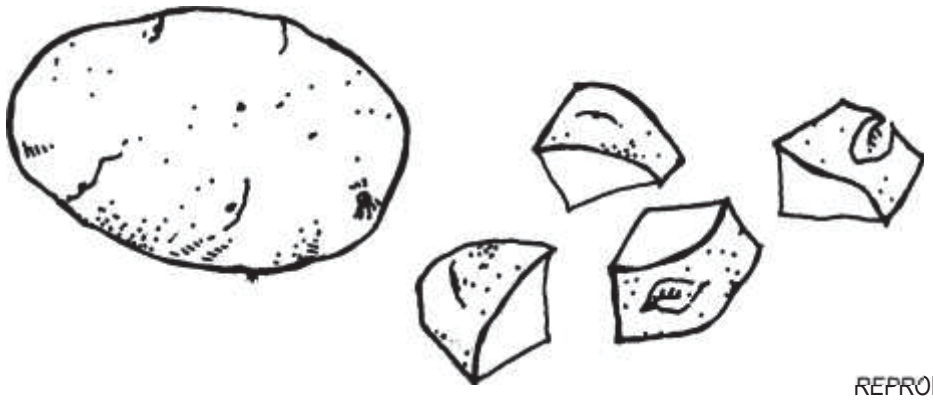
Can we say that the bryophyllum plant reproduces asexually through its leaves? (34)

Do you know any other example in which a whole new plant develops from the leaves?

How does a new plant develop from potato, sugarcane, ginger and *naagphani*? (35)

Reproduction in the potato plant

Take a potato. Look at it carefully. A new potato plant can develop from this potato. Farmers call it the potato seed.



On the basis of what you have learnt about the relationship between flowers, fruits and seeds do you think it is correct to call a potato a seed? (36)

Experiment 4

The potato has a number of small depressions on its surface. These are known as eyes. Cut a potato into pieces, making sure there is an eye in each piece. Remove the eyes from some of these pieces. Fill two cups or *kulhads* (earthenware cups) with soil. Plant the pieces with eyes in one cup and those without eyes in the other. Water both cups daily and observe what happens.

In which cup do potato plants sprout? (37)

Find out how the following plants reproduce and which part of each plant is involved: banana, sugarcane, ginger, seedless lime and grapes. (38)

Questions for revision

1. **From what you have learnt in this chapter, describe in your own words the difference between sexual and asexual reproduction.**
2. **You may have eaten bananas. Have you ever thought about how a new banana plant develops? Find out and describe the process in your own words.**

New words

Reproduction	Sexual	Asexual
Unisexual	Pollination	Artificial pollination

AREA

Chapter 7

Whose field is bigger?

The map below shows the agricultural fields owned by Shakoor, Parasu and Gayadeen.

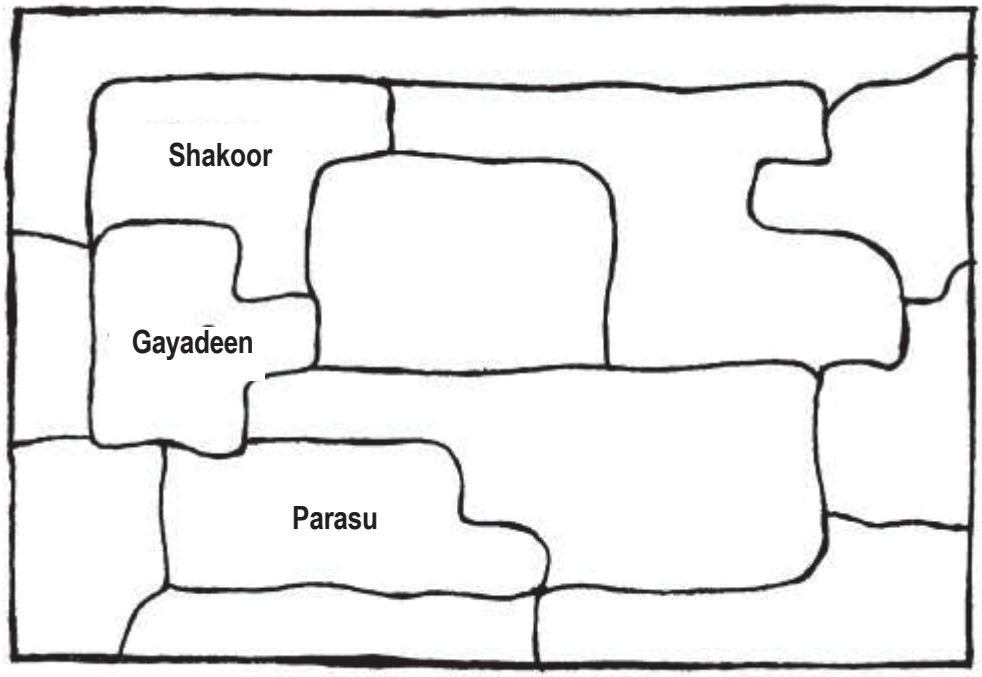


Figure 1

Can you tell by looking at the map who has the largest field - Shakoor, Parasu or Gayadeen? (1)

It's not easy answering that question just by looking at the map. So how do you find out whose field is the biggest? There is a simple method for doing this. But before discussing the method let us do the following activity.

Activity 1

Which piece is bigger

Your kit copy has a page with a square and a rectangle drawn on it. Cut them out and compare the two shapes.

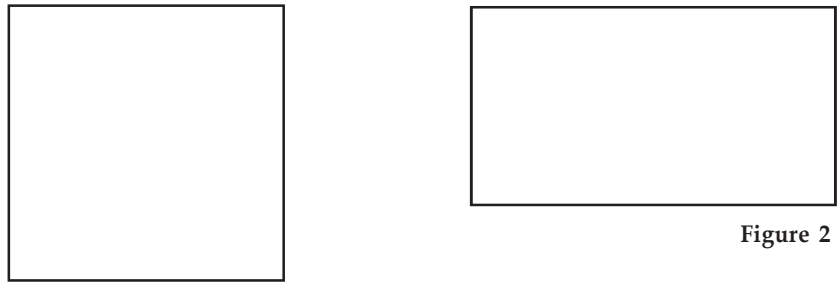


Figure 2

Which shape is longer? (2)

Which is broader? (3)

Which shape is larger? Take a guess. Can you judge which shape is larger by measuring only its length or breadth? (5)

Can you think of a method to find out which shape is larger? (6)

We often need to make such comparisons. For example, we may have to find out:

Which is the largest room in the school?

Which is the smallest window at home?

How much bigger is the biggest kite in a kite shop compared to the smallest?

Think of other similar examples. (7)

A simple method

The size of a field or piece of paper - its bigness or smallness - is related to the extent of its surface, to how far its surface spreads. The bigger the field or paper, the larger is its surface spread. You need more seeds to sow a field with a larger surface spread than a smaller one. Similarly, a larger courtyard requires more tiles to pave because its surface spread is larger.

We can judge whether a distance is large or small by its length. In the same way, we can judge whether a field or a piece of paper is large or small by its area. The area is the measure of the surface spread of the field or piece of paper. Naturally, the area of a bigger field is more than the area of a smaller one.

Let us see how area is measured. To measure length we choose a unit of measurement, such as a metre, centimetre, millimetre, etc. We then find out how many of these units, the length in question is equal to. For example, if the length is 12 cm, it means that it is equal to 12 units of 1 cm each.

Similarly, to measure area, we choose a fixed surface spread as the unit of measurement. For example, this unit could equal a square with sides which are 1 cm long. The area of such a square is 1 square centimetre. So the unit of area in this case is one square centimetre. A square centimetre is also written as 1 centimetre^2 (or 1 cm^2).

Your science kit contains a plastic cube. Each face of this cube is 1 cm^2. Cover the surface, the area of which you want to measure,

with these cubes and see how many cube faces this surface is equal to. The area of the surface is that many square centimetres.

Now find out the area of Shakoor's, Parasu's and Gayadeen's fields in cm^2. (8)

Whose field is the biggest and whose is the smallest? (9)

What are the areas of the two shapes in Activity 1? (10)

Did you guess correctly which piece was bigger? (11)

Activity 2

Measuring area:

Figure 3 shows the pictures of a man and a dog. Measure their areas with the help of the faces of the unit cubes.

Note these measurements in your exercise book. Don't forget to write the unit of measurement. (12)

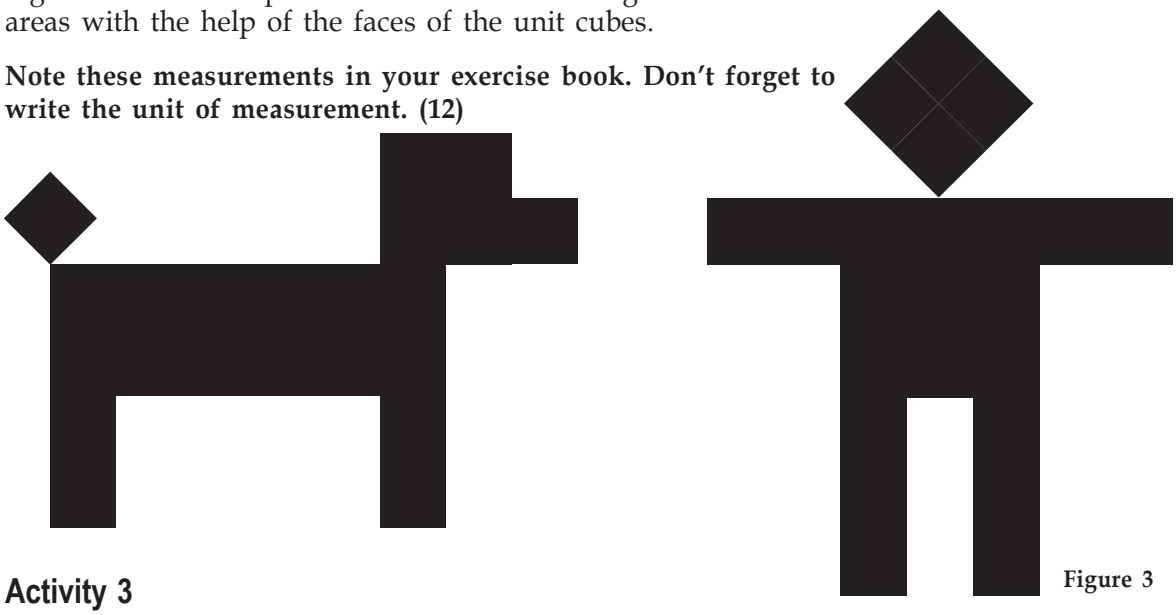


Figure 3

Activity 3

Measuring area with a sheet of graph paper:

We can also measure area with a sheet of centimetre graph paper. One such sheet is shown in Figure 4. It consists of horizontal and vertical lines one centimetre apart.

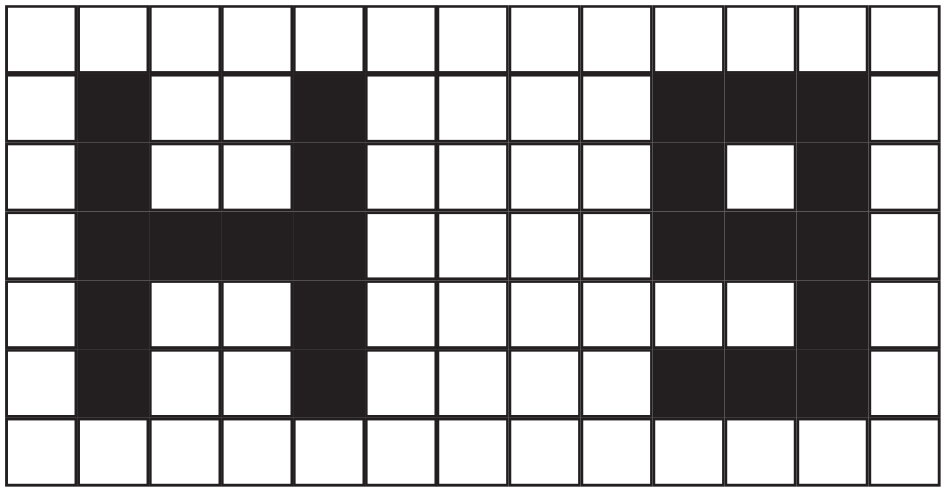


Figure 4

What is the length of one side of each square in this sheet? (13)

How many plastic cubes can you place on a square? (14)

What is the area of one square? (15)

The number of squares a figure or shape covers on the centimetre graph paper is equal to the area of the figure in square centimetres.

Two figures are drawn on the graph paper.

Find the area of both these figures. (16)

All the squares contained in the two figures in Figure 4 were complete squares. Now look at the figures drawn in Figure 5. These figures cover some squares fully and some squares partially.

Find the area of these figures. (17)

Did you face any problem in calculating the area? (18)

Can you think of a way to measure the area of such figures? (19)

Activity 4

In this activity we shall learn how to measure the area of such irregular figures.

In Class 6 you learned how to make approximations while measuring lengths. Just as you made approximations of distances to the nearest unit, you can make similar approximations while measuring area.

Let us see how this is done. To find the area of the pictures in Figure 5, we first count the number of squares that are fully covered by each picture. Then we look at the partially covered squares. If a square is less than half covered, it is not counted. If half or more than half the square is covered, it is counted as a full square.

Thus, the area of the picture is the number of squares fully covered by the figure + the number of squares that are either half or more than half covered by it.

Now find the area of the pictures in Figure 5 by making such approximations. (20)

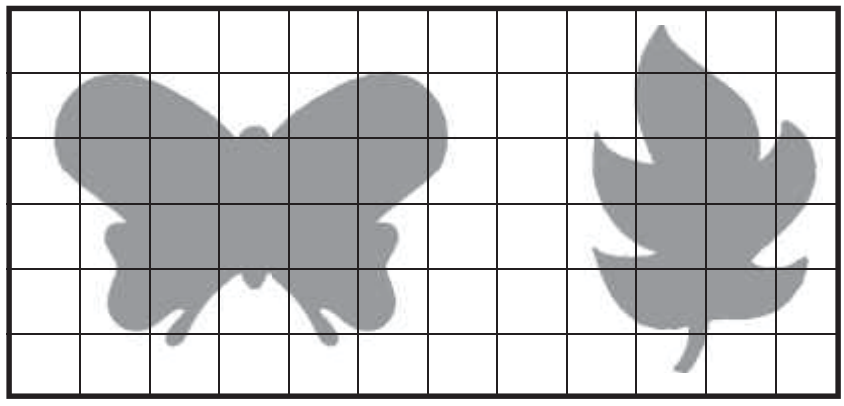


Figure 5

Length, breadth and area

You have seen how you can calculate the area of various figures with the help of a centimetre graph paper.

What are the possible factors on which the area of any figure depends? (21)

We shall try to identify these factors in the following activities, using a simple rectangular figure.

Activity 5

Take a matchbox.

How many faces does it have? (22)

Figure 6 shows three faces of the matchbox. They are labelled A, B and C. You can also label the three faces of your matchbox A, B and C.

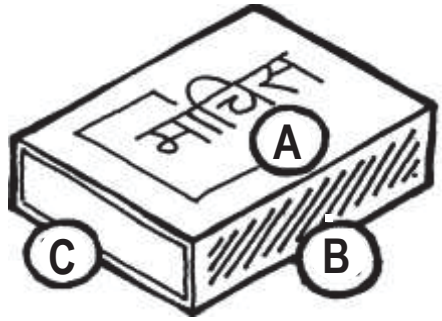


Figure 6

Are the lengths of A and B the same? (23)

Are the breadths of A and B the same? (24)

Are the areas of A and B the same? (25)

What is the reason for the difference in the areas of A and B? (26)

Now look at B and C.

Which face has the larger area? (27)

B and C have the same breadth. Then why are their areas different? (28)

Activity 6

Formula of the area of a rectangle:

In the previous activity you saw that the area of a four-sided figure depends on its length and its breadth. Let us study the nature of this relationship.

Three rectangles A, B and C are shown in Figure 7.

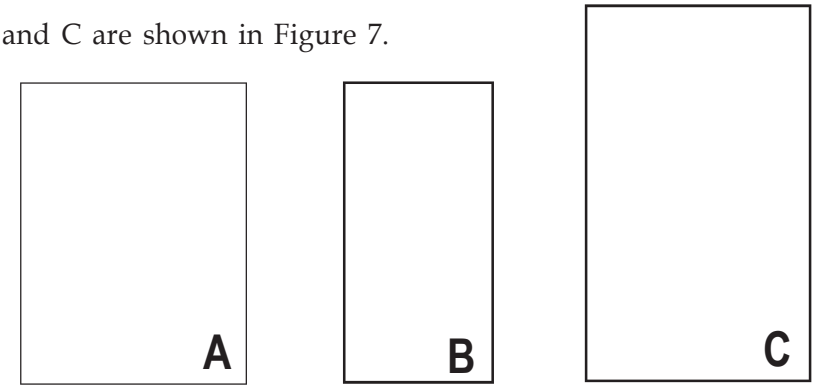


Figure 7

Measure the length and breadth of each rectangle with the help of the sides of the unit cubes and note your measurements in Table 1. (29)

Now measure the area of A, B and C with the help of the faces of the unit cubes and note these measurements in the table. (30)

Can you show the relationship between the length, breadth and

area of the rectangles in the table in the form of a formula? (31) Do you think this formula can be used to calculate the area of any figure? (32)

Table 1

Rectangle	Length	Breadth	Length x Breadth	Area (with the help of the faces of the unit cube)
A	..... cm	..... cm	..... cm^2	..... cm^2
B				
C				

If you use the formula to calculate the area of a figure, how would you check if your answer is correct. (33)

Look at the two shapes given in Figure 8.

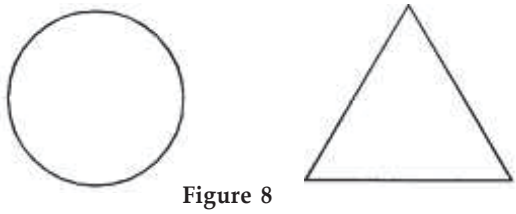


Figure 8

Can the area of these two figures be calculated using the formula we used for rectangles? (34)

The formula Length x Breadth = Area can be used only for rectangular shapes. You will need other formulae for figures of other shapes like triangles or circles. Remember that each distinct shape will have a different formula and that there is no formula for irregular figures.

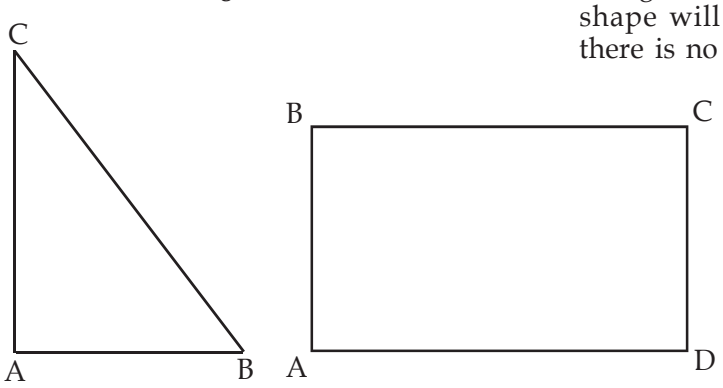


Figure 9

The perimeter : Enclosing a shape

The length of the line that encloses a shape is called its **perimeter**. The perimeters of two shapes are calculated here as an example (Figure 9).

The perimeter of the rectangle is

= total length of line ABCD enclosing the rectangle

= length of AB + BC + CD + DA

= 3cm + 5cm + 3cm + 5cm

= 16cm

The perimeter of the triangle is

= total length of line ABC enclosing the triangle

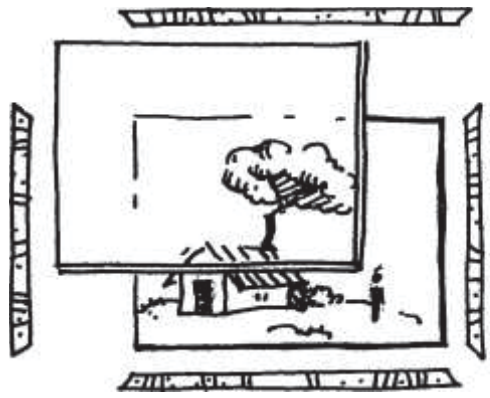
= length of AB + BC + CA

= 3cm + 5cm + 4cm = 12cm

Measure the perimeter of a page of your *Bal Vaigyanik* workbook and a page of your exercise book. (35)

Both the perimeter and the area depend on the size of the figure. But this does not mean that the perimeter and area are different names for the same thing. They are entirely different concepts.

The perimeter is the length of the line enclosing a figure while the area is the surface spread of the figure, or how much space that surface occupies or covers. The perimeter is measured in cm while area is measured in cm^2.



If, for example, a photograph is to be framed, the length of wood for the frame will depend on the perimeter of the photograph. On the other hand, the size of the glass to cover the photograph will depend on its area. Similarly, to estimate how much wood we need to make the frame of a door, we must measure the perimeter of the door. However, to assess how much paint is needed to paint the door, we must measure its area.

In the following two activities we shall study the difference between perimeter and area in more detail.

Activity 7

Same perimeter, different areas

One can draw different shapes having the same perimeter. Would the area of these shapes be the same? Let us find out.

Take a thin wire or thick thread that is a little over 16 cm long. Join its two ends and spread the wire/thread on a sheet of graph paper. Make the following shapes one by one:

a) A square whose side measures 4 cm.

b) A rectangle with a length of 5 cm.

c) A rectangle with a length of 7 cm.

d) A circle.

What are the perimeters of each of these shapes? (36)

Measure the area enclosed by the wire/thread in each case. You can do this by counting the number of squares it covers on the graph paper. (37)

Which shape has the largest area? (38)

Can different figures with the same perimeter have different areas? (39)

An exercise

Figure 10 is a diagram of a triangle.

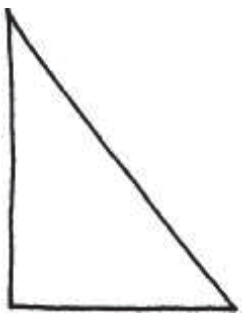


Figure 10

Copy the triangle in your exercise book and then draw a square and rectangle with the same perimeter. (40)

Are the areas of these three shapes the same? (41)

Activity 8

Same area, different perimeters

You made shapes with the same perimeter but different areas.

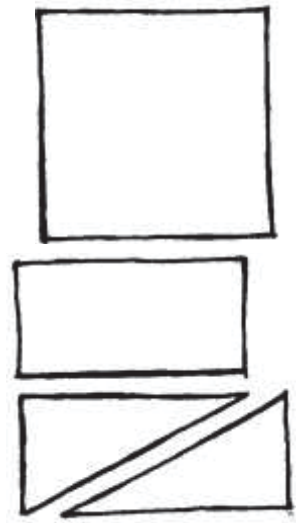


Figure 11

Can you do the reverse? That is, can you make shapes with the same area but different perimeters? Let's try.

Take a rectangular piece of paper.

Find its perimeter and area. (42)

Cut it into three pieces as shown in Figure 11. Now join the three pieces together in different ways as shown in Figure 12.

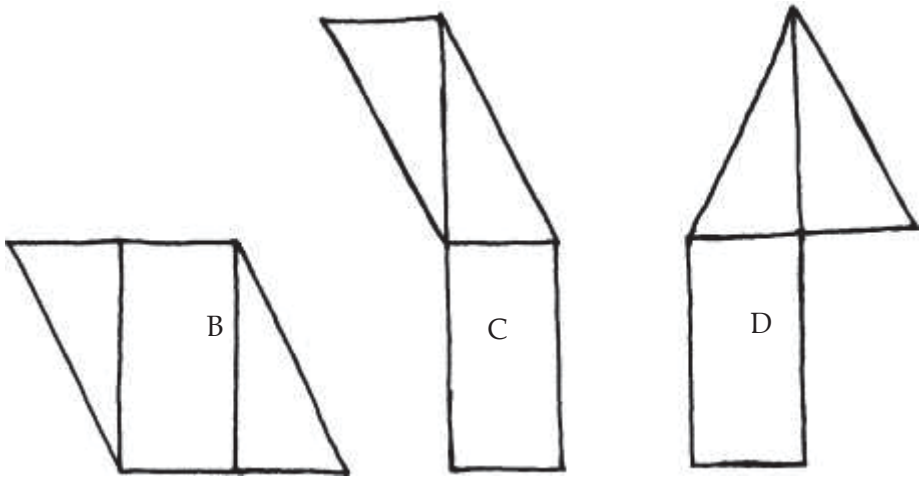


Figure 12

Will the area of these shapes be the same or will they be different? Give reasons for your answer. (43)

Measure the perimeters of these shapes. (44)

Can different figures with the same area have different perimeters? (45)

In this activity you joined pieces of paper in different ways and made a variety of shapes. In the same way, a tailor cuts cloth in different ways and makes a variety of clothes. This is both a skill and an art.

Figure 13a

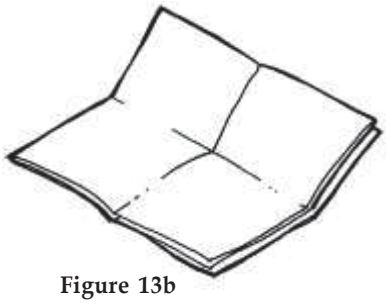


Figure 13b

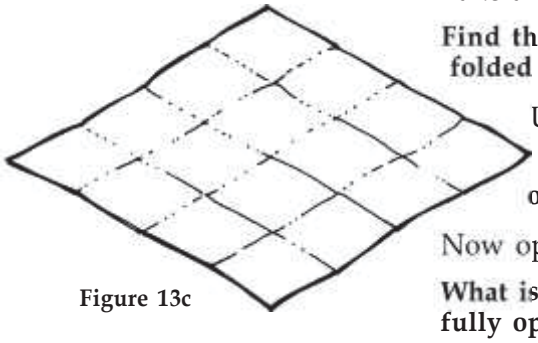


Figure 13c

Activity 9

Perimeter and area - How do they increase?

The activities you have done so far show that the perimeter and area depend on the length of the sides of a figure. However, do the area and perimeter change in the same ratio if a figure is made smaller or bigger?

Take a square piece of paper and fold it four times (Figure 13a).

Find the length of the side, the perimeter and the area of this folded paper and note these in Table 3. (46)

Unfold two folds of the paper, as shown in Figure 13b.

Note the length of the side, the perimeter and the area of this unfolded paper in the table. (47)

Now open the paper fully (Figure 13c).

What is the length of the side, the perimeter and the area of the fully opened paper? Note these in the table. (48)

Length of side (cm)	Perimeter (cm)	Area (cm^2)
Paper folded four times		
Paper folded twice		
Paper opened fully		

Table 3

Answer the following questions on the basis of your entries in Table 3:

When the length of the side of a square doubles, its perimeter and area also increase, but in different ratios. What are these ratios? (49)

When the length of the side increases four times, how many times do the perimeter and area increase? (50)

When the length of each side is halved, how much smaller does the area become? (51)

This relationship between the length of the sides, perimeter and area is also seen in other shapes

Let us test whether this relationship holds good for a triangle. Cut a sheet of paper in the shape of an equilateral triangle. Make a table similar to the one above. Now fold the paper in the way shown in the Figure 14 and record your observations in the table.

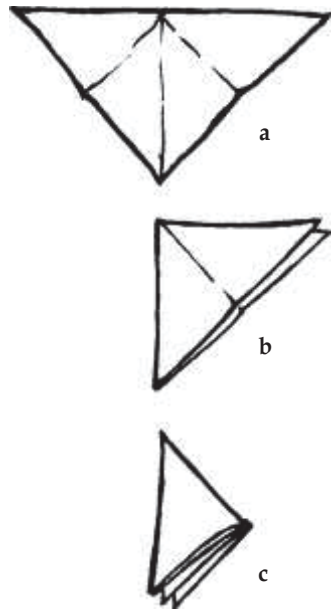


Figure 14

What conclusions can you draw on the basis of this table? Write them in your own words. (52)

There is one point you should always remember. The relationship between the length of the sides, perimeter and area holds good only if the shape of the figure does not change while reducing or enlarging it. In the two activities you did with a square and an equilateral triangle their shapes did not change. That is, they remained a square or an equilateral triangle. But if the square turns into a rectangle while folding it in half, this relationship does not hold good.

Units of area

You have used sq cm to measure area until now. There are other units to measure area.

When measuring lengths you used units like centimetre, metre and kilometre. You saw that it is better to measure small lengths in centimetres. However, for longer lengths (for example, the distance between two villages or towns) kilometres are more appropriate units.

If you have to measure the area of a field or a farm, would sq cm be an appropriate unit? (53)

Let us find out more about larger units for measuring area.

Activity 10

Take a metre scale and draw a square with a side equal to one metre on the floor. The area of this square is 1 square metre.

Square metre is also written as metre^2, m^2 or sq m. A sq m is also a unit of area.

How many 1 cm cubes can you place along one side of a square measuring 1 sq m? (54)

How many 1 cm cubes can you place along the other side of the same square? (55)

On the basis of the last two questions can you calculate how many square centimetres equal a square metre? (56)

A square metre is an appropriate unit to measure the floor area of a room or a *kabbadi* field. For example the international size of a *kabbadi* field is 125 sq m. However, to measure larger spaces like a field, you would require a unit even larger than a square metre.

Units to measure a field

The area of a field is commonly known as its ***rakba***. The *patwari* uses a **decimal** to indicate the measurements of agricultural fields in the land survey records (***khasra-khatauni***) of his village.

1 decimal = 40 sq m

If a farmer has 2.5 decimals of land, what is the area of his field in sq m? (57)

An acre is a larger unit than a decimal.

1 acre = 100 decimal

How many sq m will there be in an acre? (58)

A hectare is also a unit often used to measure the area of fields and farms.

1 hectare = 10,000 sq m

Questions for revision

1. Find the surface area of your pencil by wrapping paper around it.

2. Land in a village is being sold at the rate of Rs 10 per sq m. Calculate the cost of 3 acres and 5 decimals of land.

3. Draw a rectangle with a length of 7 cm and an area equal to that of the rectangle in Figure 15. Are the perimeters of these two figures the same?

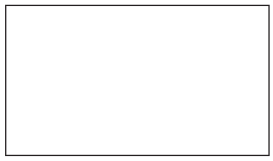


Figure 15

4. Can there be a figure which has no area? Discuss this in class and summarise your discussion in your own words.

5. Gopal built a room. It cost him Rs 1,000 to tile the floor. Kamal built a room with a length and breadth double that of Gopal's room. How much will Kamal have to spend on flooring his room?

6. Find out the area of the following, using a sheet of graph paper. You will need to draw their outlines on the graph paper.

A bangle;

Your palm;

The scale in your compass box;

Various leaves, such as *besharam*, mango, guava, etc.

Can you find the area of a tamarind leaf using the same method? What problems would you face?

New words

Perimeter *Rakba* Decimal *Khasra-khatauni*

HOW TO DRAW A MAP

Chapter 8

Raju forgot to bring his ball to school one day. So he asked his friend Venkat to go to his house and get the ball. But Venkat did not know where the ball was kept in the house. So Raju had to tell him exactly where to look.

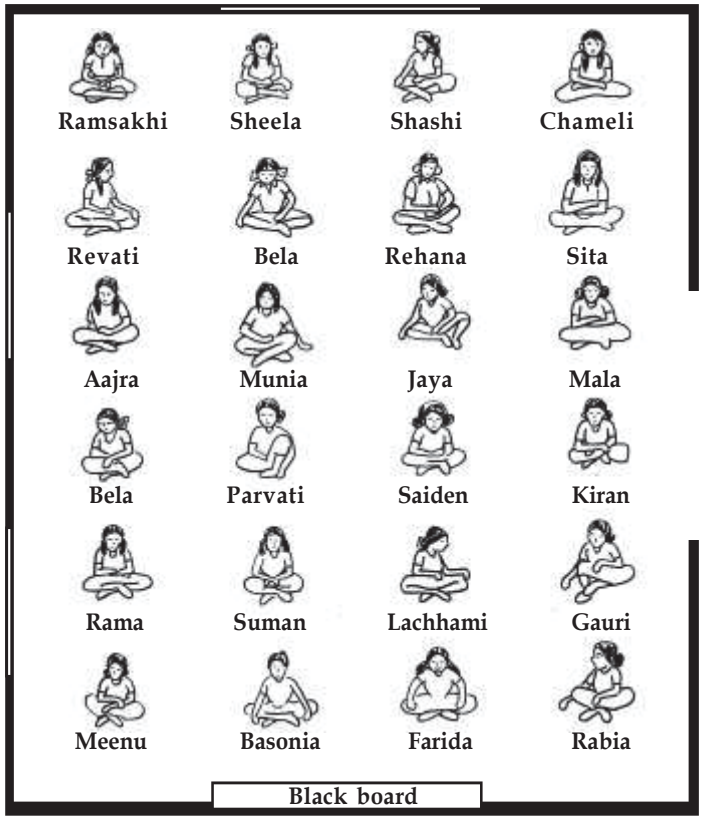
How do you think Raju gave directions to Venkat? (1)

We often need to give directions to people. For example, we may have to tell them the way to a particular place or where something has been kept or hidden. There are different ways of showing someone the location of a place or object. Such methods are used in science as well. We shall discuss one method here.

Symbols that show position

Figure 1 shows the seating arrangement in a classroom in which 24 girls are appearing for an examination.

Figure 1



Suppose you had to tell your friend where Basonia is seated, how would you do it? (2)

Who is the second girl in the third column? (3)

Did everyone in your class give the same answers to both these questions? (4)

If the answers were different, what could be the reason? (5)

Suppose we decide to number the columns in which the girls are seated in Figure 1 serially from left to right and the rows from front to back.

Would all the girls then give the same answers? Let's try to understand this with the help of a sheet of square-lined paper (Figure 2).

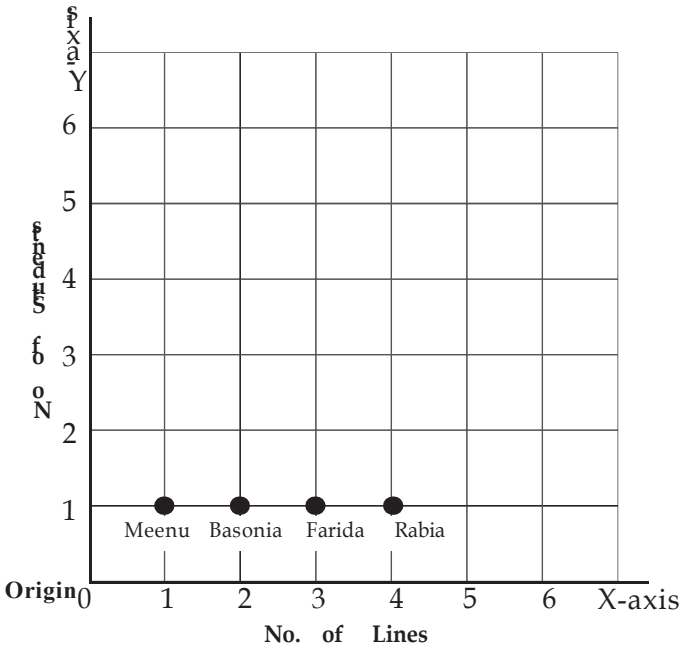


Figure 2

Who is the second student in the first column? (6)

Where is Lachhami sitting? (7)

Did everyone give the same answers this time? (8)

We can use symbols to indicate the position in which any one of the girls is sitting. So, Gauri's position would be fourth column, second row.

Write the position of the following students using this method:

a) Suman, b) Farida, c) Sheela. (9)

Identify the students from the following information:

a) Third column, third row;

b) First column, fifth row. (10)

Using numbers as symbols of position: Coordinates

If we want to write these symbols of position in a shorter form, we can use numbers. Numbers are more convenient to write than words. They also take less time to write.

We can now show Gauri's position (fourth column, second row) as simply (4, 2). All we have to remember is that the first number refers to the column and the second number to the row in which the student is sitting.

Suppose we make a mistake in writing Gauri's position, giving it in reverse order (2,4). What problem would this create? (11)

Use numbers to give the positions of the following students:
a) Basonia, b) Chameli, c) Jaya. (12)

The numbers that give the position are called **coordinates**.

Is it enough to write only 3 to give Shashi's position? (13)

Can we tell where Shashi is sitting if we write only 6? (14)

To give the correct position of a student what should we write? (15)

In Figure 2 the thick horizontal line at the bottom is called the **X-axis** and the thick vertical line at the left is called the **Y-axis**. When we give the position coordinates of anything, we always write the number for the X-axis first and the number for the Y-axis second.

Some coordinates for Figure 2 are given below. Write the names of the students sitting in these positions:

a) (4,1) b) (4,4) c) (1,2) d) (2,1) e) (3,1) f) (1,4) (16)

Write the coordinates of the following students:

a) Rehana b) Munia c) Ramsakhi (17)

Exercise 1

Write the coordinates of the following points in Figure 3:

1) a

2) b

3) c

4) d

5) e

6) f

7) g

8) h (18)

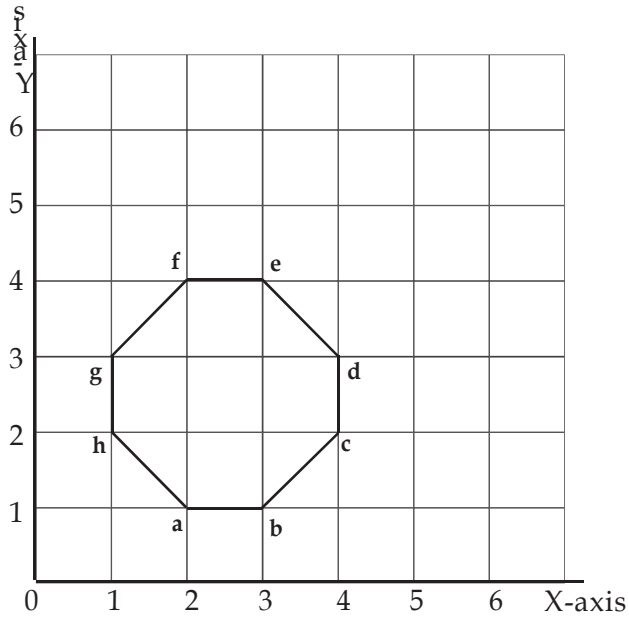


Figure 3

Exercise 2

Identify the figure by joining the dots:

Draw the X-axis and Y-axis on a sheet of graph paper.

Mark the following 12 points on it in the order in which they are given.

Point	Coordinates	Point	Coordinates	Point	Coordinates
1	(1,6)	2	(2,8)	3	(3,9)
4	(4,8)	5	(4,4)	6	(10,8)
7	(11,5)	8	(14,5)	9	(9,1)
10	(5,1)	11	(3,4)	12	(3,7)

Can you identify any figure just by looking at the dots? Now join the dots with straight lines, starting from point 1, going in sequence up to point 12 and finally to point 1 to finish.

What is the figure you have made? (19)

Reducing and enlarging figures: Choosing the correct scale

Let us now learn how to reduce and enlarge figures. Figure 4 shows the picture of a cat. Draw a reduced version of the same cat on a sheet of cm graph paper. Every line in your picture should be exactly half the length of the corresponding line in Figure 4.

Remember that the side of each square on your graph paper is 1 cm.

What is the length of the reduced cat's tail? (20)

What is the distance between the tips of its ears? (21)

What is the width of its stomach? (22)

In this exercise you reduced each line in Figure 4 by half.

What should you do to double the length of each line in the figure?

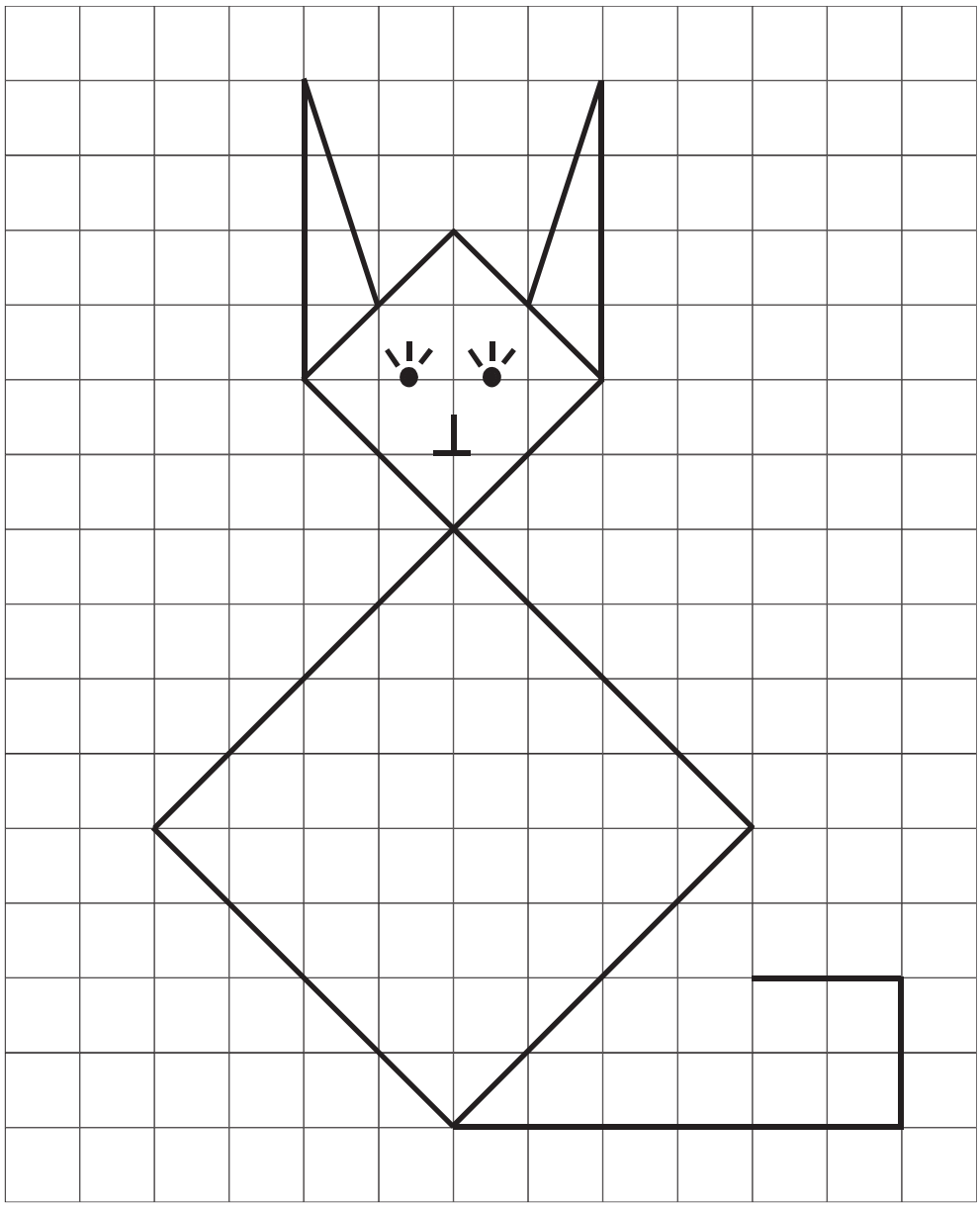


Figure 4

You need to select the correct **scale** for reducing or enlarging a figure and it is important that each part of the figure is reduced or enlarged by the same scale. Only then will the **ratio** between the parts of the reduced or enlarged picture be the same as the ratio between the parts of the original picture. Only then will the picture you draw look like a reduced or enlarged version of the original.

In Figure 4 you used the squares on the paper to reduce the size of the cat. How would you reduce or enlarge the figure if the paper had no squares?

Let us learn one way of doing this.

Enlarging figures without using squares

We need to enlarge each side of triangle ABC in Figure 5 to twice its length.

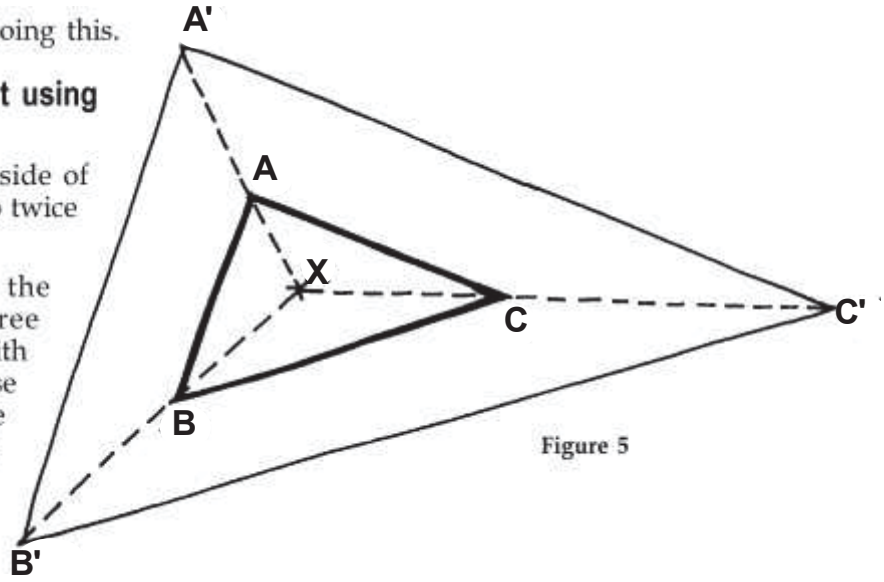


Figure 5

Mark a point X inside the triangle and join its three corners A, B and C to X with straight lines. Extend these straight lines beyond the triangle. Now measure the length of line XA. Double this length and mark the new point A' on the extended line XA. The length of XA' is twice that of XA. A' is read as A-dash or A-prime. Similarly, draw lines XB' and XC' which are twice the length of lines XB and XC respectively. If you now join A', B' and C' with straight lines you get the triangle A'B'C'.

On the basis of what you learned in the earlier chapter "Area", how many times would the area of the triangle increase if the length of each side is doubled? (23)

In Exercise 2 you made a figure by joining 12 points. Now double the length of each side. To do this, first cut the figure out neatly and paste it on a large sheet of paper. The sheet should be at least 40 cm long and 25 cm wide.

Mark a point X somewhere in the centre of the figure. Join all the corners of your figure to the point X with straight lines. Measure the distance from X to each corner.

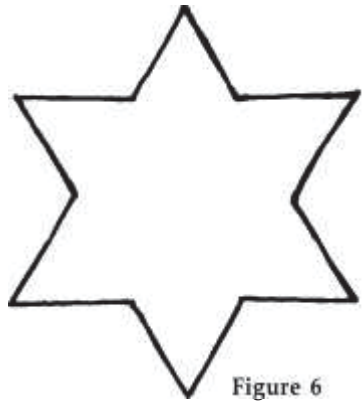


Figure 6

Double the length of each side of your figure in the same way as you did in the case of the triangle. (24)

Draw Figure 6 in your exercise book. Reduce each side by half and draw the reduced figure. (25)

Draw the map of a field

Let's now draw the map of a field. To do this, you will have to reduce the size of the field so that it fits on a sheet of paper. The first step in the process is to select a proper scale.

Selecting the scale

Assume that the field is 20 m long and 16 m wide. Suppose the graph paper on which you want to draw the map is 24 cm long and 20 cm wide. You could draw 1 m on the field equal to 1 cm on the graph paper. You should mark this scale on your map:

1 m on the field = 1 cm on the map.

This is the scale of your map. Anyone reading your map will know that 1 cm on the map represents 1 m on the field.

Suppose you are asked to draw a map of a field 80 m long and 60 m wide. Would this scale suit your graph paper? (26)

What would be a suitable scale for drawing a map of this field? (27)

Selecting the scale depends on the length and breadth of the field and of the sheet of graph paper you are going to use.

Preparation for drawing a map

Go to a field or an open space with your teacher.

Select a point somewhere near the centre of the field. Actually, this point, called the **origin**, could be anywhere in the field. Place a table or stool at the origin and put a flat wooden board on it. Tape a sheet of graph paper on the board with adhesive tape.

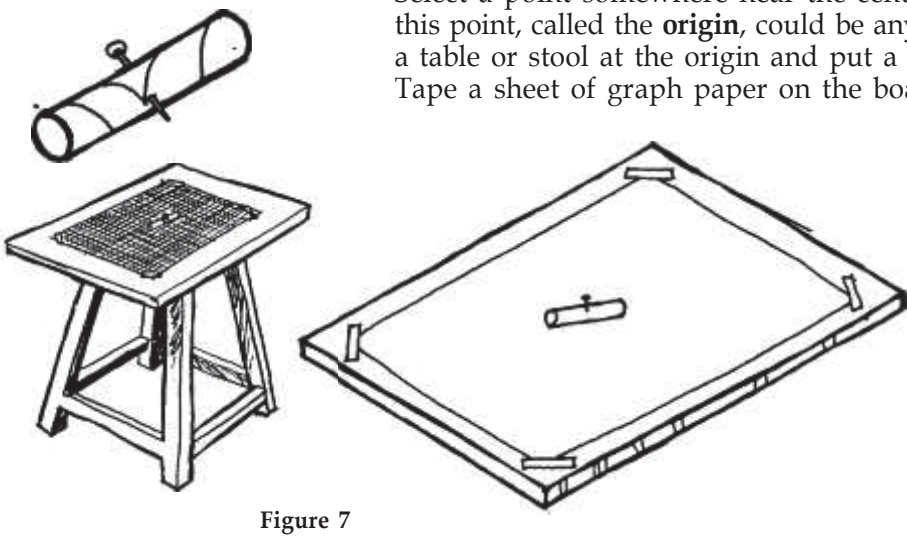


Figure 7

Use a sharp pencil to mark a point X on your graph paper approximately corresponding to the origin of the field. Fix a pin at X. If possible, attach a small paper tube or a piece of a plastic straw at X with the pin (Figure 7). This tube will help you in making your map. You must ensure that the graph paper remains firmly taped to the board and does not shift its position or orientation while you are drawing the map.

If the position or orientation of the graph paper shifts while you are drawing the map, what problems would it cause? (28)

Marking points on the map

To mark points on the map, we need to know two things. One is the direction in which the point lies and the other is its distance from the origin. Select any spot along the boundary of the field that you would like to mark on the map. Ask your friend to stand at this spot or drive a **stake** into the ground at this point. Look at your friend (or the stake) from one side of the pin. Mark a point on the paper along this line of sight between the origin and your friend. To do this, take a sharp pencil and hold it on the graph paper between the origin and your friend. The origin, the pencil and your friend should all fall on the same straight line. Since the origin and your friend are stationary, you can shift the pencil to bring it in line with the pin and your friend. It is easier to do this if you look through the paper tube fixed at the origin. When all three are in a straight line, mark the point

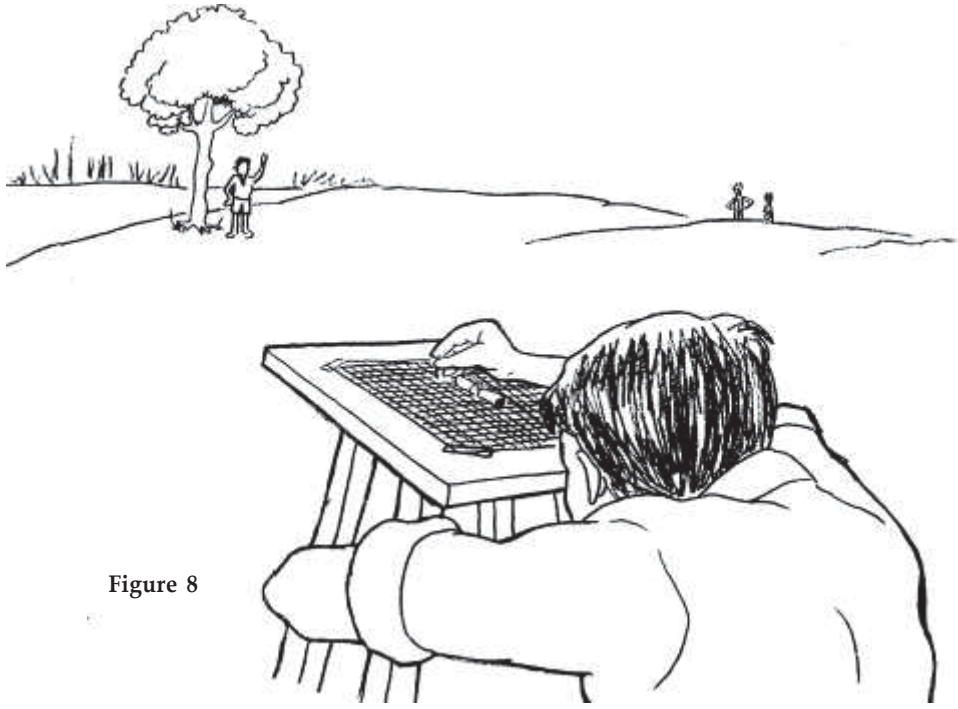


Figure 8

where the pencil is and draw a small circle around it (Figure 8).

Draw a straight line passing through this point and the origin. This line shows the direction of the spot on the boundary from the origin.

Suppose the field is the same shape as the one shown in Figure 9. You will have to mark the points A, B, C, D, E, F and G along its boundary on your graph paper. If you take O as the origin and select point A, the first thing you need to do is measure the distance from O to A on the field. You can use a metre scale or a long string to do this. Suppose the distance between O and A is 16 m and 40 cm. You will now have to select a scale to

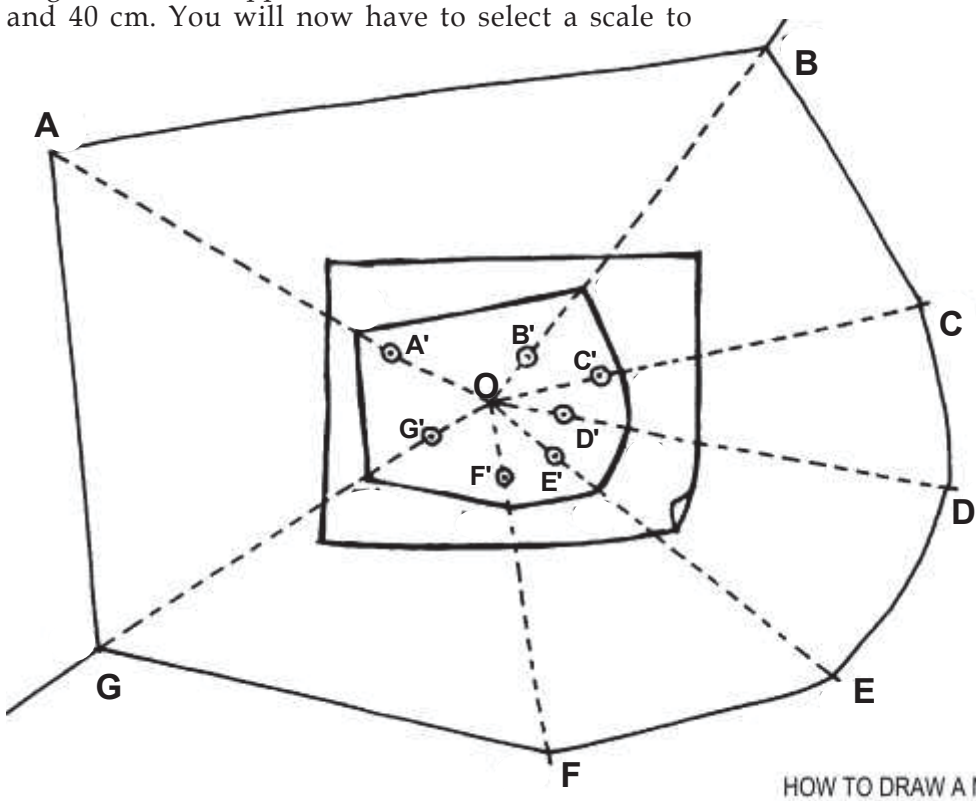


Figure 9

show this distance on the graph paper. If you take a scale of 1 m on the field equal to 1 cm on the graph paper, point A′ on the map, which represents point A on the field, must be 16.4 cm from O.

Mark point A′ on the line OA at a distance of 16.4 cm from O. Point A′ shows the correct location on the map of point A on the boundary.

Now take the other points along the boundary one by one and mark their direction and distances on the map using the same method. Name the points on the map B′, C′, D′, E′ and F′.

Don't forget to indicate the scale on your map.

How to select points along the boundary?

When you select different points along the boundary, keep the following in mind:

If the boundary forms a straight line at any place, you can select the two end points of that segment for your map. For example, in Figure 9, the segment AB is straight. Hence, when you join their representative points A′ and B′ on the map with a straight line, you get a correct picture of the boundary between A and B. The same would hold true for the segments EF, FG and GA, which are straight.

If the segment is not straight you will have to select more than two points to be able to represent the contours correctly on your map.

For example, in Figure 9 the segment from B to E is curved. To show the curvature on the map, two more points C and D have been chosen.

You can decide where more points are required, depending on the curvature or contour of the field whose map you want to draw.

To complete the map join all the points you have marked on the graph paper. You now have a map of the field you have chosen to depict.

Complete your map

Apart from the boundary of the field, there are many more details you will need to show in order to make a good map. For example, you should show features like trees, wells, pump houses, irrigation canals, electricity poles, etc in the field. You can mark their direction and distance from the origin in the same way that you marked the points along the boundary.

How correct or incorrect is your map

How can you find out whether your map is correct or not? One simple method is given on the next page.

Select two points in the field that you have shown on the map. For example, you could select A and F in Figure 9.

Measure the distance between A and F and note it in your exercise book. (29)

Now measure the distance in cm between points A′ and F′ in your map and convert this into metres, using the scale with which the map was drawn

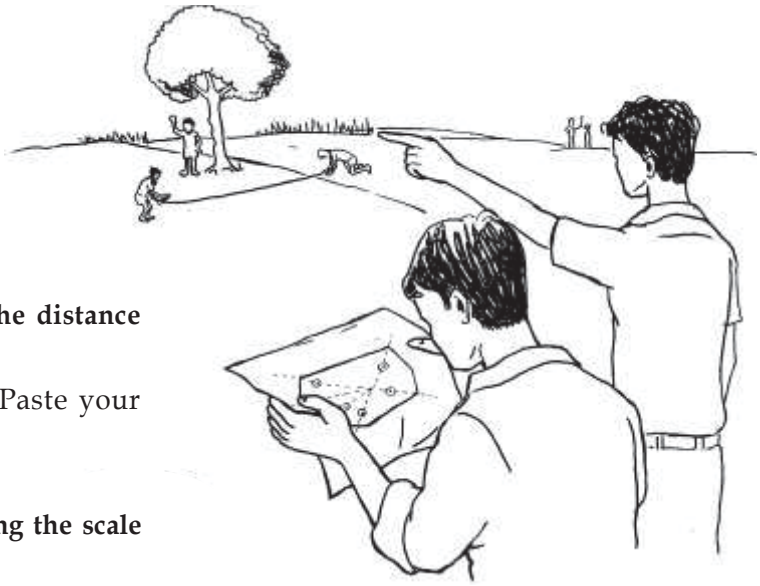


Figure 10

Do all your calculations in your exercise book. (30)

Is the distance you measured between points A and F equal to the distance calculated from the map? (31)

If it is, then your map is correct. Paste your map in your exercise book.

Find the area of the field. (32)

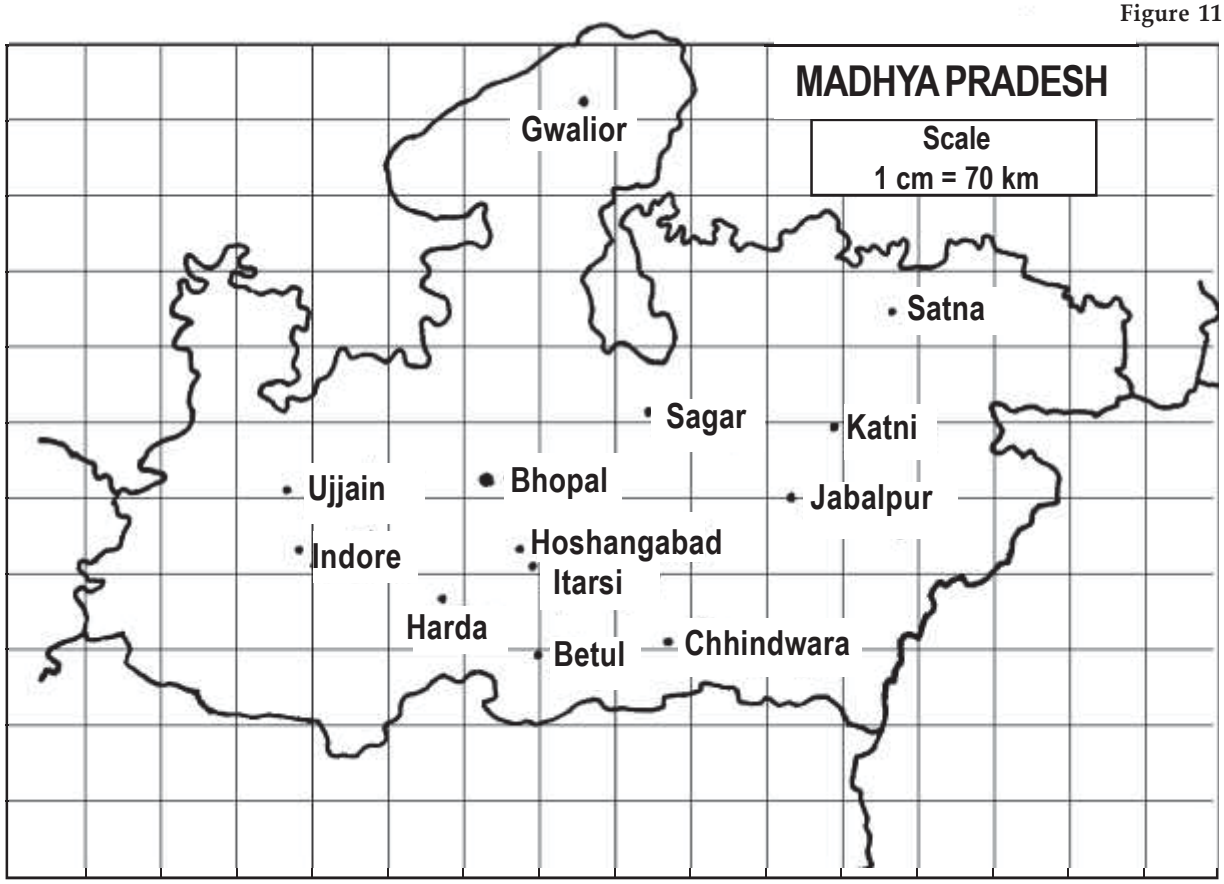
Could you calculate the area by using the scale you chose for the map? (33)

Exercise 3

Figure 11 shows the map of Madhya Pradesh. The names and locations of different cities are marked on this map.

Find the distance between Bhopal and five other cities. (34)

Figure 11



By counting squares and using the scale of the map, find the area of Madhya Pradesh. (35)

Some questions for revision

1. Mark the following points on a cm graph paper:

1. (14, 8)	2. (13, 7)	3. (11, 9)	4. (12, 11)
5. (13, 12)	6. (16, 12)	7. (19, 10)	8. (20, 7)
9. (20, 6)	10. (18, 4)	11. (18, 5)	12. (19, 6)
13. (18, 8)	14. (16, 8)	15. (15, 6)	16. (16, 6)
17. (14, 0)	18. (13, 4)	19. (13, 0)	20. (11, 0)
21. (11, 4)	22. (8, 4)	23. (7, 0)	24. (5, 0)
25. (5, 4)	26. (4, 0)	27. (2, 0)	28. (2, 8)
29. (1, 6)	30. (2, 9)	31. (12, 11)	

Starting from point (14, 8), join the points in sequence with straight lines. What figure do you get?

2. Draw the X-axis and Y-axis on a sheet of graph paper. Mark the following eighteen coordinates in the order they are given.

1. (2, 6)	2. (3, 5)	3. (5, 5)	4. (7, 1)
5. (8, 1)	6. (8, 5)	7. (11, 5)	8. (12, 3)
9. (13, 3)	10. (12, 6)	11. (13, 9)	12. (12, 9)
13. (11, 7)	14. (8, 7)	15. (8, 11)	16. (7, 11)
17. (5, 7)	18. (3, 7)		

Join them with straight lines in the given sequence.

Write the name of the figure you obtain.

3. Enlarge the figure obtained in Question 2 by doubling the length of each of its sides.

4. You used a graph paper 24 cm long and 20 cm wide to draw the map of the field that was 20 m long and 16 m wide. What scale would you choose for drawing the same map if you are given a graph paper that is 12 cm long and 10 cm wide?

New words

Column	Row	X-axis	Y-axis	Scale
Coordinates	Origin	Ratio	Stake	

Chapter 9

INTERNAL ORGANS OF THE BODY

PART 1

Cars, tractors, motorcycles and scooters are made of many different parts. Each part performs a different function, but they all work together in harmony to move the vehicle forward.

Have you ridden a bicycle? It has handlebars, front and rear wheels, a chain, brakes and many other parts. If these do not work in harmony, what would happen? Try and imagine such a situation. If the handlebars turned the front wheel in one direction and the rear wheel in another direction, could anyone ride a bicycle?

Our bodies too have many parts that work together in harmony. If they did not, what do you think would happen?

We can see some parts of our body, like our hair, skin, eyes, nose, ears, etc. These parts are called our external organs. We can easily observe and study them. But most of our organs are situated inside our body. These are our internal organs. We cannot see them. How can we study them and understand how they work? Students of medicine study internal organs by the **dissection** of dead bodies, but it is not possible for us to do this. We must find other ways of studying them.

Many animals, big and small, have organs that are similar to ours. The rat is one such animal. Rats are commonly available and are small enough to be easily **dissected**. We can dissect a rat and study its internal organs. This is one way in which we can learn about our own internal organs.

Thus, there are at least three different ways in which we can go about studying the internal structure of the human body:

1. By observing the internal organs of a dissected rat and comparing them with our own internal organs.
2. By examining those internal organs that we can see or sense from outside.
3. By collecting information about specific diseases that affect our internal organs and understanding the functions of these organs.

We will continue the study of our internal organs in Class 8.

Section 1

Organs that help the body to move: Our muscles and muscular system

You may have sometimes climbed a tree to pluck its fruit on your way to school. In school, you sit down, get up, write with your pen and do experiments. Every day you move your hands and legs, turn your neck, bend your waist, and so on. All this movement is carried out with the help of organs that lie beneath our skin. We cannot see them, but we can sense them and see the way they move beneath our skin. In much the same way, we cannot see a person hidden beneath a blanket, yet we can tell that the person is under the blanket from his form and shape, particularly when he moves. If you observe a cow, bull or horse walking or running, you will see some **fleshy** structures moving beneath the skin around their shoulders and hips. These structures are called muscles.

We shall carry out a few experiments to find out how these muscles help us to move. We shall also see which activities of the body these muscles are connected with.

Experiment 1

Hold your right hand straight out in front of you at shoulder level, with the palm facing upwards. Clench your fist.

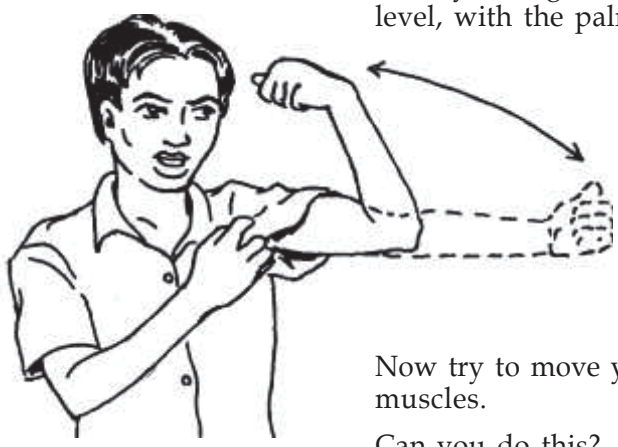


Figure 1

Fold your forearm in the way shown in Figure 1, moving your palm towards your shoulders. When your palm touches your shoulder, straighten your arm again. While doing so, press the muscles (biceps) of this arm with the finger of your other hand. Repeat this exercise several times and try to see and feel how the muscles of your arm move.

Now try to move your arm up and down without moving your muscles.

Can you do this?

Experiment 2

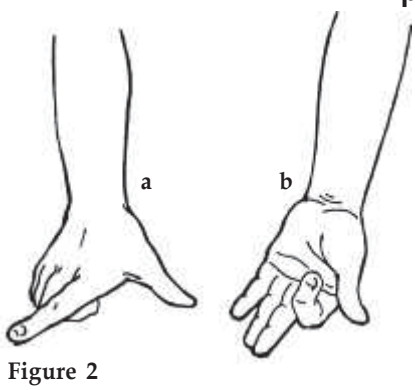


Figure 2

Hold one of your hands in front of you as shown in Figure 2 (a), with the palm facing downwards. Fold and unfold the fingers of this hand, one by one. Observe the back of your palm between the fingers and the wrist and study the movement of the muscles.

Can you identify the different muscles that move as you open and close each finger?

Now hold your hand with the palm facing upwards, as shown in Figure 2 (b), and fold and unfold your fingers one by one. Study the muscles that move.

Can you identify the different muscles?

Try to open and fold your fingers without moving these muscles. Is it possible to do so?

Experiment 3

Squat on the floor and bend one leg at the knee. Grasp the calf of that leg tightly with both hands and lift the leg slightly off the ground (Figure 3). Now move your foot rapidly up and down.

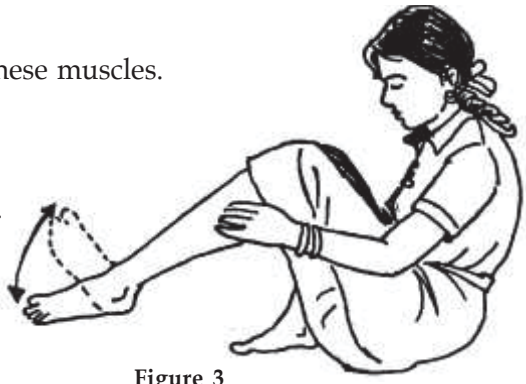


Figure 3

Do you feel the muscles in your calf moving?

Can you move your foot up and down without moving these muscles?

Experiment 4

Stand up straight, grasp one of your thighs tightly with both hands, lift your knee up and then swing your leg backwards and forwards (Figure 4).

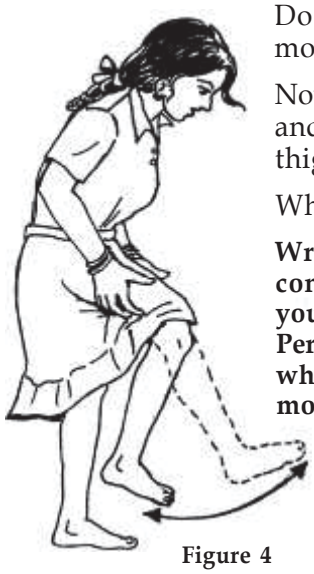


Figure 4

Do you feel the muscles of your thigh moving?

Now try and swing your leg, forward and backward, without moving your thigh muscles.

What happened?

Write in your own words, the connection between moving parts of your body and your muscles. (1)
Perform the following actions and say whether you were able to feel the movement of any muscles:

1. **Fluttering your eyelashes.**
2. **Chewing.**
3. **Breathing in and out.**
4. **Lifting a weight.**
5. **Moving your toes. (2)**

If you wish to move any part of your body you have to move some muscle or the other. In other words, it is only by the movement of muscles that we are able to move parts of our body. The muscles found in different parts of the body together constitute the muscular system. The muscular system of human beings is shown in Figure 5.

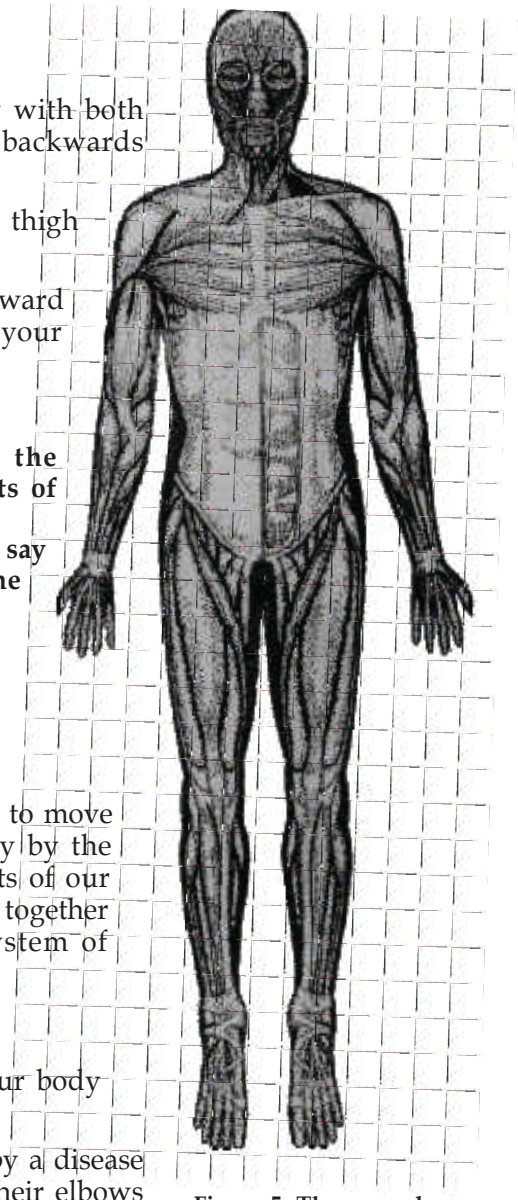


Figure 5: The muscular system of human beings covers the whole body.

Polio - A disease of the muscles

What would happen if the muscles of any part of our body stop functioning? Can that part move?

You may have seen children whose legs are wasted by a disease called **polio**. These children crawl with the help of their elbows or walk upright with great difficulty.

Health workers administer the polio vaccine to children. This medicine protects - or vaccinates - the child against polio.

Tendons

Some muscles are connected directly to the bones. Others have round, white, rope-like fibres at the ends that connect them to the bones (Figure 6). These fibrous structures are called tendons.

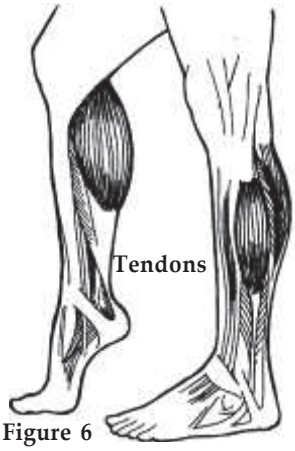


Figure 6

Experiment 5

Recognise your tendons

You can feel the tendons in several parts of your body. Place a brick or any other heavy object on your palm as shown in Figure 7. Bend that arm from the elbow. While doing so, press the inner part of your elbow with a finger of your other hand. Do you feel a hard rope-like structure? That is one of your tendons.

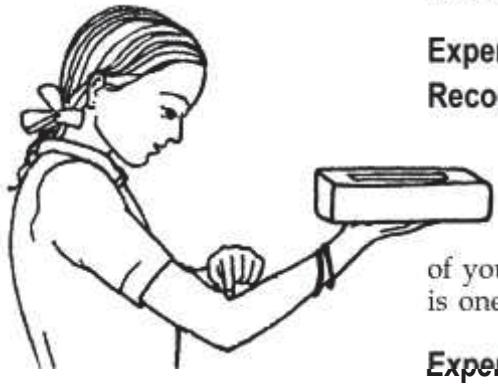


Figure 7

Experiment 6

Squat on the floor with your feet straight in front of you. Bend one knee as shown in Figure 8 and lift your leg a little off the ground. Feel the tendons on the inner part of your knee joint with both hands.

How many tendons were you able to identify?

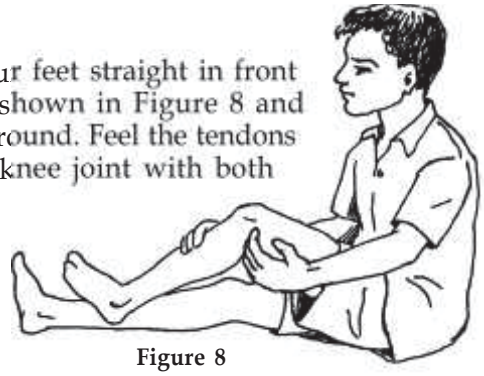


Figure 8

Experiment 7

There is a tendon just above your heel. Bend your knee in the way shown in Figure 9 and lift your heel off the ground. Try and feel this tendon.

Try and identify the tendons in other parts of your body.

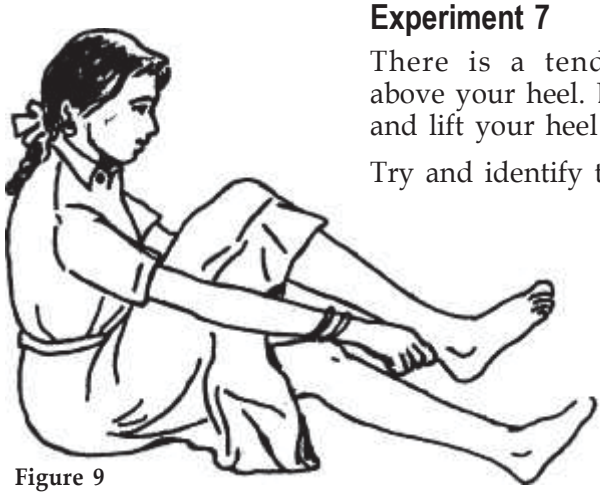


Figure 9

New words

Dissection	Dissected	Muscular system	Polio
Muscle	Tendon	Campaign	

Section 2

You learned some things about the muscular system earlier in this chapter. Now you will learn some things about your bones. You will do this by moving different parts of your body, like you did earlier.

When a person is injured, the doctor often takes an **x-ray** of the injured bone. The shape and structure of bones are clearly seen in x-ray photographs. In this way, a doctor can find out whether a bone is cracked, broken or dislocated.

Try and bring some x-ray films of broken bones to the class so that everyone can have a look at them.

Can you identify the broken bones in the x-rays? Is there an x-ray which shows a broken bone that has not been joined properly? If you break a bone in your hand and it does not join properly, how would it affect the functioning of your hand? Try and imagine such a situation.

If you know of any person whose broken bones have not healed properly, try and find out how the injured part of the body and its work has been affected.

The skeletal system

Bones help maintain the shape and structure of the body and protect some tender organs from injury. They also help us in our movements. All the different bones in our body are said to form a single structure known as the **skeleton**.

A diagram of a skeleton

Cut out the two diagrams of the human skeleton in your kit copy. One diagram shows the skeleton as seen from the front and the other as seen from the back.

Try to feel and identify the different bones in your body. As you identify each bone, colour the corresponding bone in the diagram.

Press one of your elbows with the fingers of your other hand. Bend and straighten the elbow as shown in Figure 10(a). Do this four or five times.

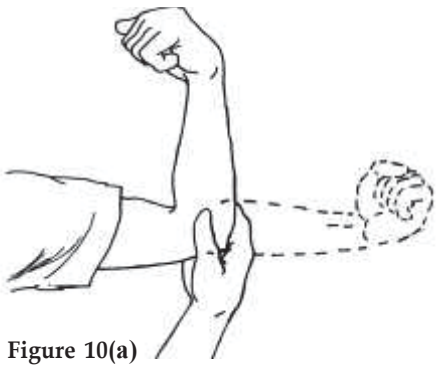


Figure 10(a)

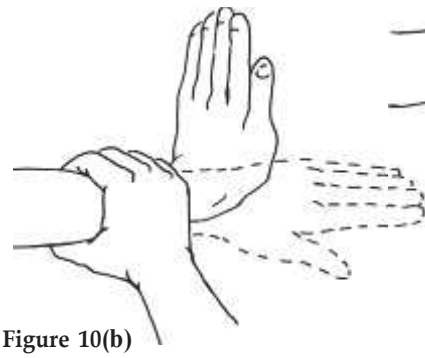


Figure 10(b)

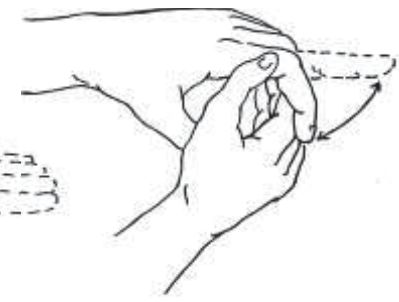


Figure 10(c)

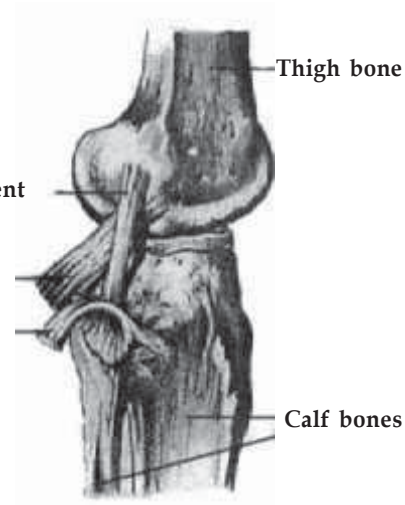


Figure 11 The ligaments of the knee

In the same way, hold your wrist and rotate your palm (Figure 10(b)).

Hold the joint of one finger between the thumb and forefinger of your other hand. Bend and unbend the finger at the joint (Figure 10(c)).

Is there only one single bone stretching from your shoulder to your fingertip? Move or rotate different parts of your arm and try to see how many different bones you can identify.

You saw earlier that muscles are joined to the bones to help them move. In the same way, two bones are joined together in a special way by fibres. These fibres are called ligaments (Figure 11).

The jawbone

Ask your friend to open his mouth and move his lower jaw up, down and sideways.

Observe his face carefully.

Did you notice any joint in the bones near his ear?

This is the place where the lower jawbone is joined to the skull.

Now try and locate these joints in your own lower jaw.

Press your fingers on both sides of your face at the spots where you have identified these joints. Open your mouth and move your lower jaw in the same way your friend did (Figure 12).

Figure 12

Can you feel the joints between your lower jawbone and your skull?

The clavicle

Fold one arm and rest it on your waist. Now slowly lift your arm and shoulder together (Figure 13).

Run a finger of your other hand from just below your neck towards your shoulder. Try and locate a raised bone there. This is the clavicle.

Locate the clavicle on the other side of your neck as well.

Look at the diagram showing the front view of the skeleton. See where the clavicle joins the shoulder blade. Now try and locate the joint between your clavicle and shoulder blade.

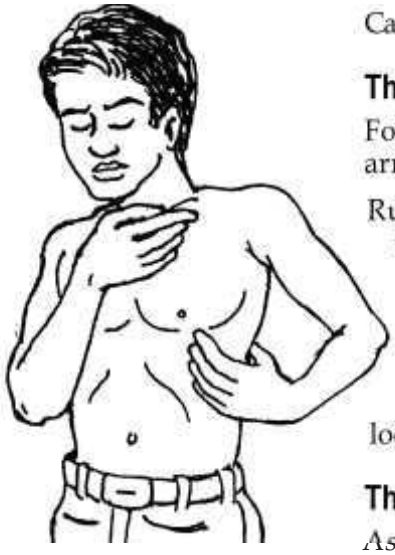


Figure 13

The ribs

Ask your friend to breathe in deeply and hold his breath for some time.

Run your finger over his ribs and try to count as many of his ribs as you can.

How many of the ribs shown in the diagram were you able to locate?

Run your finger along one of your friend's ribs and trace where it goes behind his back. Find out where the other ribs join at the back. The diagram of the skeleton shows that all the ribs join the **spinal column** at the back. In the front, all the ribs, barring the two lowest ribs, join a long flat bone in the chest. This bone is called the sternum. In this way, the ribs form a cage. Observe the rib cage carefully in the front and rear views of the skeleton.

Now take a look at the picture of the rat labelled A in your kit and see which important organs are protected by the rib cage.

Make a list of these organs in your exercise book. (3)

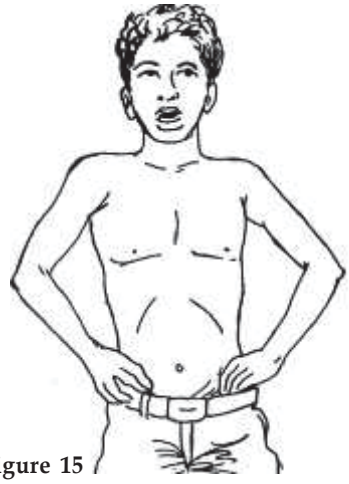


Figure 15

The pelvic girdle

Press the area just below your waist with the fingers of both hands as shown in Figure 15.

Can you feel similarly shaped bones on both sides of your body?

What appear to be two separate bones are the two ends of a single large bone. This large bone is the hip bone or pelvic girdle. Identify the pelvic girdle in both diagrams of the skeleton.

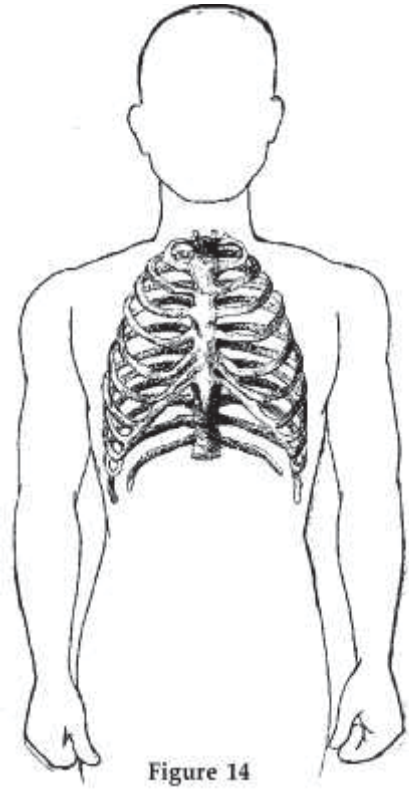


Figure 14

The bones of the legs

How many different joints can you identify by moving your legs?

Locate the bones in your leg and compare them with those shown in the front view of the skeleton. Find the joint between the hip and leg bones in your diagram.

The knee

Hold your leg straight, grasp your kneecap with your fingers and move your knee.

Do you feel a saucer-like bone moving on your knee?

Identify this bone in the diagram of the front view of the skeleton.

The feet

Feel, press, move and shake the different parts of your feet and try and identify as many bones as possible.

Indicate the bones you located in the front view of the skeleton.

Why couldn't you feel the other bones in your feet? (4)

The spinal column

Look at the rear view of the skeleton.

Ask your friend to stand up, bend forward at the waist and try and touch his toes with his palms (Figure 16).

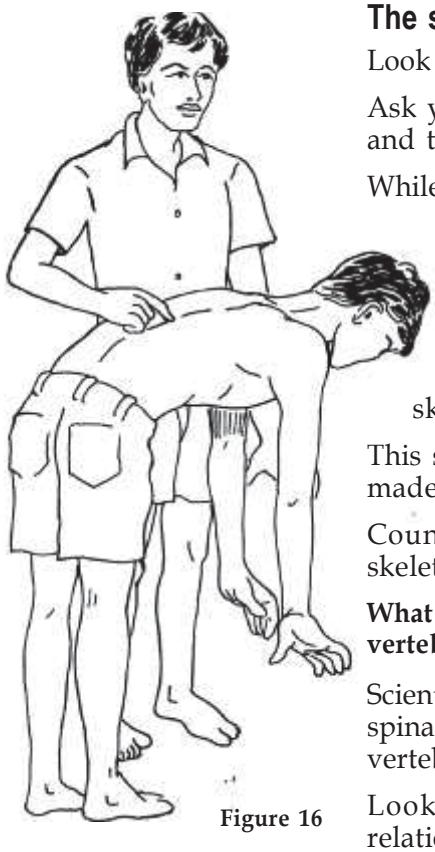


Figure 16

While he is in this position, run a finger along the centre of his back from below the neck.

Is the long structure running down the middle of his back a single bone or is it made up of many small bones joined together?

Look at this structure carefully in the rear view of the skeleton.

This structure is called the spinal column. The small bones it is made up of are called **vertebrae**.

Count the number of vertebrae in the spinal column of the skeleton in your diagram.

What would happen if you had a single bone instead of separate vertebrae? (5)

Scientists have found that there are 33 separate vertebrae in the spinal column of an infant. As the infant grows, the nine lowest vertebrae fuse into a single bone which is triangular in shape.

Look at both diagrams of the skeleton and find out the relationship of this triangular bone to the pelvic girdle.

Press your lower back with your fingers and feel how hard and strong the bone is there. This strong bone is formed by joining the fused vertebrae with the pelvic girdle. Figure 17 shows how the spinal column, pelvic girdle and thigh bones are joined.

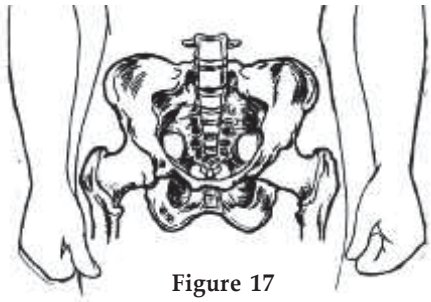


Figure 17

Now explain the different ways the pelvic girdle is used in the body. (6)

Ask your friend to stand and press his hands against a wall, as shown in Figure 18.

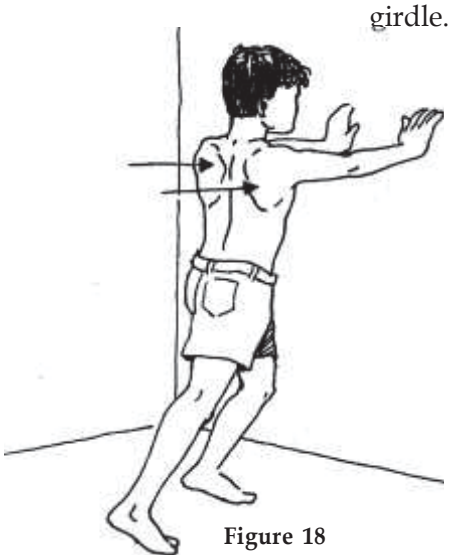


Figure 18

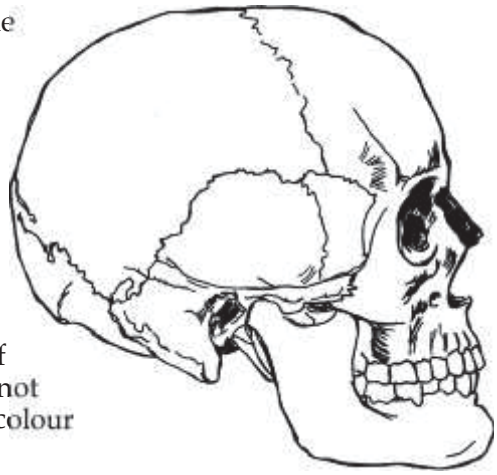
Look at his back while he is doing this. Do his two shoulder blades become clearly visible just below his shoulders?

Look at both diagrams of the skeleton and see the connection between the shoulder blades and the arms.(7)

What is the relationship between the shoulder blades and the clavicle? Look at the diagrams and explain. (8)

The skull

Examine the skull carefully in both diagrams of the skeleton.



Can you see the joints of the bones which make up the skull?

What is the major difference between the joints in the bones of the skull and the joints in the bones of the leg? (9)

Have you coloured all the bones you have identified so far in the diagrams of the skeleton? Have your friends also done the same? Find out if they have identified some bones which you were not able to. Try and locate these bones in your body and colour them in your diagrams.

Glue these diagrams of the skeleton in your exercise book. (10)

Flexible bones - Cartilage

Feel your ears with your fingers. Press them and bend them.

Are some parts of your ear soft and some other parts hard?

The hard parts are made of a substance called cartilage.

Find the cartilage in your nose.

Cartilage is present in other parts of the skeleton as well, for example, between the ribs and the sternum and between the vertebrae of the spinal column. Try and identify the cartilage in these places in the front view of the skeleton.

Different kinds of joints in the skeletal system

You have seen that the human skeleton is made up of many bones and that these bones have joints between them. We can move the various parts of our body because of these joints.

You may have seen different kinds of joints in things around you. Does the human skeleton also have different kinds of joints? Let us find out.

Ball and socket joint

You will have to make a model to understand how the joint between the shoulder blades and the bones of your arms works. Place a fused bulb inside the half shell of a coconut and rotate it in the way shown in Figure 19.

A joint made by fitting a ball into a socket is called a ball and socket joint. In this joint the bone can rotate easily in all directions.

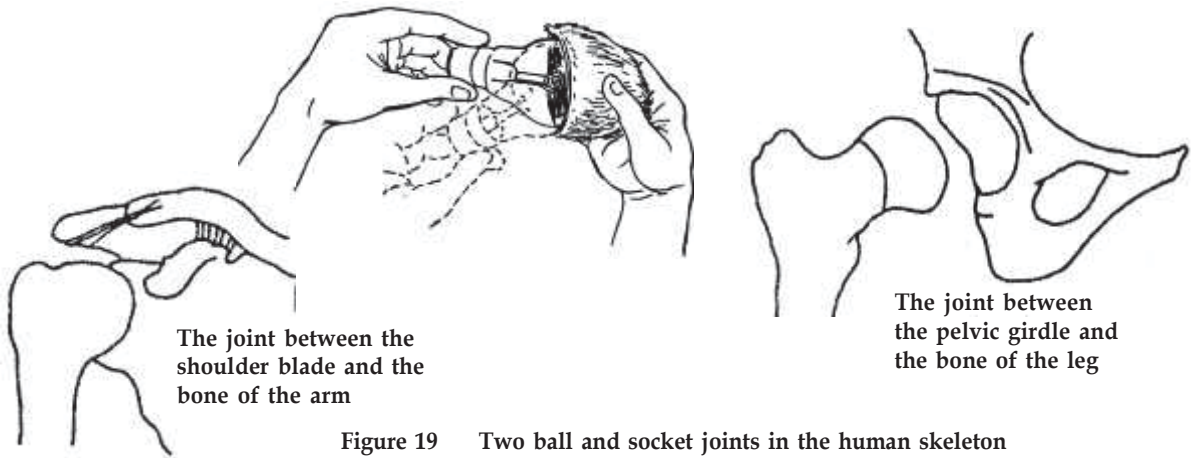


Figure 19 Two ball and socket joints in the human skeleton

The hinge joint

Straighten your arm and hold your elbow in the palm of your other hand. Try and rotate your forearm in all directions at the elbow joint.

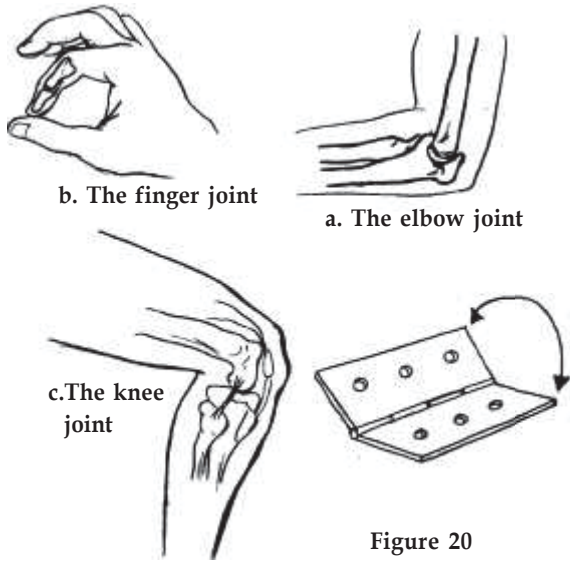


Figure 20

Were you able to rotate your forearm at the elbow joint in the same way you rotated your arm at shoulder joint?

If you couldn't, what could be the reason for not being able to do so?

Is it possible that there is a difference between the shoulder joint and the elbow joint?

Straighten your arm and bend your forearm up and down at the elbow as shown in Figure 20a.

Could you bend your forearm beyond 180^0?

To understand how the elbow joint works, open and close the lid of a box or attaché case. Is there some similarity between opening and closing the lid and the movement of the forearm?

Look at Figure 20 and then look for other joints, similar to a door hinge, in your body. Make a list of these hinge joints. (11)

Another property of the elbow joint

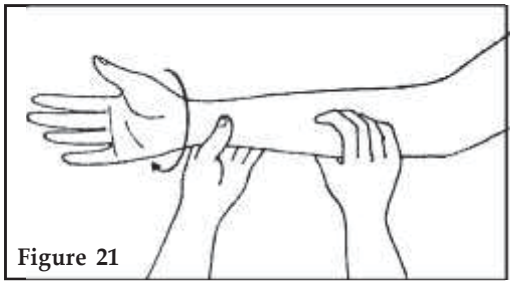


Figure 21

You studied the bones of your arms. How many bones were you able to locate between your elbow and wrist? Identify the outer and inner bones below the elbow in the two diagrams of the skeleton. These are some of the bones you cannot easily feel from the outside.

Let us do an experiment to understand how these two joints move. Ask your friend to straighten her

arm, with the palm facing upwards. Hold her forearm with both your hands. Press the inner bones of the forearm with the fingers of one hand, as shown in Figure 21. Ask your friend to rotate her forearm. Can you feel the difference in the movement of the two inner bones as she rotates her forearm?

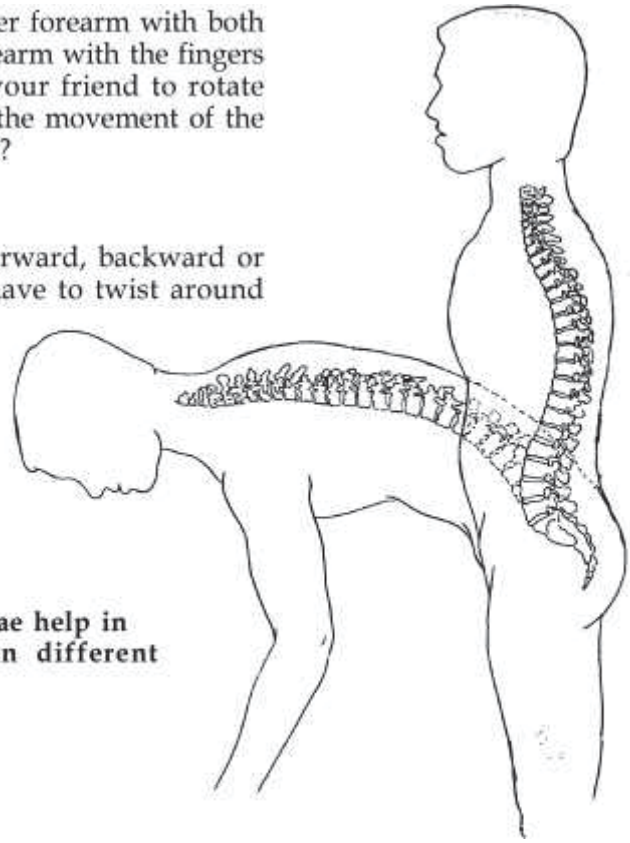
Your spinal column is a spring

Very often you have to bend your body forward, backward or sideways from the waist. You sometimes have to twist around as well.

Could you explain what property of the spinal column enables you to make such movements? (12)

You have seen in both diagrams of the skeleton that there is a tender and flexible cartilage between the vertebrae of the spinal column.

How does the cartilage between the vertebrae help in allowing the spinal column to rotate in different directions? (13)



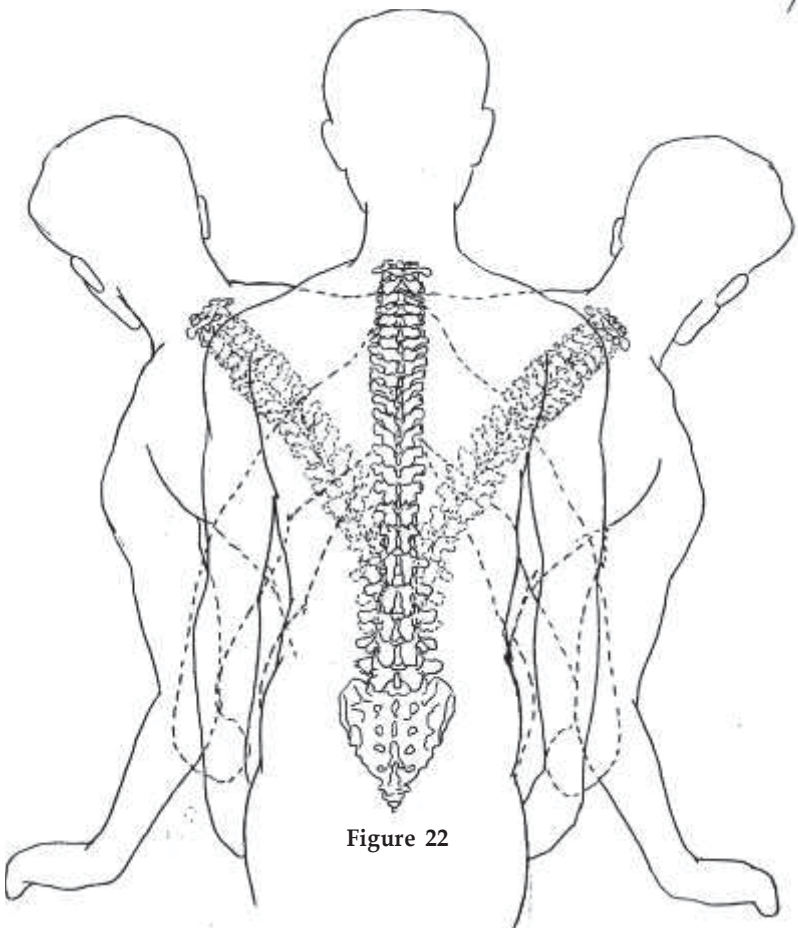


Figure 22

First aid for broken bones

If you are injured and the pain is unbearable and if a swelling occurs in that part of your body, it may be because a bone is broken.

In such a situation:

1. The injured person should not move at all.
2. If a bone in the arm or leg is broken, a splint should be made of bamboo or wood, or any other stiff material, and tied to the injured limb as shown in Figure 24.
3. The injured person should be covered with a blanket and taken to a hospital as soon as possible.

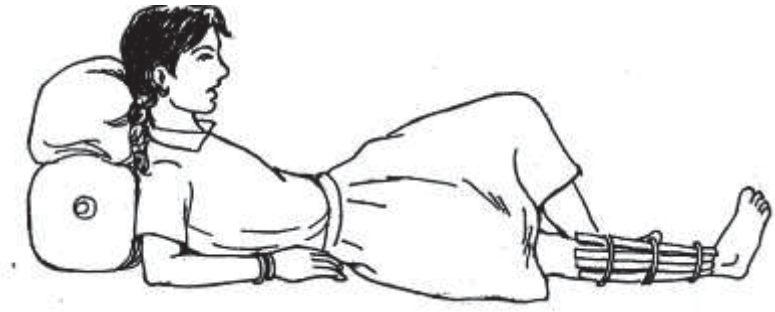


Figure 24

Some questions for revision

1. Imagine a situation where you have no bones in your body. Describe, with reasons, what would happen.

2. Try and identify the joints in the body of a goat or cow. Make a list of these joints.

3. What difficulties would you face if your fingers had only a single bone?

New words

Skeleton	X-ray	Clavicle
Spinal column	Pelvic girdle	Vertebrae
Hinge joint	Cartilage	Ball-and-socket joint
Fleshy	Ribs	

VOLUME

Chapter 10

How is milk measured? (1)

How many cups of tea can you fill from a small jug? How can you find out? (2)

Is the weight of a glassfull of rice equal to that of a glassfull of wheat? If their weight is not equal, then what do they have in common? (3)

How do we calculate the amount of pesticide or urea solution to be sprayed on a crop? (4)

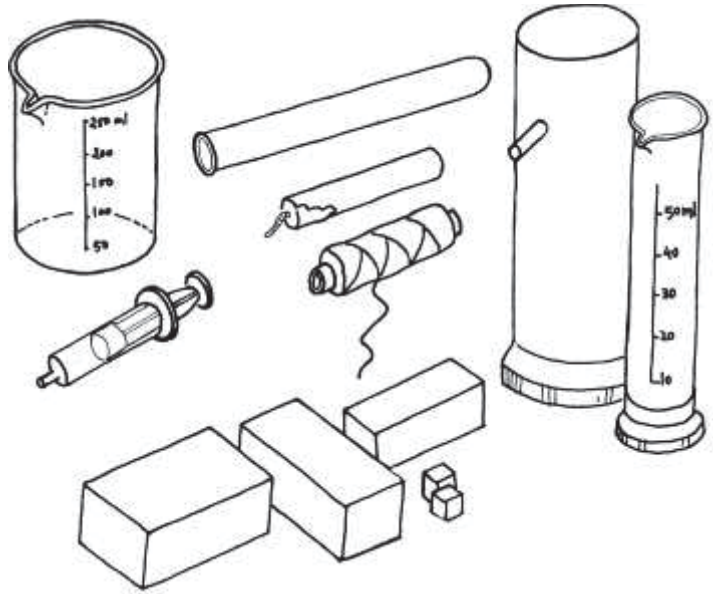
How do shopkeepers measure kerosene? (5)

How much diesel does it take to fill a jerrycan? (6)

In all these cases, you may have seen people using a vessel of a specific measure to calculate the volume of liquid. This measure is called a litre.

A litre is the standard unit to measure the volume of liquids. In this chapter you will measure the volume of several things and study their properties.

Let us begin with the volume of liquids.



Experiment 1

Your teacher will show you four containers filled with water.

Guess which container has more water and which has less? (7)

Water and other liquids assume the shape of the container they are poured into. This often makes it difficult to estimate which container has more water and which has less.

How would you check whether your estimate was right or wrong? (8)

Try your method to check which container has more water and which has less. (9)

Did you use a vessel of a fixed measure to compare the volumes of water? Since we often have to measure milk, kerosene and

medical solutions at home, you have probably used this method before to measure liquids.

The Litre

Your kit has a transparent square plastic container. When filled to the brim this vessel can hold a litre of water or any other liquid. It has markings that divide the litre into ten equal parts.

Measuring (graduated) cylinders and their least count

The litre is a large unit of volume. To measure volumes less than a litre we use a unit called a millilitre, which is also written as ml. One litre equals 1,000 millilitres.

1 litre = 1,000 millilitres

Your kit has two measuring cylinders - one large and one small. The larger measuring cylinder can measure up to 250 ml of liquid at a time and the smaller one can measure up to 50 ml at one go.

Look at the markings on both the cylinders.

Can you measure 10 ml of liquid using the bigger measuring cylinder? (10)

Fill water up to any mark in this cylinder.

Find out how much more water it would take to raise the level to the next mark on the measuring cylinder. (11)

You calculated the amount of water contained between two consecutive markings of the measuring cylinder in the above question. This amount of water is the least count of the measuring cylinder (Figure 1).

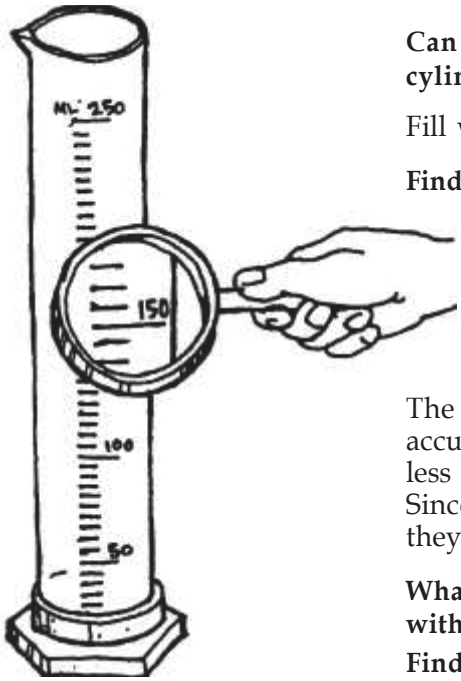


Figure 1

The least count is the minimum amount of liquid that can be accurately measured by this measuring cylinder. If the liquid is less than this minimum amount we can only estimate its amount. Since such estimates are bound to vary from person to person they cannot be considered to be the least count.

What is the minimum amount of liquid that can be measured with the larger measuring cylinder? (12)

Find out the least count of the smaller measuring cylinder. (13)

Experiment 2

A syringe as a measuring cylinder:

You are probably familiar with injection syringes. Try and get a syringe without a needle from somewhere and bring it to the class. This syringe can be used to measure volume. To do so, you must first seal the end where the needle is fitted by melting it over a flame (Figure 2).

Once you do so, it is ready for use as a measuring cylinder.

Find out the least count of your syringe. (14)

Experiment 3

A test tube as a measuring cylinder:

The test tubes in your kit can also be used as measuring cylinders. Let's make one.

Take a test tube and paste a narrow strip of paper on its side. Before pasting the paper smear it with kerosene so that it becomes **translucent**. You can then see the level of liquid through it.

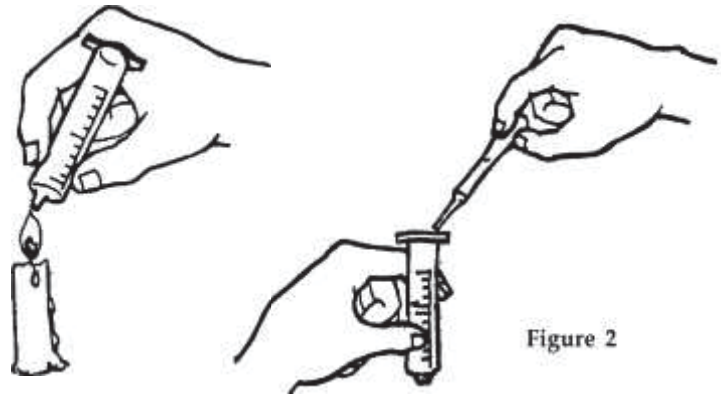


Figure 2

Pour 1 ml water into the test tube with a syringe. Mark the water level on the strip of paper. This is the 1 ml mark of your measuring cylinder.

Pour 1 ml water at a time into the test tube and mark the water levels for each additional ml on the paper strip. Do this till the test tube has 10 ml of water. Label the water level marks 1, 2, 3 and so on up to 10. Write ml at one corner of the paper strip so that you remember the unit being used to measure volume. Your test tube measuring cylinder is ready.

What is the least count of this measuring cylinder? (15)

Household measures of volume

If you look around your home you will find many things which can be used to measure the volume of liquids. Examples include feeding bottles, mugs, buckets, medicine bottles, glucose bottles, etc. If possible, bring these things to the class and find the least count of each of them.

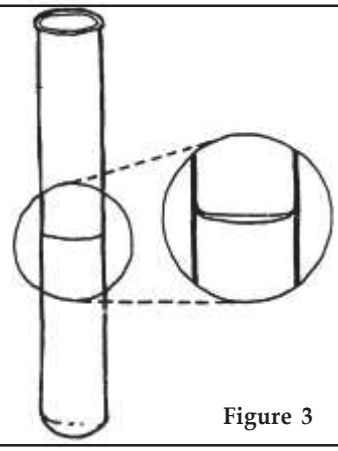


Figure 3

THE CORRECT WAY TO OBSERVE THE WATER LEVEL

How does one find the water level in a test tube?

Fill a test tube with water and hold it at eye level. Look carefully at the water level. If the test tube is clean you will notice that the surface of the water is not flat but curved slightly downwards from the edges. Such a shape is called **concave** (Figure 3).

The lowest part of the curvature is taken as the level of liquid in the test tube, as shown in the figure.

Experiment 4

Drop by Drop

Use a dropper to fill 5 ml of water, drop by drop, in a syringe or test tube. Count the number of drops.

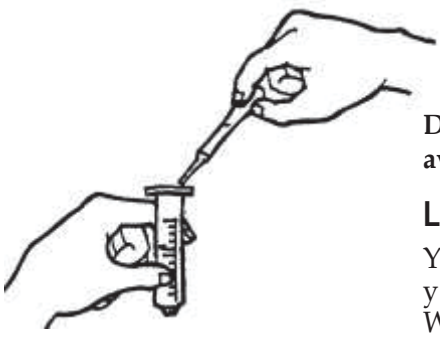


Figure 4

How many drops are there in 5 ml of water? (16)

How much water does each drop contain? Calculate the approximate volume in ml, up to the second decimal place. (17)

Did you calculate the actual volume of a drop of water or its average volume in the above question? (18)

Let's find out

You fill glass tumblers, mugs or jugs with water every day. Have you ever measured how much water each of these contains? Why not find out today? Use the measuring cylinders you made to find out how much water can be filled into different vessels at home or in the classroom.

The volume of solids

You have learnt how to measure the volume of liquids. Let us now do a few experiments to find out how we can measure the volume of solid objects.

A familiar story

You may have heard the story of the thirsty crow and the pitcher of water. The crow was thirsty but could not drink from the pitcher because the water level was too low - beyond the reach of its beak. So the clever crow began dropping pebbles into the pitcher. The level of water inside the pitcher rose and finally the crow was able to drink its fill of water.

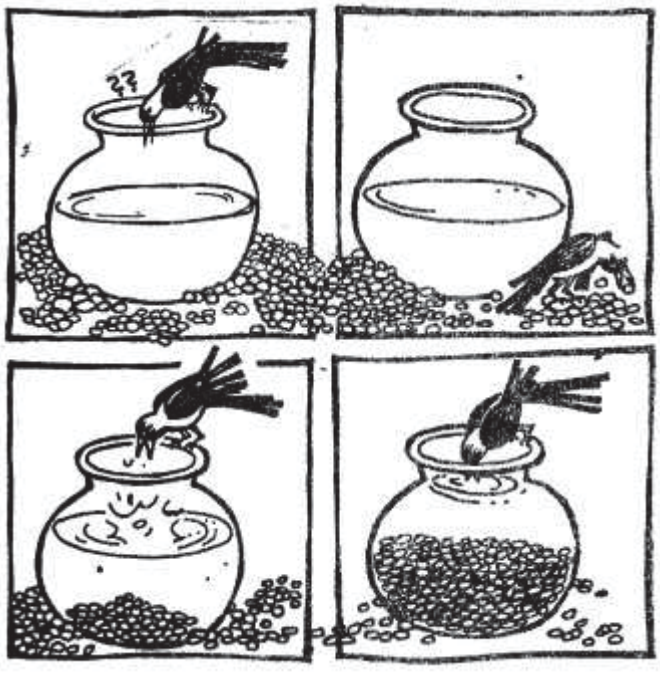


Figure 5

What do you think happened when the pebbles were dropped into the pitcher?

When a pebble is dropped in water, it occupies space by **displacing** the water. Where does the water displaced by the pebble go? This displaced water occupies a new space, but its volume does not change - the amount of water remains the same. So when pebbles are dropped in the pitcher, the water level rises.

Experiment 5

Let's do an experiment similar to what the crow did. However, unlike the crow, our aim is not to drink water but to measure the volume of solid objects.

You have three different sized blocks. Label them A, B and C. Fill a beaker half full with water and mark the water level. Tie Block A with a thread and immerse it in the water.

Did the water level rise? (19)

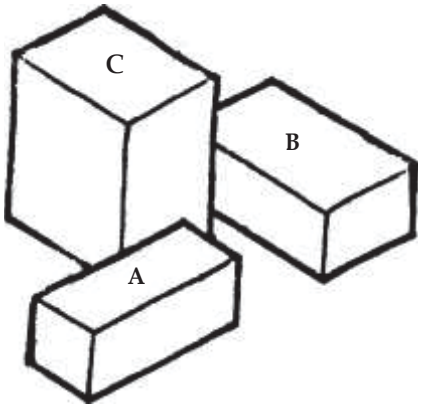
Remove the block.

Did the water level fall back to its earlier mark? (20)

Repeat the experiment with blocks B and C.

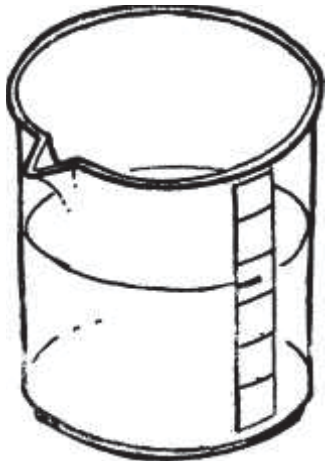
Since you have already read the story of the crow and the pitcher, you must have figured out why the water level rose in your experiment. When the block is immersed in water, it displaces water from the space it occupies. The space occupied by an object is its volume. So a block immersed in water displaces an amount of water that is equal to its volume. You saw that on removing the block, the water returns to its original level.

Can this method be used to measure volume? Let us see.



Paste a strip of graph paper on the outer surface of the beaker. Fill the beaker half full with water. Mark the water level on the graph paper and label it X. Immerse Block A in the water like you did earlier. Mark the new water level on the paper strip with an A (Figure 6). Repeat the experiment with Blocks B and C. Mark their respective water levels B and C on the paper strip.

While doing the experiment, take one precaution. Ensure that the water level is at X before you immerse each block.



In which case did the water level rise the most - for Block A, B or C? (21)

Is this block the largest among the three? (22)

What do you think is the relationship between the volume of the block and the rise in water level? Can you explain this relationship? (23)

Before we proceed further we need to learn more about the units in which volume is measured.

Just as there are specific units to measure length and area there are also specific units to measure volume. The standard unit for measuring volume is a cube with sides equal to 1 cm. The volume of such a cube is 1 cubic centimetre. We can write this as 1 cc or 1 cm^3. Similarly, a cube with a 1 metre side has a volume of 1 cubic metre or 1 cu m or 1 m^3.

Your kit contains plastic cubes with 1 cm sides. Each cube has a volume of 1 cc or 1cm^3. So you can use these cubes as units for measuring volume.

We are now ready to measure the volume of Blocks A, B and C.

First fill the beaker with water to the point marked X. Drop the plastic cubes into the water one by one. Continue dropping cubes until the water level reaches point A.

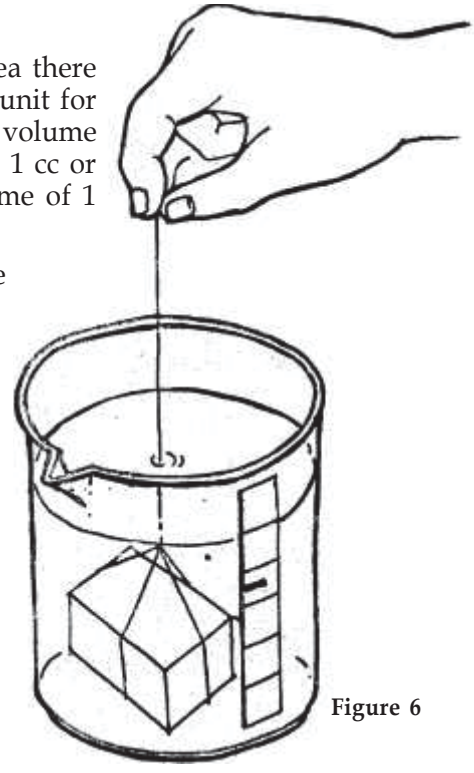


Figure 6

Count the number of cubes you have used to make the water level reach point A and note this number in your exercise book. (24)

In the same way, find out how many cubes are needed to raise the water level from point X to point B and Point

C. Note the respective number of cubes in your exercise book. (25)

What relationship do you see between the volume of the blocks and the number of cubes used to raise the water level to the respective points? Explain with reasons. (26)

What are the volumes of Blocks A, B and C in cubic centimetres? (27)

Use the same method to find the volume of other blocks in the kit in cubic centimetres. (28)

Experiment 6

Water, milk or oil - they are all the same:

You may be wondering how water, milk and oil can be the same? There are many differences between the three liquids. However, things that are different can also have similarities. This experiment is based on one similarity between water, milk and oil.

In the previous experiments you saw that when solid objects are immersed in water they displace water and occupy a space equal to their volume. That is why the water level rises. Suppose we use milk or oil instead of water. Will their level rise as much as the level of water?

Take a guess, but give reasons for your guess. (29)

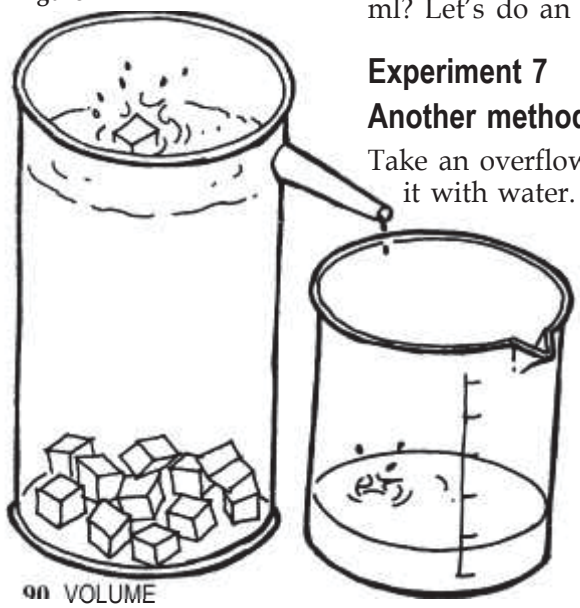
Now do an experiment to test your guess. Take the beaker used in Experiment 5 and fill it with milk or oil up to the same point marked X in the previous experiment. Repeat Experiment 5.

Each time a block was immersed did the milk or oil rise to the same level as water rose in Experiment 5? (30)

What did you learn from this experiment? Write your answer in your own words. (31)

In the above experiments you measured the volume of solid objects in cubic centimetres. You also measured the volume of liquids in millilitres earlier. What is the relationship between 1 cm^3 and 1 ml? Let's do an experiment to find out.

Figure 7



Experiment 7

Another method of measuring volume:

Take an overflow vessel (Figure 7). Place it on a level surface. Fill it with water. Wait till the water stops dripping from the spout and the level is stable. Then place an empty beaker under the spout and drop 50 plastic cubes, one by one, into the overflow vessel. Water will flow out from the spout and collect in the beaker.

How much water collected in the beaker? Use your measuring cylinder to find its volume.

You know that the volume of a plastic cube is 1 cubic cm or 1cm^3. What is the volume of 50 cubes?

Make a table like the one given below and record your observations in it. (32)

Repeat the experiment using different numbers of cubes.

Table 1

S No	Object	Amount of water flowing out from the overflow vessel (ml)
1.	50 cubes	
2.	80 cubes	
3.	100 cubes	

Look at your table.

Do you see a relationship between the volume of a cube and the amount of water it displaces? (33)

This is another method of measuring volume. Explain this method in your own words in your exercise book. (34)

Use this method to measure the volume of some other object like a stone or a fruit.

If a 1 cm^3 solid object is dropped into the overflow vessel how many millilitres of water will be displaced? (35)

What would be the volume of a cube needed to displace 1 litre of water from the overflow vessel? (36)

The volume of liquids is also written in cubic centimetres instead of millilitres.

Do you think it is wrong to do so? If your answer to this question is yes, give reasons why you think it is wrong. (37)

A problem

When a cork is put in water, it floats on the surface.

What problem would you face in finding its volume? (38)

Suggest a way of overcoming this problem. (39)

Find the volume of the cork using your method. (40)

Experiment 8

Think first and then do

You found the average volume of a drop of water. Now find the volume of a gram (*chana*) seed.

Write your answer and explain the method you used in your exercise book. (41)

Experiment 9

A formula for measuring the volume of a block

In this experiment we shall join plastic cubes together to form a block identical to Block A. To do this, place the plastic cubes

next to each other in a row equal in length to the length of Block A (Figure 8a).

How many cubes did it take to make this row? (42)

Now make similar rows of cubes and place them side by side so that a layer of cubes is formed whose length and breadth is equal to that of Block A (Figure 8b). Make several such layers of cubes and stack them one above the other till their height matches the height of Block A (Figure 8c).

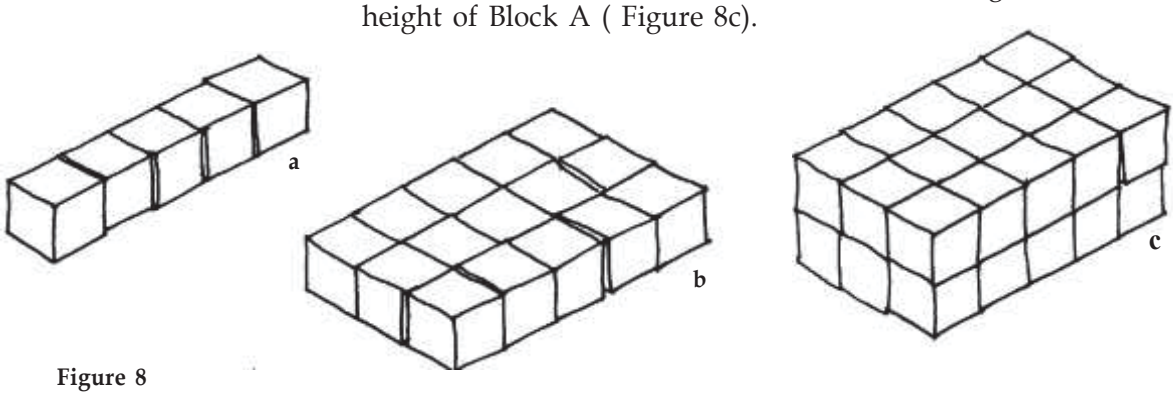


Figure 8

Does the total number of cubes used give you the volume of Block A? (43)

Measure and note the length, breadth and height of Block A in Table 2. (44)

Does the number of cubes equal the product of the length, breadth and height of Block A? (45)

What conclusions can you draw from your answers to Questions 43 and 45? Write your conclusion in the form of a formula for calculating volume. (46)

In the same way, write the relevant figures for the other two blocks in Table 2. Also note the volume of the blocks in cm^3 measured in Experiment 5 or 7. (47)

Table 2

S. No. of Blocks	Length (cm)	Breadth (cm)	Height (cm)	Product (cm^3)	Volume (cm^3)
a					
b					
c					

Is your formula for volume correct for all the blocks? (48)

How much water will be displaced if all the blocks are simultaneously immersed in the overflow vessel? (49)

Experiment 10

How did the litre become a unit of volume?

Measure and note down the length, breadth and height of the inside surfaces of the one-litre plastic container provided in the kit. (50)

Calculate how many cubes fit into a litre and write your answer. (51)

Experiment 11

Size and volume

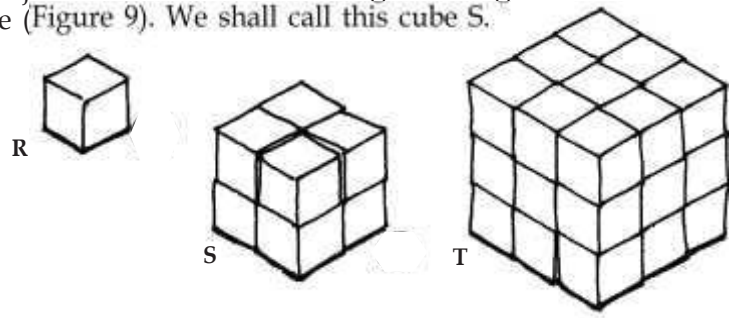
In the chapter "Area" you saw that doubling the sides of a square increases its area by four times. Similarly, if we halve the sides of a square the area is not halved but reduced to a quarter of the original area.

If the sides of a cube are doubled how many times do you think its volume would increase?

Let us find out by placing cubes having 1 cm sides together. We shall label each such cube R. You already know the volume of these cubes.

Write down the volume of Cube R in Table 3. (52)

Let's now join some of these cubes together to get a cube with a 2 cm side (Figure 9). We shall call this cube S.



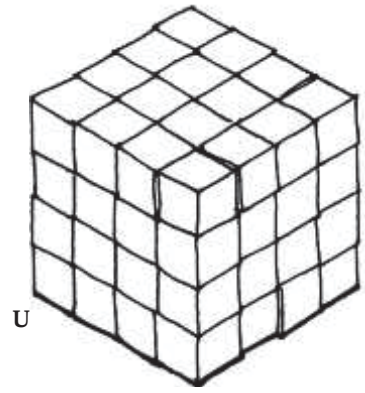


Figure 9

How many R cubes did it take to make Cube S? (53)

Note the length and volume of Cube S in the table. (54)

In the same manner, let us make cube T and Cube U. Cube T has sides measuring 3 cm and Cube U has sides 4 cm long.

Note the length of the side and volume of Cubes T and U in the table. (55)

Table 3

Cube	Length of side (cm)	Volume (cm^3)	How many times larger than volume of Cube R
R			
S			
T			
U			

On the basis of the table, can you explain what happens to the volume of a cube when the length of its side is doubled? (56)

If you wish to increase its volume 27 times how many times must you increase the length of its side? (57)

If each side is halved, how much smaller would its volume be? (58)

The relationship between the length of the side and volume is not limited to cubes alone. This relationship holds good for all shapes. For example, if the diameter of a ball is doubled, its volume does not increase two or four times. It increases eight times. Similarly, if the length of each side of a water tank is

three times that of a second tank, the volume of the first tank will be 27 times that of the second tank.

Diversity in unity

In the chapter "Area" you saw many shapes that look different but have the same area. In the same way, can objects that look different have the same volume? Let's find out.

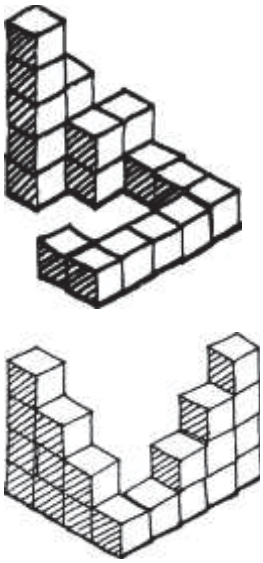
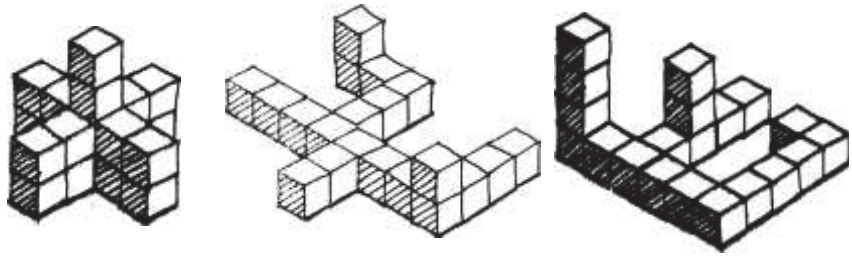


Figure 10

Experiment 12

Different things, same volume:

Take twenty 1 cc cubes and make the shapes shown in Figure 10.



Do all these shapes have the same volume? (59)

Can a ball and a cube have the same volume? (60)

How can you estimate whether two objects with different shapes have the same volume or not? (61)

Questions for revision

1. **Sohail measured two litres of milk and gave Sunita three fourths of the milk. How much milk does Sohail have now? Give your answer in ml.**
2. **What is the least count of the measuring cylinder in the figure? Find the volume of water it contains.**
3. **How will you measure the volume of an iron nail? Explain your method in detail. Now measure the volume of a nail using your method. Did you face any problem in measuring the volume? If so, describe your problems.**
4. **A measuring cylinder contains 75 ml of water. Seema dropped seven 1 cc blocks into it. How high will the water level in the cylinder rise?**
5. **Estimate the volume of each of the following things and then find out their actual volume by measuring them:**
   - **A cup of tea**
   - **A lime, a peanut, a tamarind seed**
   - **A ball**
   - **Your *Bal Vaigayanik* book**
6. **A person needs to drink at least two litres of water every day. Find out how many glasses of water this would be approximately equal to.**
7. **How will you find the volume of a watermelon? Discuss this problem in class.**
8. **Can you think of a method to measure the volume of your own body?**

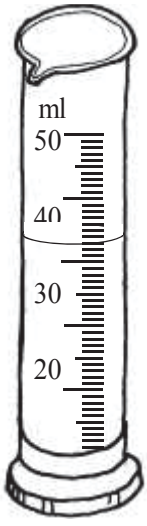


Figure 11

New words

Concave Translucent Displace

GAMES WITH AIR

Chapter 11

The hot air of the arid summer months parches your throat and dries your skin. Then comes the monsoon and its moisture-laden wind is soothing. In winter, the breeze chills you to the bone. Bicycling in the direction the wind blows is easy, but try bicycling against the wind and you'll find yourself huffing and puffing. If the wind gets stronger, it raises a storm. Dust and gravel fill the air and trees are uprooted.

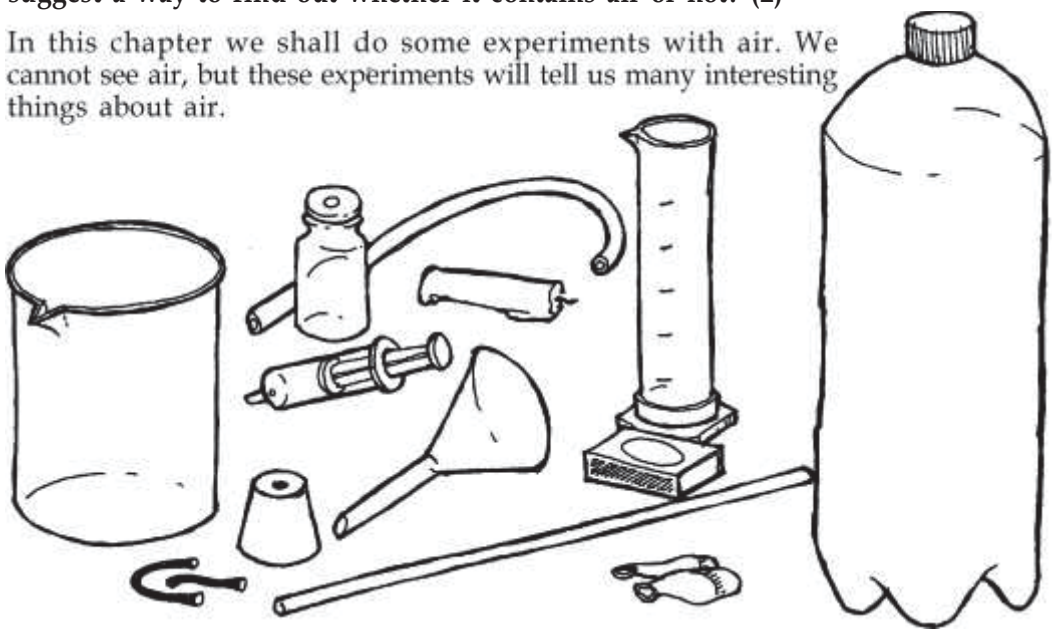
Yes, you must have felt and experienced the presence of air in many different ways.

List the ways in which you can tell whether air is present around us. (1)

Suppose there is no breeze blowing and everything is still. How can you tell whether air is present or not, or where it is? Under a tree on which not even a leaf stirs? In a room? In an empty glass? In a closed bottle? In a glass tube?

Do you think an empty bottle or glass contains air? Can you suggest a way to find out whether it contains air or not? (2)

In this chapter we shall do some experiments with air. We cannot see air, but these experiments will tell us many interesting things about air.



Experiment 1

Where air is present and where it is not:

If you dip a glass in water, will it fill with water? You may think this is a silly question because you usually fill your glass by dipping it in a vessel of water. But try filling a glass with water by immersing it in the way shown below.

Stuff some paper in the bottom of the glass (Figure 1). Invert the glass and immerse it in a bucket of water. The glass should be completely under water.

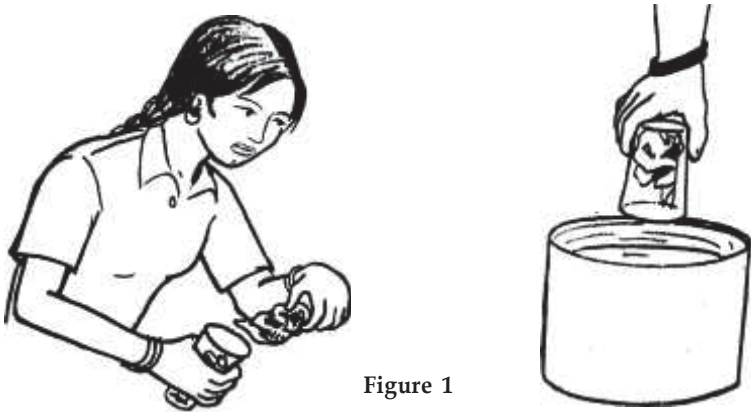


Figure 1

Did the paper in the glass get wet or not? Take a guess before actually checking. (3)

Take the glass out of the water and, keeping it inverted, check whether you guessed correctly.

What would happen if you tilt the glass while immersing it in water?

Try the experiment and write what you observe in your own words. (4)

Experiment 2

Will water fill the glass?

Fill a beaker with water. Float a piece of coloured paper or a deflated balloon on the surface. Invert a transparent glass over the paper/balloon and push the glass down into the water (Figure 2). Check whether the glass is filled with water or not. The balloon/paper will indicate the level of water inside the glass.

Figure 2

Draw a diagram to show the levels of water in the beaker and the glass. (5)

Did the glass fill with water? (6)

Is there something that prevents the water from entering the glass? What is that obstruction? (7)

We can observe the same thing happening in other experiments as well. So let's check whether there is air in a bottle.

Experiment 3

Fill a bottle with water

Fill a bucket with water. Take a narrow-mouthed bottle and immerse it in the bucket till it fills with water.

Did something come out of the bottle when water entered it? How do you know whether something came out or not? (8)

Which property of air did you learn about from your observations in Experiments 1 to 3? (9)

Would it be correct to say that a glass or bottle that we think is empty is actually full of air? (10)

The volume of air

If air is everywhere, can you suggest a way to measure its volume? For example, if you want to find out how much air there is in an injection bottle, how would you find out?

If you can think of a way to measure the volume of air, discuss it in class. Use your method to find out how much air the injection bottle contains.

The following experiment gives one way of measuring the volume of air.

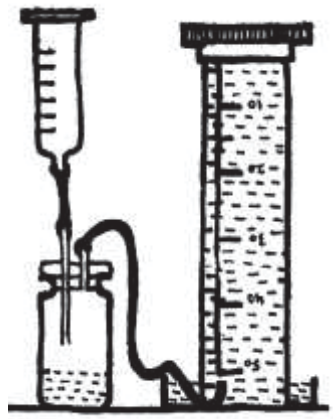


Figure 3

Experiment 4

Make two holes in the rubber stopper of a large injection bottle. Insert two empty refill pieces through the holes. Attach valve tubes to the upper ends of the refills and set up the arrangement shown in Figure 3.

Attach an inverted syringe to the free end of one of the valve tubes. Take a measuring cylinder and fill it with water. Invert the measuring cylinder in a plate of water without letting the water spill out. Insert the free end of the other valve tube into the measuring cylinder.

What you have to do now is pump water into the injection bottle with the syringe. As water enters the injection bottle, the air it contains is forced out through the other refill into the measuring cylinder. When the injection bottle is filled with water, all its air goes into the measuring cylinder. You can check the measuring cylinder to find out how much air it contains.

So go ahead and do the experiment. Fill water in the injection bottle with the syringe. But ensure that the second valve tube is inside the measuring cylinder while you are doing so.

When the injection bottle is filled with water, check the reading of the measuring cylinder and note how much air it contains. (11)

Now measure the volume of the water in the injection bottle. (12)

Is the volume of water the same as the volume of air in the measuring cylinder? (13)

On the basis of this experiment, can you suggest a simple way to measure the volume of air present in a utensil? (14)

Is the volume of air constant?

In Experiment 4 you measured the volume of air. Is this volume constant or can it change? Let us find out by doing some experiments.

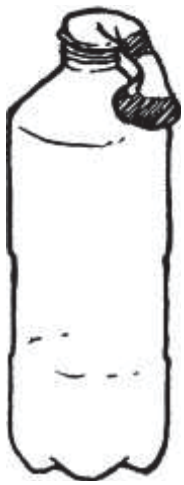


Figure 4

Heat air and see what happens

If you pump a lot of air into the tyre of a bicycle and leave the bicycle out in the sun for a long time, the tube in the tyre sometimes bursts.

Why does this happen? Let us heat air to try and understand what happens.

Experiment 5

Attach a large balloon to the mouth of a half-litre plastic bottle (Figure 4). Be careful not to squash the bottle while doing so. Place the bottle in the sun. Inspect it after 4 to 5 minutes.

What happened to the balloon? (15)

Why did this happen? (16)

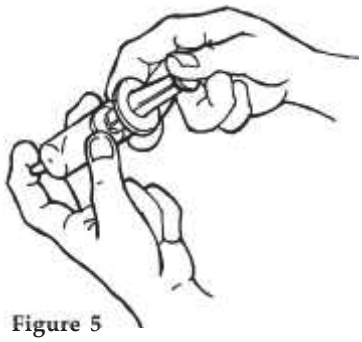


Figure 5

Cool the bottle by placing it in the shade. Inspect it again after 5 minutes.

What is the condition of the balloon now? (17)

Why did this happen? (18)

Can you now explain why a bicycle tube sometimes bursts in summer? (19)

Experiment 6

Take a syringe and draw out its **plunger** to the limit.

Is the syringe filled with air? (20)

What is the volume of this air? (21)

Close the nozzle of the syringe with a finger and press the piston. (Figure 5)

Were you able to press the piston? (22)

Did you feel a pressure on your finger while doing so? (23)

What happened to the volume of air after you pressed the piston? (24)

Did the amount of air in the syringe decrease or did only its volume decrease? (25)

Fill the syringe with water and repeat the experiment.

Could you press the piston down when the syringe was filled with water? (26)

You saw a difference in one property of air and water in this experiment. What is that property? (27)

Can the volume of air be reduced by applying pressure? (28)

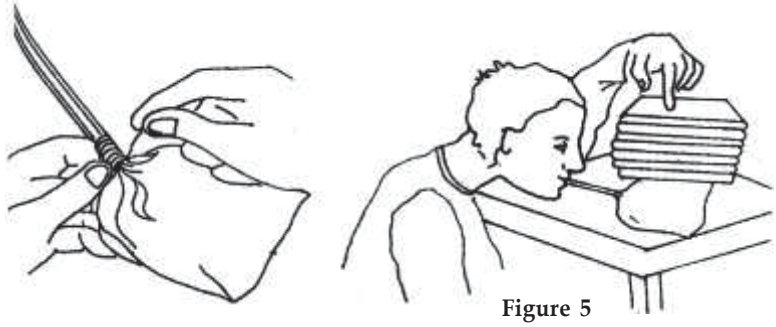


Figure 5

Air pressure

In Experiment 6 , you felt a slight **pressure** on your finger when you closed the nozzle of the syringe and pressed the piston. What caused this pressure? Was the air in the syringe exerting the pressure?

Let us do some experiments on air pressure to find an answer to this question.

Experiment 7

Take a thick polythene packet - a milk packet would be ideal. Insert a glass tube or an old ball-point pen into the packet, as shown in Figure 5, and tie its mouth tightly with thread. Place the packet on a table and put a couple of books on top of it. Blow air into the packet through the tube.

What happened? Why did this happen? (29)

Experiment 8

Take a large plastic bottle and a two-holed rubber cork that fits firmly into its mouth. Insert two glass tubes into the two holes of the cork. The glass tubes should fit tightly in the holes. Tie a coloured balloon to the lower end of one of the glass tubes.

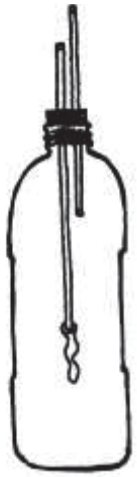


Figure 6

Close the mouth of the bottle with the cork and seal it with sealing wax to make the bottle airtight. The balloon should be inside the bottle as shown in Figure 6.

Now suck air out of the bottle through the tube that doesn't have a balloon attached to it.

What happened to the balloon? (30)

Why do you think this happened? (31)

Experiment 9

Take a glass tube and fill it three fourths with water. Close one end with your thumb and dip the other end into a beaker of water (Figure 7).

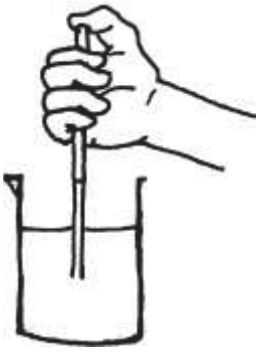


Figure 7

Did the water in the tube remain inside or did it flow into the beaker? (32)

Remove your thumb from the top end of the tube.

What happened? (33)

Experiment 10

Fill a half-litre plastic bottle one third with water. Select a one-holed cork that fits firmly into its mouth. Insert a glass tube through the hole in the cork. Seal the glass tube in the cork with

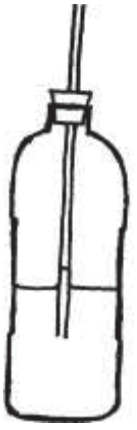


Figure 8

sealing wax or candle wax to make the cork airtight. Fit the cork firmly into the mouth of the bottle. The lower end of the tube should be submerged in the water in the bottle (Figure 8). Blow hard into the bottle through the tube and quickly remove your mouth.

What happened? (34)

Experiment 11

Drain out the water from the bottle used in the previous experiment and refix the cork tightly. Squeeze the bottle gently with both hands and then squash it a little. But take care not to break it. Invert the slightly crushed bottle and dip the tube into a beaker of water. Relax the pressure of your palms on the bottle.

What happened? (35)

Questions for revision

1. **How much air does a bucket contain? Suggest a way to measure the amount of air.**
2. **Take an injection bottle. Insert a piece of a refill into its rubber cap and fix the cap on the bottle. Put a drop of water on top of the refill or fill a little water in it. Hold the bottle tightly in your palm. What happened to the drop of water? Why did this happen?**
3. **Take a syringe like the one used in Experiment 6. Pull its plunger to the halfway mark. Close its nozzle with your thumb and try to pull the plunger to its outer limit. Were you able to pull the plunger easily? What did you feel on your thumb? What happens when you leave the plunger after pulling it?**
4. **You did several experiments with air in this chapter. Fill in the table below on the basis of your observations:**

Table: Properties of air

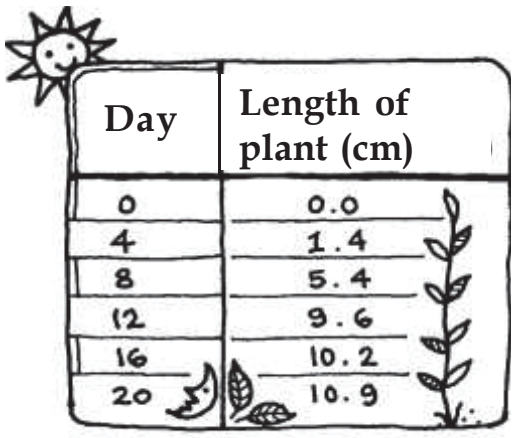
Experiment No	Property of air the experiment illustrates
1.	
2.	
3.	
4.	
5.	

New words

Pressure Plunger

THIS IS THE WAY TO MAKE GRAPHS

Chapter 12

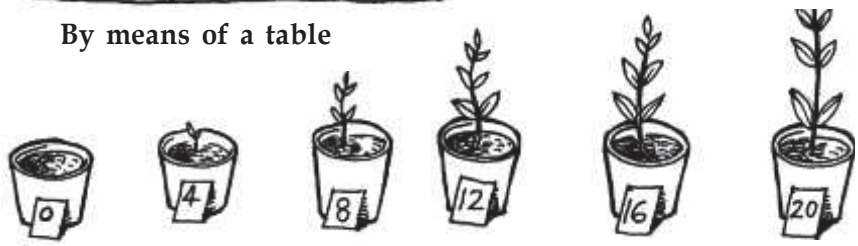


Day	Length of plant (cm)
0	0.0
4	1.4
8	5.4
12	9.6
16	10.2
20	10.9

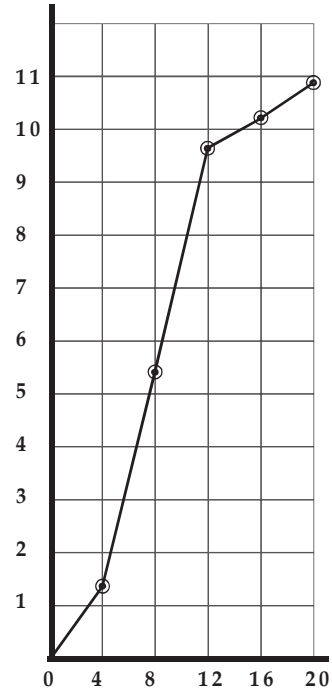
By means of a table

Sunita planted a tree. In the first four days it grew 1.4 cm. After that it grew faster, becoming more than 9 cm long in 12 days. But then its rate of growth slowed down.

In words



By means of a picture



By means of a graph

There are many ways of giving information - in words, through a picture, with the help of a table, etc. As an example, some ways of depicting the growth of a plant (the increase in its length) are shown in the illustration above. One such way is through a graph. A graph is a good way to present information in a simple and easy-to-understand manner.

We shall learn to make and read graphs in this chapter.

Exercise 1

Through a graph

Huma drew a 1 cm x 1 cm square. She then drew squares with sides 2 cm, 3 cm, 4 cm and 5 cm long.

She decided to measure the perimeter of these squares. Do you remember how you measured the perimeter in the chapter "Area"?

Huma measured the perimeter of her squares and noted the measurements in a table.

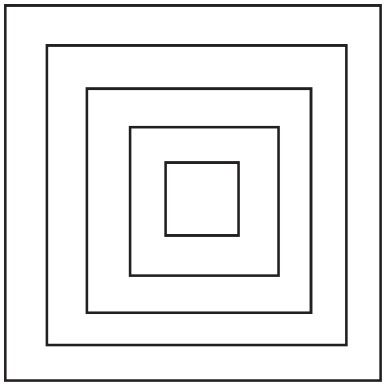


Figure 1

Table 1

No	Length of side of square (cm)	Perimeter of square (cm)
1.	1	4
2.	2	8
3.	3	12
4.	4	16
5.	5	20

On studying the figures in her table, Huma concluded that the perimeter of a square increases when the length of its side increases. But she wondered whether the perimeter increased randomly or according to some rule. She decided to find out. Using the figures in Table 1, she plotted a graph to try and understand the relationship between the length of the side of a square and its perimeter.

Let us plot the same graph. Take a graph paper from the kit copy in your workbook. The thick lines form 1 cm x 1 cm squares. The sides of these squares have been further divided into ten equal parts.

What is the length of each part? (1)

How to make a graph

1. First of all, sharpen your pencil. A blunt pencil can spoil your graph.

2. Use a scale to draw the lines of your graph. To begin with you have to make two lines - one horizontal and one vertical. Leave a gap of 1 cm from the bottom of the graph paper and draw your horizontal line. Similarly, leave a gap of 1 cm from the left edge of the graph paper and draw your vertical line. Both lines should be drawn on the thick lines of the graph paper (Figure 2). The horizontal line is called the X axis and the vertical line is the Y axis. If you remember, you drew the X and Y axis in the chapter "Learning How to Make Maps".

The point where both these lines meet is called the origin. You should always mark the origin at the lower left hand corner of your graph paper.

3. The next step is to identify the two measurements you will use to make your graph. What we wish to see is how the perimeter of a square changes when the length of its side changes.

4. You can give the length of the side of the square in centimetres on the X axis. So write "Length of side of square (cm)" below the X axis.

5. Similarly, you can show the perimeter of the square on the Y axis. So write "Perimeter of square (cm)" in the margin of the Y axis. The Y axis should be at least 20 cm long for this graph.

6. Mark the origin as 0. Mark 1 cm divisions on the X axis, beginning from the origin, and number them 1, 2, 3, 4, 5 and so on.

7. We have to show the perimeter of the square on the Y axis. Look at the perimeter figures in Table 1. The largest square has a perimeter of 20 cm. So divide the Y axis into twenty 1 cm divisions, beginning from the origin, and number them 1 to 20.

You are now ready to mark the entries in your table on your graph paper. Each square has two numbers, one for the length of its side and the other for its perimeter. The two numbers together give you a point on the graph. Since you have five squares, you will have five points on your graph. You get your graph line by joining these five points with straight lines.

Points of a graph

Table 1 shows that the square with a side of 1 cm length has a perimeter of 4 cm. How do these two numbers get you a single point on the graph?

1. Since the length of the side of the first square is 1 cm, draw a vertical line at the 1-cm mark of the X axis. This line will be parallel to the Y axis.

2. The perimeter of the square is 4 cm. So draw a horizontal line at the 4-cm mark of the Y axis. This line will be parallel to the X axis.

3. Encircle the point where these two lines intersect. This is your first graph point of your first square.

Now, mark the graph point for the second square. What are the two numbers for this square? Find them in Table 1. The table shows the length of the side of the second square is 2 cm and its perimeter is 8 cm. Now, repeat the same three steps:

1. Draw a vertical line on the X axis at the 2-cm mark, parallel to the Y axis.

2. Draw a horizontal line on the Y axis at the 8-cm mark, parallel to the X axis.

3. Encirle the point where these two lines intersect.

In the same way, draw the graph points for the three remaining squares.

Joining the points to get the graph line

You now have five points on your graph paper. What will the line joining them look like? Will it be a straight line? If you think it is a

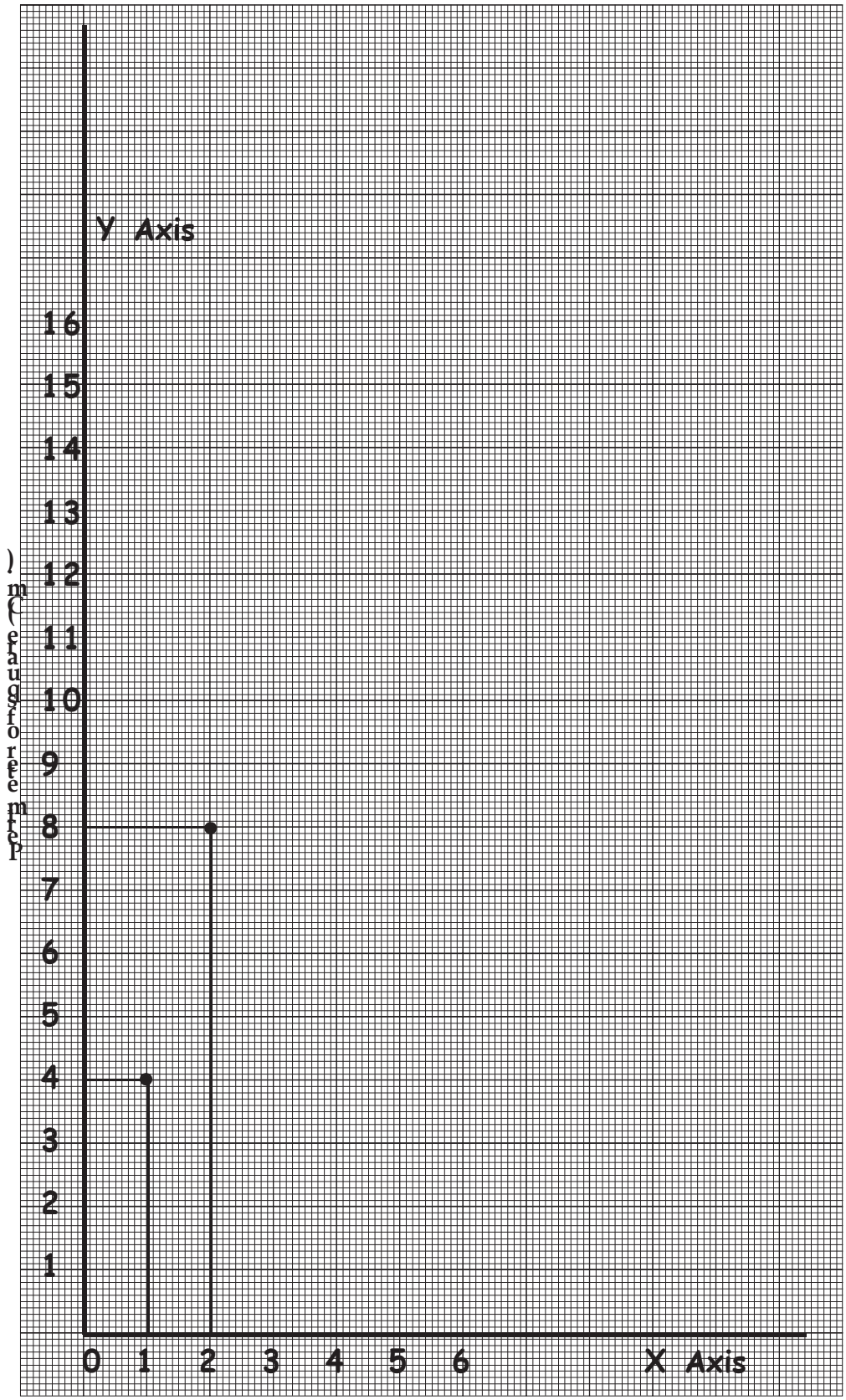

Y Axis
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0 1 2 3 4 5 6
X Axis
Length of side of square (Cm.)

Figure 2

straight line, use your ruler to join the points. But keep a few things in mind while doing so.

Place the ruler on the graph paper in such a way that as many points lie as near to it as possible. Shift or rotate the ruler to find the best position. Draw a straight line in this position. This is your graph line (Figure 3).

If your graph line is not straight, you may have made a mistake in charting the points. Try and identify your mistake and rectify it.

More information from a straight line graph

The graph of the length of the side of a square and its perimeter is always a straight line. A straight line can give you a lot of additional information. Let's see how.

You made your graph with the data of five squares. If your graph is correct and neatly drawn, it can give you information about more squares as well. This is possible because every point on the straight line carries information about other squares. Every point describes the standard relationship between the length of the side of a square and its perimeter. For example, what will the perimeter of a square be, with a 4.5-cm-long side? This figure is not given in your table but you can find out from your graph.

Which is the axis for the length of the side of a square in your graph? Draw a vertical line on the X axis at the 4.5-cm mark. Ensure that this line is parallel to the Y axis. Mark the point where this line intersects the graph line as A (Figure 3). This point A has the information that you are looking for. It will tell you the perimeter of a square with a 4.5cm-long side. Can you guess how?

Draw a vertical line parallel to the X axis from point A to the Y axis. Where does this line cut the Y axis? Take the reading of this point and find its actual value from the scale for the Y axis. This is the perimeter of the square with a 4.5-cm long side.

Extending a straight line graph

Suppose you want to find the perimeter of a square with a 6-cm long side. Can you find the answer from your graph? To do this, extend your graph line with the help of a scale.

Now find the perimeter of a square with a 6-cm long side. (2)

Extend the graph line downwards to the origin.

Does the line pass through the origin? (3)

Can the origin be a point of this graph line? (4)

What will be the length of the side of the square at the origin? (5)

What will be the perimeter of a square with a side 0 cm long? (6)

At which point on the graph paper will you show a square with a side and perimeter of 0 cm? (7)

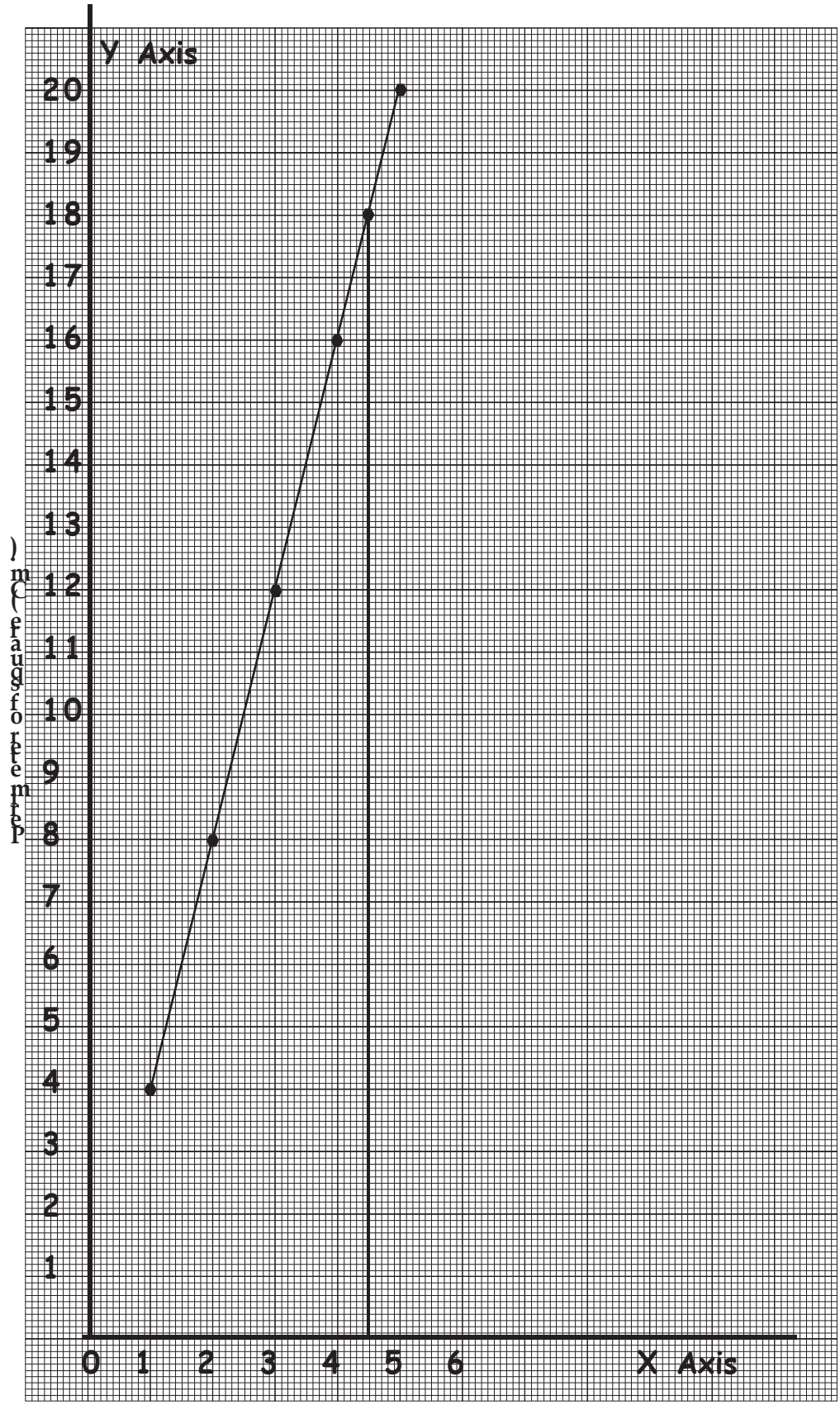

Y Axis
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0 1 2 3 4 5 6
X Axis
Length of side of square (Cm.)

Figure 3

Exercise 2

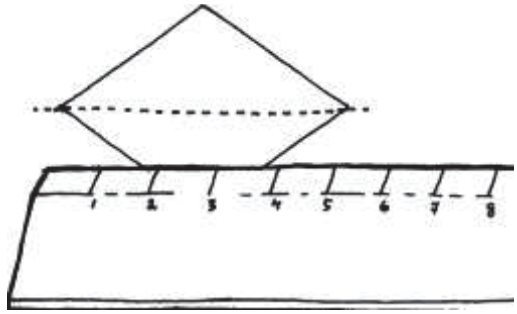
Relationship between the side of a square and its diagonal:

Make a square with a 1 cm side on the square-lined paper in your kit copy. Measure its diagonal with a scale.

In the same way, make squares with sides 2, 3, 4 and 5 cm long. Measure their diagonals and note them in Table 2. (8)

Table 2

Length of side of square (cm)	Diagonal of square (cm)
1.0	
2.0	
3.0	
4.0	
5.0	



Now draw a graph with these figures. Take care to follow all the necessary steps while drawing the graph. (9)

How to choose the axis

What will you show on the X axis? Keep in mind a simple rule to decide this.

You should show the measurement that changes, and causes a change in the other measurement, on the X axis.

In this exercise, you change the length of the side of a square to see what difference it makes to the length of its diagonal. So, you should show the length of the side on the X axis and the length of the diagonal on the Y axis.

Look at your graph and answer the following questions:

What is the length of the diagonal of a square with a 3.5-cm long side? (10)

If a square has a 6-cm long diagonal, what is the length of its side? (11)

Extend the straight line of your graph at both ends and answer the following questions:

If the side of a square is 7.5 cm long, what is the length of its diagonal? (12)

If the diagonal of a square is 1 cm long, how long is its side? (13)

Will this graph pass through the origin? (14)

Experiment 1

How much water?

Take a measuring cylinder from your kit. If you have studied

the chapter "Volume" you will know that a measuring cylinder is used to measure the volume of liquids.

In this experiment you should fill the measuring cylinder with water, pouring a little at a time and noting the volume of water and the height of the water column each time you add water. You should then plot a graph with these figures.

First, make the following table in your exercise book.

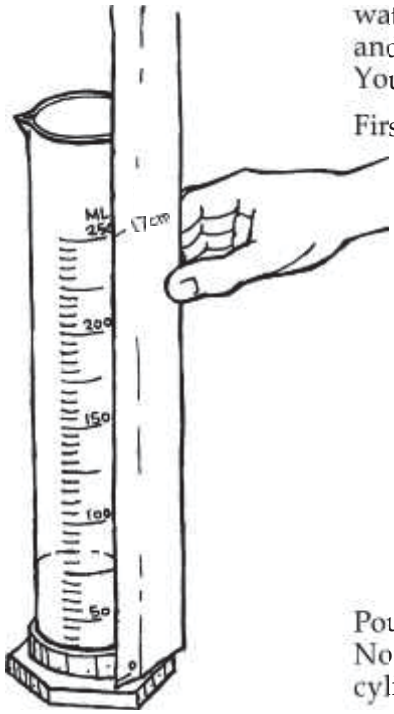


Table 3

Volume of water (ml)	Height of water column (cm)
25	
50	
75	
...	
...	
...	
250	

Pour water to the 25 ml mark in your 250 ml measuring cylinder. Note the height of the column of water from the base of the cylinder.

Keep adding 25 ml water to the cylinder and measure the height of the water column each time. Repeat this process until the measuring cylinder is filled with water.

Let's make a graph

You must now plot a graph of the volume of water and its column height from the measurements in Table 3.

What measurement will you show on the X axis and why? (15)

What measurement will you show on the Y axis and why? (16)

Choosing a scale

In the chapter "Learning to make maps" you chose a scale to show distances on the map. With the help of the scale you were able to show large fields on the map.

In this case you must choose a scale for your graph to show the volume of water on the X axis and the column height on the Y axis.

What is the length of the X axis on your graph paper?

If you take 1 ml equal to 1 cm, will you be able to show a volume of 250 ml on your X axis? (17)

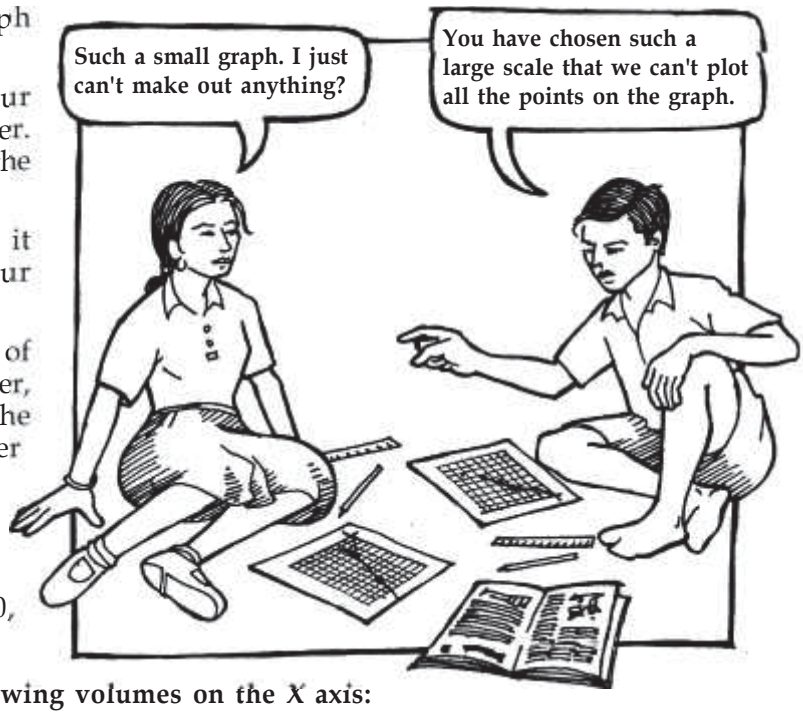
So it is important to choose a proper scale to show the volume on the X axis. Remember three things while doing so:

1. Choose a scale that will enable you to show your largest

measurement on the graph paper.

2. Choose a scale so that your graph covers the entire paper. This makes it easier to read the graph.
3. Choose a scale that makes it easier for you to do your calculations.

For example, if we take 1 cm of the X axis to equal 20 ml of water, then we can easily show all the readings for the volume of water on the X axis. The largest volume of 250 ml will fall on the 12.5 cm point of the X axis. So mark each successive cm point on the X axis 20, 40, 60, 80, 100, etc.



Where will you show the following volumes on the *X* axis: 30 ml, 50 ml, 54 ml, 86 ml? (18)

Now you need to choose the right scale for the Y axis. Keep in mind the three points given above as well as the range of your measurements while choosing a scale for the Y axis.

On the top right corner of your graph write:

Scale of graph

X axis : 1 cm = ... ml

Y axis : 1 cm = ... cm

Now plot the graph with the figures in Table 3. When you have plotted all the ten points, look at them carefully. Is it possible to make a straight line graph with these points? To find out, place a ruler along the points and adjust it to see in which position it touches the maximum number of points. Draw your graph line in this position with a pencil.

Does your graph line pass through the origin? Why? (19)

Exercise 3

You may have seen graphs in newspapers and magazines. If you learn to read these graphs you can get a lot of useful information from them. We have plotted two graphs till now. Let us now practice reading some readymade graphs.

Two graphs are given below.

Graph A (Figure 4) shows the percentage of students enrolled in middle schools in India. By percentage of students enrolled we mean the number of children between the age of 11 and 14 years that are enrolled in middle schools out of the total

population of children in that age group. For example, in 1981 the total population of children between the age of 11 to 14 years in our country was about 4,98,00,000 (Four crores ninety eight lakhs). In the same year, the number of children in this age group studying in middle schools was about 2,07,00,000 (two crores seven lakhs). So, we calculate the percentage of enrolment in this way:

$$\text{Percentage of enrolment} = \frac{\text{Total number of children studying in middle schools}}{\text{Total population of children between 11 and 14 years}} \times 100$$

$$= \frac{20700000}{49800000} \times 100 = 42\ \%$$

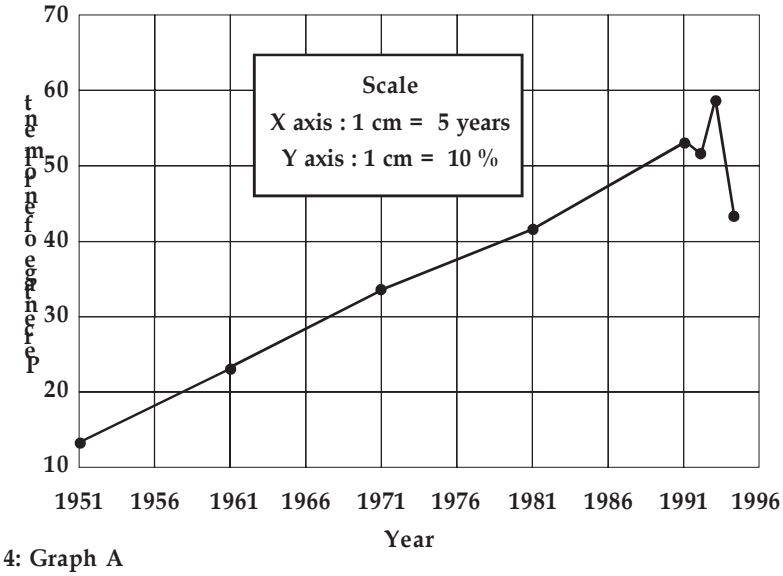


Figure 4: Graph A

What does the X axis of Graph A show? (20)

What does the Y axis show? (21)

What is the scale of the graph? (22)

From the graph, find out the enrolment percentage in 1970 and 1993. (23)

In which year was the enrolment percentage the highest? (24)

What changes have occurred in the enrolment percentage from 1950 to 1993? (25)

If the percentage of children enrolled in middle schools increases, how will it affect our country and our children? (26)

Graph B (Figure 5) shows the sex ratio in our country. This ratio tells us the number of women per thousand men. So if a country has 1,000 men and 1,020 women, the sex ratio of that country would be 1,020. If nature had its way, the number of women in any country would be slightly more than the number of men.

That means the sex ratio would be slightly over 1,000. The average sex ratio in developed countries is around 1,052. But the average sex ratio in developing countries is only about 962. The overall sex ratio of the entire world in 1992 was 990.

What does the X axis of Graph B show? (27)

What does the Y axis show? (28)

What is the scale of the graph? (29)

Use the graph to find out the sex ratios in India from 1901 to 1991. (30)

In which year was the sex ratio the highest? (31)

When was the sex ratio the lowest? (32)

What changes have taken place in the sex ratio between 1901 and 1991? (33)

Discuss the reasons for the low sex ratio in India with your teacher. (34)

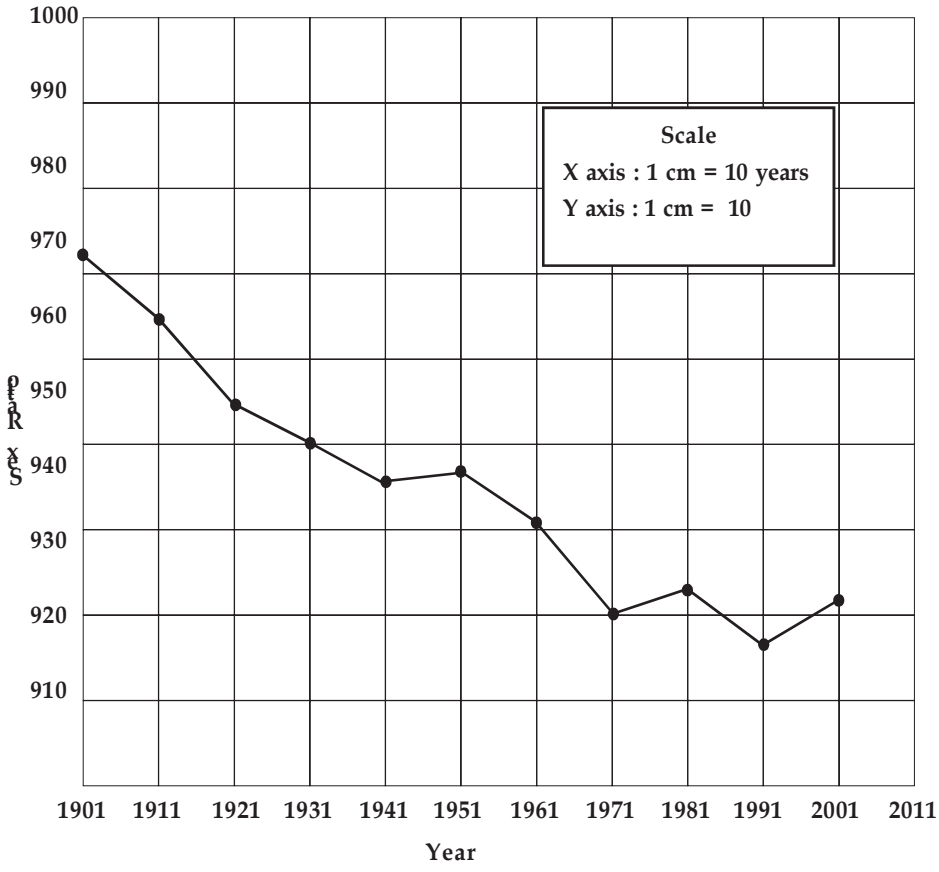


Figure 5: Graph B

Exercise 4

Suman performed an experiment with pieces of copper. She took a piece of copper with a volume of 4 cc. She weighed it and noted the weight in Table 4. Similarly, she weighed copper pieces with volumes of 8, 12, 16, 20 and 24 cc. She noted these weights too in the table.

Use the figures in this table to plot a graph of the volume and weight of copper pieces.

Table 4

No.	Volume of copper (cc)	Weight of copper (gm)
1.	4	36
2.	8	71
3.	12	108
4.	16	144
5.	20	181
6.	24	216

While choosing your scale ensure that the largest figure can be shown on the graph paper and that your graph covers the entire paper. Also, you should find it easy to make your calculations.

Is your graph in the form of a straight line?

Does your graph line pass through the origin? Why? (35)

Study your graph and answer the following questions:

What is the weight of a piece of copper with a volume of 3 cc? (36)

When put in water, a copper piece displaces 17 cc of water. What is its weight? (37)

A copper cube weighs 100 gm. What is its volume? (38)

A copper bangle weighs 60 gm. If it is immersed in water, how much water will it displace? (39)

Exercise 5

Gopal's school played a limited overs cricket match against the neighbouring village school. Gopal's team scored 36 runs in its quota of 10 overs. Table 5 shows the score of Gopal's team at the end of each over. On the basis of this table, plot a graph of his team's score.

Table 5

Overs	Score
1	3
2	6
3	9
4	12
5	16
6	20
7	24
8	28
9	32
10	36

The graph will not be in the form of a straight line. It will be a combination of two straight lines.

How many runs were made in each of the first three overs? (40)

How many runs were made in each of the last three overs? (41)

After which over of the match did the run rate per over pick up? (42)

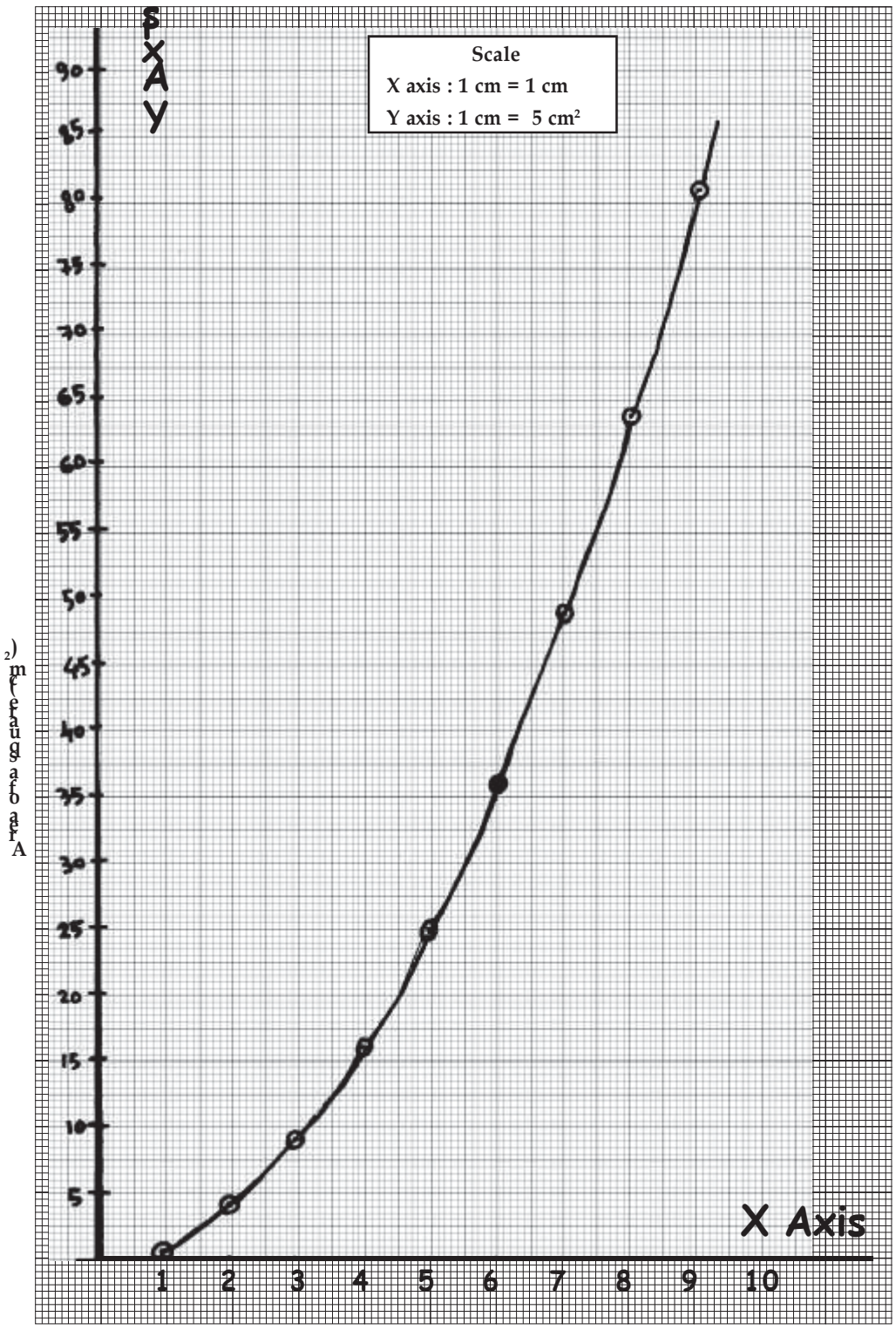
Does your graph line pass through the origin? Why? (43)

Exercise 6

Figure 6 shows a graph of the length of the side of a square and its area. A total of 10 squares were taken and their sides were 1, 2, 3, ... 10 cm long respectively.

What kind of a graph line is this? (44)

Why does the graph line pass through the origin? (45)
What will be the area of a square with a 3.5-cm long side? (46)
What will be the area of a square with an 8.7-cm long side? (47)



What will be the length of the side of a square whose area is 20 sq cm? (48)

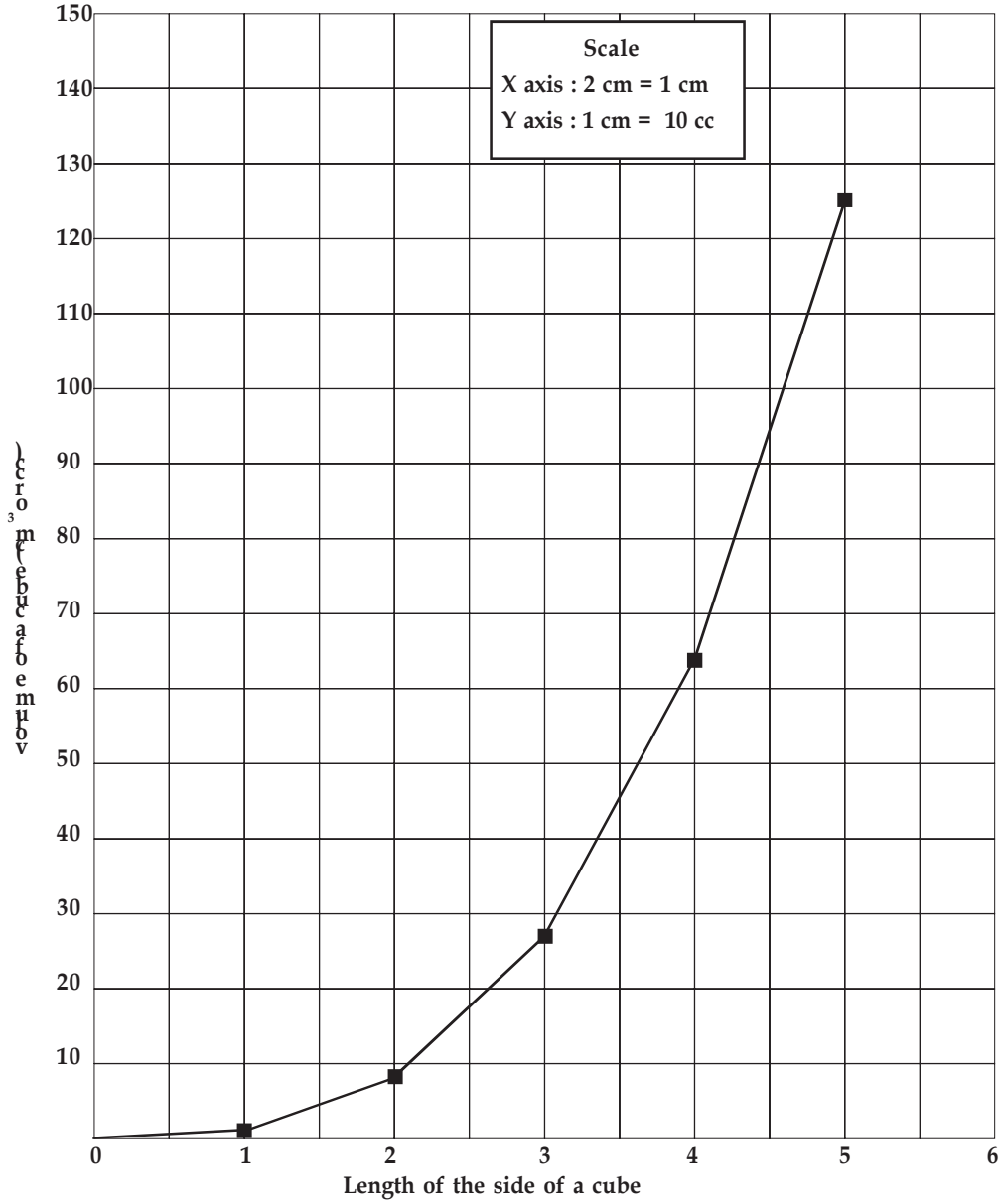
What will be the length of the side of a square whose area is 70 sq cm? (49)

How will you use this graph to find out the square root of numbers? Find out the square root of 55. (50)

Questions for revision

1. Rajesh plotted a graph to show the relationship between the length of the side of a cube and its volume. The graph is given below. Answer the following questions on the basis of this graph:

a) What measurement has Rajesh plotted on which axis?



b) What is the scale of his graph?

c) What is the volume of a cube with a side 2 cm long?

d) What will be the approximate length of the side of a cube with a volume of 100 cc?

e) What will be the volume of a cube with a 2.5-cm long side?

f) Can you extend this graph line like you did in Exercise 1 and find out the volumes of cubes with 6-cm and 7- cm long sides? Give reasons for your answer.

g) Can you express the relationship between the length of the side of a cube and its volume in the form of a formula?

2. On the basis of the figures given in the table below, plot a graph to show the relationship between the diameter of a circle and its circumference.

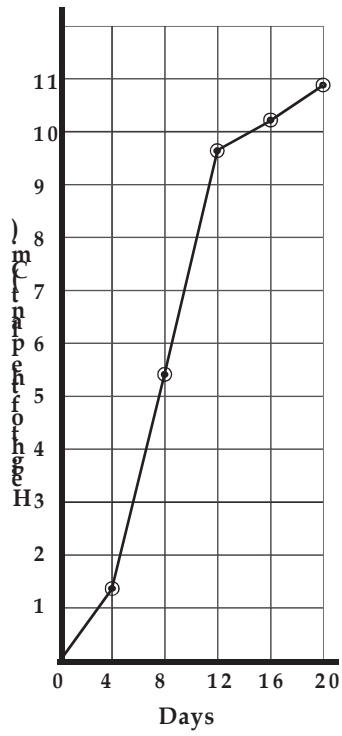
Diameter of circle (cm)	Circumference of circle (cm)
1.0	3.2
2.0	6.3
3.0	9.4
4.0	12.6
5.0	15.7

3. This graph shows the growth of a plant over a period of time.

a) What is the scale of the graph?

b) What is the height of the plant on the 8th and 12th day?

c) On the basis of this graph, describe the growth of the plant in four or five sentences.



MAKING FRIENDS WITH BIRDS

You see birds everywhere. But have you ever observed them carefully?

Watching birds, identifying them and observing their behaviour is a very interesting experience. There are many things you can observe about birds - their shape and colour, the way they look, their habits, the food they eat, etc. For many people, bird watching is a hobby.

You can maintain a diary or a notebook of your bird watching. It would be a good idea to assign a new page for each bird. You could record all the information you have or gather about that bird on this page.

Write the name of the bird at the top of the page. If possible, find a picture of the bird and paste it on the page and list all the information you have collected. If you can't find a picture, try and draw one.

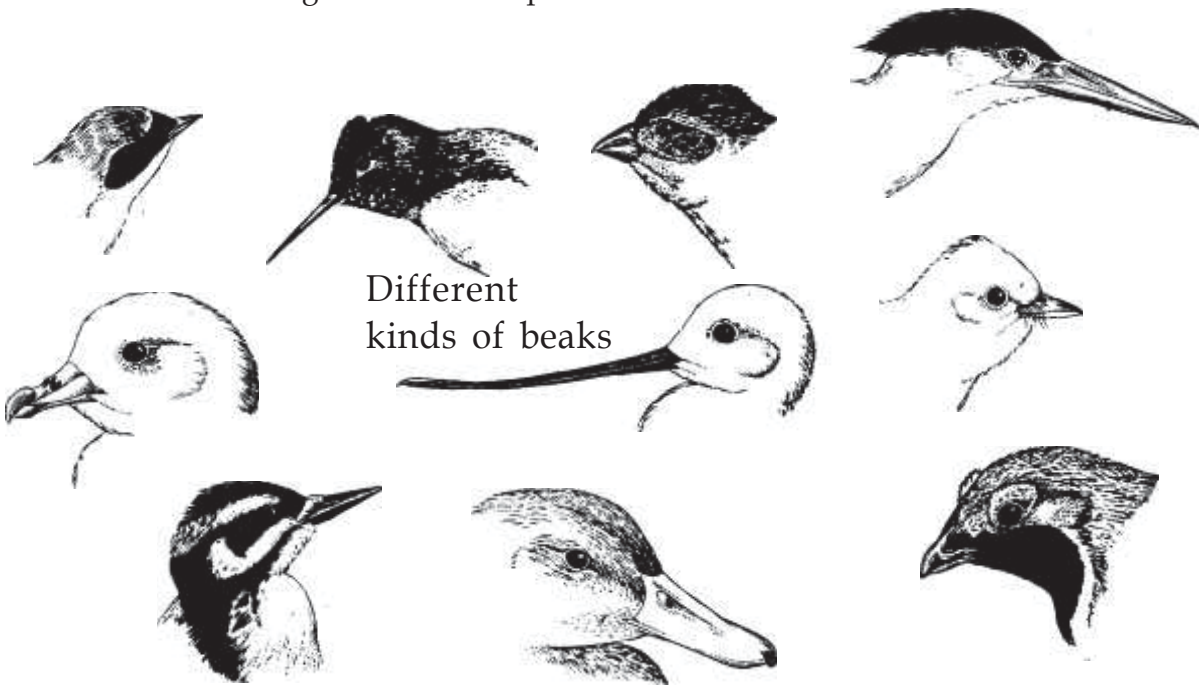
Here are some more suggestions to help you in observing birds:

Length: What is the approximate length of the bird? You can use the length of a familiar bird, like a sparrow or a crow, to judge the length of the bird.

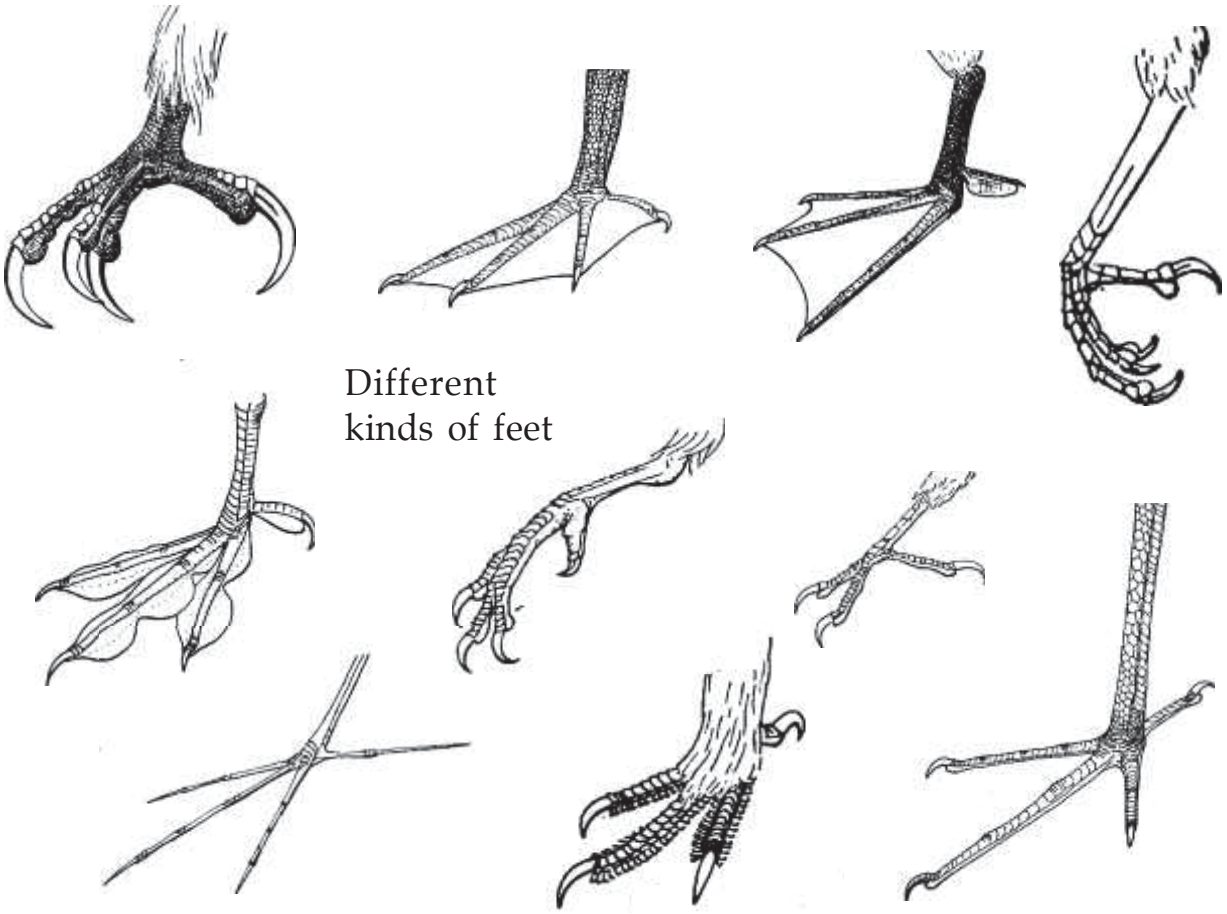
Colour: Is the entire body of the bird of the same colour? Is the chest plain coloured, or does it have smudges, or is it spotted? Is the tail spotted? Are the wings evenly coloured or do they, too, have spots?

Eyes: What is the colour of the eyes? Are the eyes fully encircled by a line? Or is there a line only above the eyes?

Beak: Is the beak long or short? Is it pointed or hooked?



Different kinds of beaks



Different
kinds of feet

Legs: Are the legs long or short? What is the shape of the claws? How does the bird sit or walk?

Tail: What is the length of the tail? Is the edge of the tail pointed, rounded or square? Does the bird keep wagging its tail? Does it hold its tail high or is it kept low?

Wings: Are the wings' tips rounded or pointed? You will have to look at the bird in flight to observe this. If possible, draw a picture of the wings spread out.

Voice: Listen carefully to the voice of the bird. You can recognise birds faster by their calls. You could also try to imitate the bird's call.

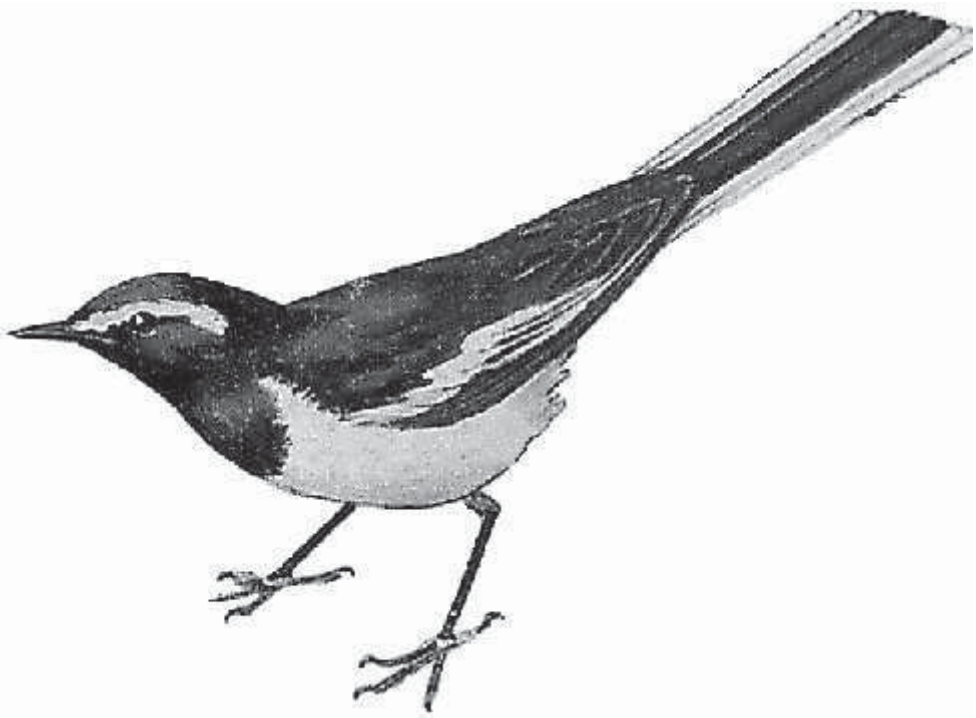
Habitat: Where is the bird usually sighted – in the field, near water, on a tree, in the bushes or on electric wires? Does the bird perch on some special trees?

Food: What does the bird eat – insects, grain, meat or fruit?

Season: In which season do you usually sight the bird?

A description of the khanjan is provided on the next page as an example. It should enable you to understand what to observe and how to record your observations in your diary.

KHANJAN



Length: About 21cm (a little bigger than a sparrow).

Colour: The back and head are black in the male and gray in the female. The stomach is white. The tail has a white stripe down the centre and along the edges. There is also a white stripe above the eye, like an eyebrow.

Tail: Long, thin and rectangular.

Beak: Small, thin and pointed.

Voice: Its call is "tzeet-tzeet" in a thin voice. Calls in a variety of sweet whistles. During the mating period the male sings melodious songs.

Food: Insects.

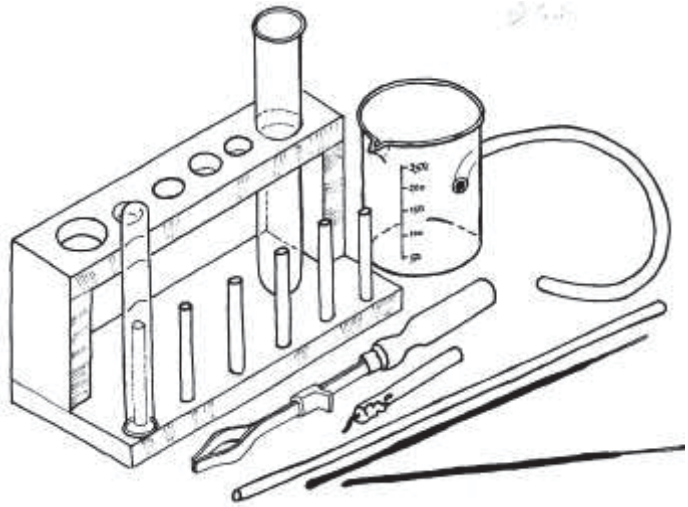
Habitat: Mainly on the ground. Usually spotted near a river or pond or in fields flooded with water.

Other information: Usually seen in pairs. Can also be spotted in small groups while feeding. Wags its tail up and down while chirping. Sits next to the water, constantly wagging its tail while feeding.

The male and female can be differentiated on the basis of their colour.

GASES

Chapter 13



You have done a number of experiments with air. You learned that air occupies space in the same way that solids and liquids do. And like liquids, gases also do not have a stable or definite shape. They take the shape of the container in which they are kept. You also learned another important difference between air and liquids - the volume of air can be reduced by compressing it.

All substances like air that do not have a definite shape or volume are called gases.

Let us prepare some gases and study their properties. Before we begin our experiments the teacher will prepare lime water and pink phenolphthalein indicator solution for the whole class.

Preparation of lime water

Fill a beaker halfway with water. Add about 5 gm of the lime that we apply to betel leaves. Stir the beaker well and let it stand overnight. Filter this **solution** the following day (Figure 1). Use this filtrate in all the experiments you perform. This solution should be transparent.

Figure 1

Pink phenolphthalein indicator solution

Fill a beaker halfway with water and add ten drops of phenolphthalein solution. Add a few drops of lime water. Do you observe any change in colour?

If the solution is light pink in colour, use it for the experiment. If the colour is dark pink, add some water to make it light pink before using it. Phenolphthalein solution is an **indicator**, like litmus paper.

You have already seen that there are two types of phenolphthalein indicator solutions: a pink solution and a

colourless solution. If the pink solution becomes colourless when it is added to a substance, it indicates that the substance is acidic in nature. If the colourless solution turns pink when added to a substance, it indicates that the substance is alkaline in nature. Neutral substances do not affect either the pink or the colourless phenolphthalein solution.

Experiment 1

Carbon dioxide

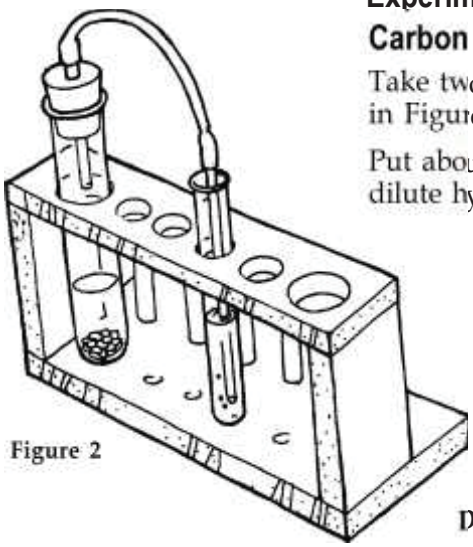


Figure 2

Take two glass tubes and join them with a rubber tube as shown in Figure 2.

Put about 5 gm of marble chips into a boiling tube. Pour enough dilute hydrochloric acid into the boiling tube to cover the marble chips. Fix one glass tube in a one-holed rubber cork and fit it tightly in the mouth of the boiling tube. Ensure that the lower end of the glass tube dips into the boiling tube without touching the hydrochloric acid.

Fill a test tube halfway with a lime water solution. Dip the second glass tube into this solution in the test tube.

Do the marble chips react with the hydrochloric acid? (1)

Look at the solution in the test tube. Has a gas formed in the boiling tube? Give reasons for your answer. (2)

Does the lime water undergo a change? (3)

Which observation suggests that a new substance was formed in the boiling tube? (4)

Test the properties of the gas by doing the following experiment.

Experiment 2

Fill one fourth of a test tube with pink phenolphthalein solution.

Pass the gas through the phenolphthalein solution like you did in Experiment 1.

What effect did the gas have on the phenolphthalein solution? On the basis of your observation, can you tell whether the gas is acidic, basic or neutral? (5)

Experiment 3

Collect the gas in a test tube using the method shown in Figure 3.

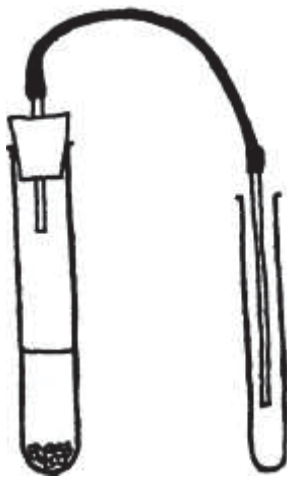


Figure 3

What is the colour of this gas? (6)

How does it smell? (7)

Now put strips of wet blue and red litmus paper into the test tube, one by one.

Which of the two litmus papers changed colour? What was the

change? Can you tell the nature of the gas on the basis of your observation? (8)

Return the litmus papers to your teacher. You can use them again.

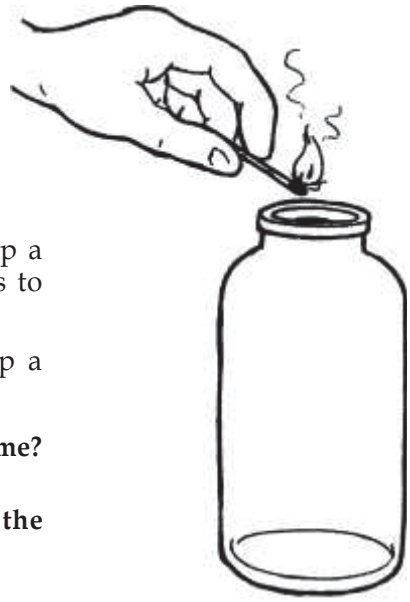


Figure 4

Experiment 4

Take an empty glucose bottle or any other glass bottle. Drop a burning matchstick into the bottle and note the time it takes to extinguish (Figure 4).

Fill the bottle with gas as you did in Experiment 3. Drop a burning matchstick into the bottle.

How much time did the matchstick take to extinguish this time? (9)

What did you learn about the nature of the gas formed by the reaction between marble chips and hydrochloric acid? (10)

How can this property be used in our daily life? (11)

Experiment 5

Put a wet blue litmus paper in a boiling tube.

Did the colour of the litmus paper change? (12)

Fill the bottle with gas as you did in Experiment 4. Pour the gas into the boiling tube in the same way you pour water. While pouring the gas, take care not to invert the bottle over the boiling tube. Hold it at a slight tilt so that the air inside the boiling tube can escape as the gas from the bottle flows into the boiling tube (Figure 5).

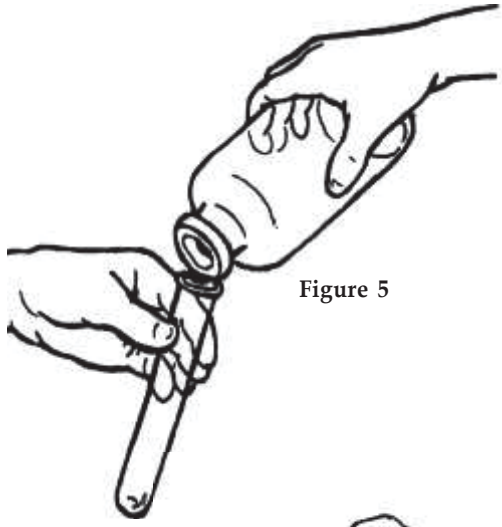


Figure 5

Remove the bottle after some time and put a wet blue litmus paper in the boiling tube.

Did the colour of the litmus paper change? (13)

On the basis of your answers to Questions 12 and 13 can you conclude that the gas from the bottle flowed into the boiling tube? (14)

On the basis of this experiment can you tell which is heavier - the air or the gas? (15)

You learned about several properties of this gas in these experiments. Make a list of these properties. (16)

The name of this gas is **carbon dioxide**.

Do this before you start the next experiment

Fill a test tube to the brim with water, close its mouth with your thumb and invert it. Place the inverted test tube in a container of water and remove your thumb. The water in the test tube should not flow out when you remove your thumb (Figure 6a and b).

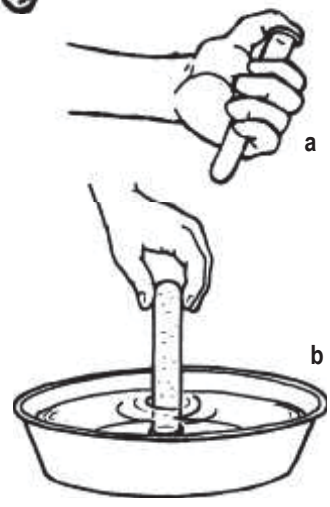


Figure 6

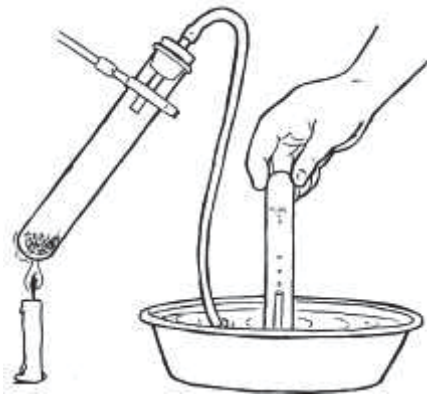


Figure 6c

Experiment 6

Oxygen

Put about 2 gm to 3 gm of potassium permanganate in a boiling tube. Set up the apparatus as shown in Figure 6c and heat the boiling tube. Use a test tube holder to hold the boiling tube over the flame.

What happened to the chemicals in the boiling tube? (17)

Did a gas collect in the test tube containing water? How can you tell that a gas has collected there? (18)

What is the colour of the gas? (19)

Keep the test tube containing the gas aside. We won't do any experiments with this gas because it contains some air.

Fill another boiling tube with this gas. Close its mouth with a cork and place it on a stand.

How does the gas smell? (20)

Figure 7

Experiment 7

Light an incense stick. Dip the smouldering end in the boiling tube (Figure 7)

What happened? Which property of the gas did you learn from your observation? (21)

Take another boiling tube filled with the gas. Light a matchstick and drop it in. Let it burn completely. Keep dropping lighted matchsticks until you no longer observe the effect of the gas on the flame. Now drop a final lighted matchstick into the boiling tube.

What happened? (22)

What happened to the gas in the boiling tube that helped the matchsticks to burn? Where did it go? (23)

Does this experiment show that the gas in the boiling tube is consumed by the burning matchsticks? (24)

Now recall what you did in Experiment 4. Can you say which gas was formed by the burning matchsticks that now extinguishes them? (23)

Experiment 8

Fill another boiling tube with this gas as you did in Experiment 7. Test the gas with wet blue and red litmus papers. Close the mouth of the boiling tube with a cork and place it on the stand.

Which of the two litmus papers was affected by the gas? (26)

Experiment 9

Pass this gas through lime water and pink phenolphthalein indicator solution, like you did in Experiments 1 and 2.

What happened to the lime water? (27)

What happened to the colour of the pink indicator solution? (28)

On the basis of your answers to Questions 26 and 28, assess whether the gas is acidic, basic or neutral. (29)

This gas is called **oxygen**.

Comparing carbon dioxide and oxygen

You produced two gases in this lesson. Compare the two gases by filling the following table.

Table 1

S. No	Property	Carbon dioxide	Oxygen
1	Colour		
2	Smell		
3	Effect on blue litmus		
4	Effect on red litmus		
5	Effect on burning matchstick		
6	Effect on smoldering incense stick		
7	Effect on lime water		
8	Effect on pink indicator solution		

Experiment 10

The science of burning : carbon dioxide and oxygen

Place two small candles on a table or the floor and light them. Cover one candle with a beaker or glass tumbler (Figure 8).

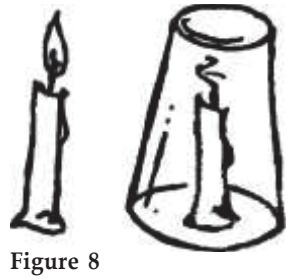


Figure 8

Can you now guess why the covered candle was extinguished? (31)

Take four containers of different sizes. For example, you can take a 250 ml conical flask, 500 ml glucose bottle, a one-litre plastic bottle and a two-litre plastic bottle.

Cover the burning candle one by one with these containers and find out how long it takes for the candle to extinguish in each case.

Record your observations in Table 2

Table 2

S.No	Volume of the container (ml)	Time taken for candle to extinguish (second)

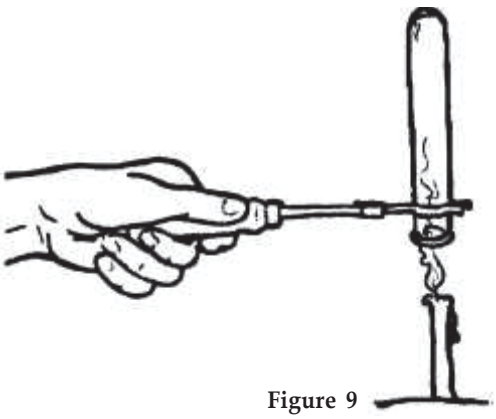


Figure 9

Experiment 11

Invert a boiling tube over the flame of a candle with the help of a test tube holder. The flame should not touch the sides of the boiling tube (Figure 9). After some time, remove the boiling tube and add some lime water to it, shaking it well.

What happened to the lime water? (33)

Which gas collected in the boiling tube? (34)

From where did this gas come? (35)

You performed a number of experiments on burning different substances in air, oxygen and carbon dioxide.

Fill in the blanks on the basis of what you have learnt.

1) ..... gas helps a lighted matchstick to burn brighter.

2) ..... gas is consumed when a matchstick burns.

3) Without ..... gas a matchstick cannot burn.

4) From Experiment 11 we can conclude that the gas formed when we burn various things is .....

5) ..... gas extinguishes burning objects.

6) Things burn in air. That means air contains ..... gas.

7) When a substance burns in air ..... gas is consumed and .....gas is formed. (36)

Write in your own words what changes take place in air when any substance burns. (37)

Exercises for revision

1. A gas turns blue litmus red. Is it acidic or basic? How will it effect pink phenolphthalein indicator solution?

2. A candle burns in a large room in which a bulb is lit. Suppose we remove all the air from the room. What effect will this have on the bulb and the candle? Give reasons for your answer.

3. A fire extinguisher does not contain water. Rather, a gas comes out of it that puts out the fire. On the basis of what you have learnt in this chapter, can you say which gas this is?

4. What would happen if there is no oxygen in the air?

5. You learned about two gases in this chapter. Do you know about any other gases? List them and their properties.

New words

Oxygen Carbon dioxide Indicator Solution

RESPIRATION

Chapter 14

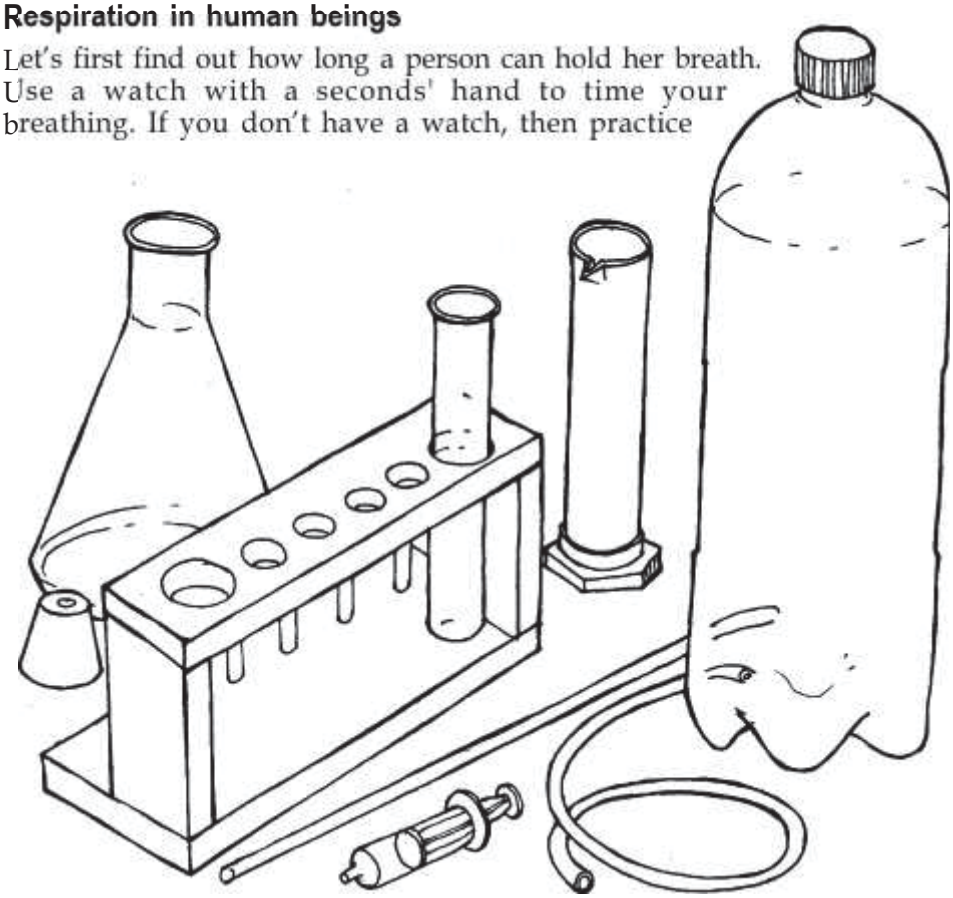
We can survive without food for several weeks. You may have heard about people going on a fast or hunger strike to protest against injustice. They survive for many days without eating anything. But they drink some water or other liquids every day. We can survive for a few days if we get a little water, but we feel suffocated if we don't get air even for a short while.

In this chapter we shall see what happens when human beings respire. What difference is there between the air we breathe in and the air we breathe out? Do plants also respire? We shall perform some experiments to find out.

Experiment 1

Respiration in human beings

Let's first find out how long a person can hold her breath. Use a watch with a seconds' hand to time your breathing. If you don't have a watch, then practice



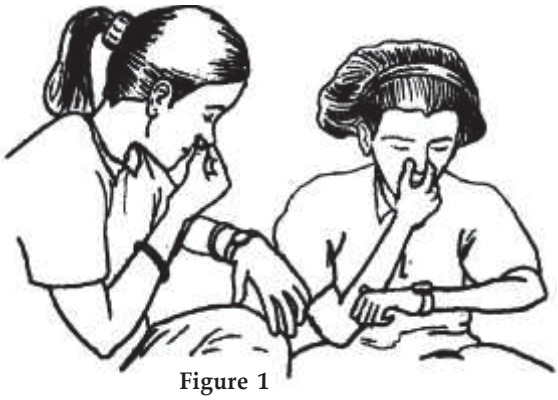


Figure 1

counting at a uniform rate. You can measure the time by counting. Close your mouth and nose with your fingers so that air cannot pass through them.

How long could you close your mouth and nose? (1)

What did you feel when you kept your mouth and nose shut for so long? (2)

Experiment 2

How many breaths in a minute?

Hold a finger under the nose of one of your friends. The side with the fingernail should face the nostrils. Ask your friend to breathe in and out normally.

What did you feel on your finger when your friend exhaled? (3)

Figure 2

Use this method to find out how many times your friend inhales and exhales in a minute. (4)

Did your friend inhale as many times as she exhaled in a minute? (5)

The process of breathing in air is called **inspiration** and breathing out air is called **expiration**. The number of times we breathe in and breathe out in a minute is called the **expiration rate**.

Exercise and breathing

You may have noticed that we pant after running or exercising. Do you think exercise and running affect the rate at which we breathe in and out?

In your opinion does the expiration rate increase or decrease after exercising? (6)

Figure 3

The air we breathe in fills our lungs that are located in our chest. In the following experiment we shall see what happens to our chest when we inhale or exhale air.

Experiment 3

Take a length of twine or a measuring tape. Wrap it around the chest of one of your friends and measure the width of his chest. Hold the tape lightly and ask your friend to breathe in and out deeply a few times.

How does the width of the chest change when air is inhaled or exhaled? (7)

Experiment 4

How much air is there in your breath?

Use a two-litre plastic bottle to make a measuring cylinder. To do this, pour 100 ml of water at a time, in

the bottle and mark the water level after each addition.

Now fill water in the bottle to the brim and invert it in a bucket of water. Remember, the bottle should contain no air bubbles after you invert it. Insert one end of a rubber tube into the mouth of the bottle under water. Hold the other end of the tube in your hand. Inhale as much air as you can and blow the air into the measuring cylinder through the rubber tube. Blow out as much air as you can in a single breath. This air will collect in the measuring cylinder. As a result, the water level in the cylinder will fall.

Figure 4

How much air were you able to exhale in a single breath? (8)

Find the amount of air the others in your group breathe out in a single breath and compare these amounts.

Was the amount of air the same for all your friends? (9)

Figure 5

Experiment 5

Is there a difference between inhaled and exhaled air?

Exhale air through your nose on the back of your index finger.

Is this air warm? (10)

Now use a syringe to pump some air on your finger.

Is the air from the syringe also warm? (11)

Experiment 6

On cold winter mornings you may have noticed that the air you breathe out is misty.

Why does this happen?

We shall do an experiment to find out.

Take a mirror. Wipe it clean with a cloth. Blow air from your mouth onto the surface of the mirror.

Examine the mirror surface carefully. What did you see? (12)

Clean the mirror again and blow air onto it with a syringe.

Did you see the same effect on the mirror this time? (13)

On the basis of this experiment would it be correct to say that exhaled air is more moist than air from a syringe? (14)

Why did we use a syringe in Experiments 5 and 6? (15)

You must have understood from these experiments that there are differences in the air we breathe out and the air from a syringe.

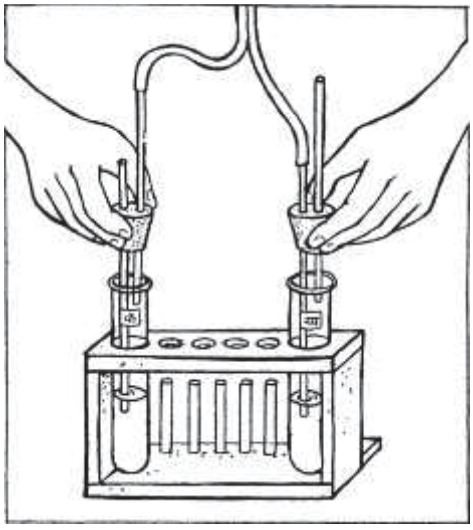


Figure 6

What does your breath contain?

Let's now do an experiment to find out the effect of inhaled and exhaled air on pink phenolphthalein indicator solution and lime water.

Prepare pink phenolphthalein indicator solution and lime water in the same way you did when studying "gases".

Experiment 7

Set up the apparatus shown in Figure 6 for this experiment. Be careful while inserting the glass tube in the cork. It can break. So take the help of your teacher in doing this.

Fill one-fourth of both boiling tubes with pink phenolphthalein solution. Mark them A and B. Now repeatedly blow in and suck out air from this apparatus as shown in Figure 7.

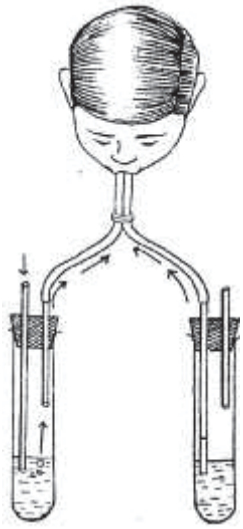


Figure 7

Find the answers to the following questions while doing the experiment:

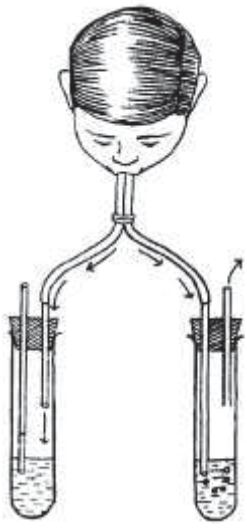
1. **When you suck in air, through which boiling tube does the outside air flow in? How can you find out?**
2. **When you blow air out, through which boiling tube does the air flow outside? Do you know why the air does not go out through the other boiling tube as well?**
3. **In which boiling tube did the colour of the indicator solution change?**
4. **Is the inhaled air similar to the exhaled air? If not, what are the differences? (16)**

Wash and clean the two boiling tubes, and fill one-fourth of both with lime water.

Repeat the experiment of blowing in and sucking out air.

Answer the following questions on the basis of this experiment:

1. **What was the colour of lime water in boiling tubes A and B before you began the experiment?**
2. **In which boiling tube did the lime water turn milky after you blew in and sucked out air?**
3. **What difference did you find between the inhaled and exhaled air in this experiment? (17)**



You studied the properties of oxygen and carbon dioxide in the chapter "Gases".

On the basis of what you learned can you say which gas is present in exhaled air? (18)

Can you explain how and from where this gas came, in the exhaled air? (19)

The air we breathe in does not contain only oxygen. It is a mixture of many gases. Similarly, the air we breathe out is not only carbon dioxide, but a mixture of several gases. The quantity of gases in every 1,000 ml of inspired and expired air is as follows:

S.No.	Gases	Inhaled air (ml)	Exhaled air (ml)
1	Oxygen	210	165
2	Carbon dioxide	0.4	40
3	Nitrogen and other gases	790	795

Can you state the difference between inhaled and exhaled air on the basis of Experiments 5, 6, 7 and this table? (20)

Experiment 8

Respiration in plants

Do plants respire in the way humans do? Let's do an experiment to find out.

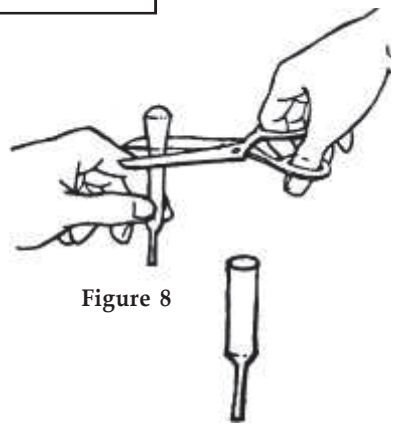


Figure 8

Take a conical flask. Fit a two-holed rubber cork tightly into its mouth and insert glass tubes into the two holes. Fit a rubber tube on one of the glass tubes and a funnel on the other. If the funnel does not sit tightly on the glass tube, make a funnel with an ink dropper. A simple way to do this is shown in Figure 8. Fill about one-fourth of a test tube with lime water and dip the rubber tube into it.

Now add water to the funnel drop by drop (Figure 9). Keep adding water till the conical flask is filled one-fourth with water. Observe the test tube carefully while you add water.

Figure 9

Did the lime water change colour? (21)

Now remove the water from the conical flask and put some flowers and buds in it. Fit a cork on the flask and let it stand for half an hour.

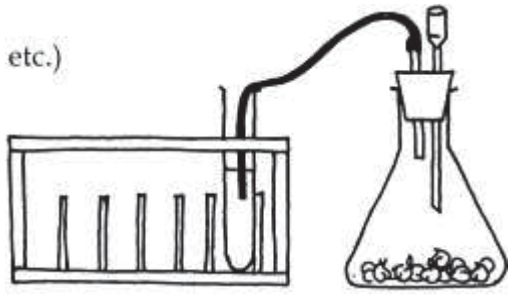
Now add water drop by drop to the conical flask through the funnel as you did in the previous experiment. Examine the test tube carefully while doing so.

Did the lime water change colour this time? (22)

Experiment 9

Respiration in sprouted seeds

Repeat Experiment 8, using sprouted seeds (*moong*, gram, etc.) instead of flowers and buds.



How was the lime water affected when sprouted seeds were used in the experiment? (23)

On the basis of your observations, can you say that flowers, buds and sprouted seeds respire? Give reasons for your answer (24)

Plants respire like us. But it is difficult to observe their respiration through experiments. Both plants and animals use oxygen during respiration.

You may have heard of big hospitals keeping cylinders filled with oxygen. When a person has breathing problems s(he) is given oxygen. An oxygen mask is fitted over her/his nose and mouth and connected to the oxygen cylinder with a rubber tube. Sometimes a patient is given oxygen during an operation.

A brain teaser

Scientists knew there is no oxygen on the surface of the moon even before man landed there.

Do you think the first person who landed on the moon could have found living beings like us on its surface? Give reasons for your answer. (25)

How do people who go to the moon survive without oxygen? (26)

ARTIFICIAL RESPIRATION

If a person cannot breathe (s)he needs first aid immediately. This is what you should do:

1. If something is stuck in the mouth or throat of the person, remove it immediately. If the throat is choked with phlegm, try to clear it immediately. Straighten the tongue and pull it to the front of the mouth.
2. Make the person lie on a couch/bed with her/his head hanging over the edge. Open the mouth by pulling down the jaw.
3. Close the person's nose with your fingers. Open her/his mouth fully and blow in air through your mouth. You should blow in enough air to fill her/his chest so that it expands. Then pause while the air comes out of the person's lungs. Repeat the process at least 15 times per minute. In the case of newborn babies you require a lesser amount of air but it should be blown at a faster rate of at least twenty five times a minute. The patient should be given mouth-to-mouth artificial respiration in this manner until (s)he starts breathing on her/his own.

Questions for revision

1. In this chapter you did experiments on respiration in flowers, seeds etc. Can you suggest an experiment to study respiration in an entire plant?

2. In Experiment 8 why was the experiment first done with an empty flask?

3. Can you identify any similarities between respiration and burning on the basis of what you learned in this chapter?

New words

Inspiration	Living beings	Expiration
Expiration rate	Artificial respiration	

LIGHT

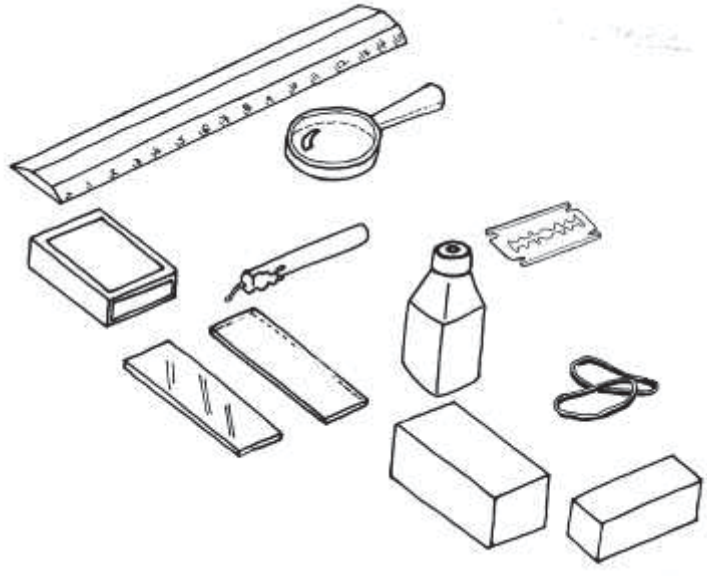
Chapter 15

We cannot see in the dark. Darkness means the absence of light. When we enter a room and say the room is dark, it means there is no light reaching our eyes from any object in the room. So we cannot see any of these objects.

We see an object only when light from it reaches our eyes. This can happen in two ways. First, the light reaches our eyes after striking the object. For example, during the day, sunlight strikes objects around us and then falls on our eyes. So we see those objects. Or else the object is itself a source of light, in other words it produces light. This light reaches our eyes and we see the object. Some examples of such objects are a burning candle, a glowing electric bulb, etc.

You may have heard that cats and owls can see in the dark. Yes, cats and other animals that hunt at night can see better than us in dim light. But even a cat cannot see in total darkness.

In this chapter, we shall try to understand many things about light. For example, what is the path of a ray of light? What happens when light rays fall on a mirror or a lens? How do our eyes see things? How are microscopes and telescopes made? And so on.



Shadows

If light does not fall on a surface, there is darkness. A shadow forms when an object prevents light from reaching a surface. If you spread your hands in sunlight, they cast a shadow on the ground.

In Class 6, you learned to make animal shapes by casting shadows with your hands in different ways. Rotate your hands to see whether the shape of their shadow changes.

We said earlier that we see an object only when light from it reaches our eyes. Is that why we can't see an object situated on the other side of a wall? But the question then is, why doesn't the light from this object reach our eyes? Is it because the rays of light travel only in a straight line? Let us find out by performing an experiment.

Experiment 1

The path of light

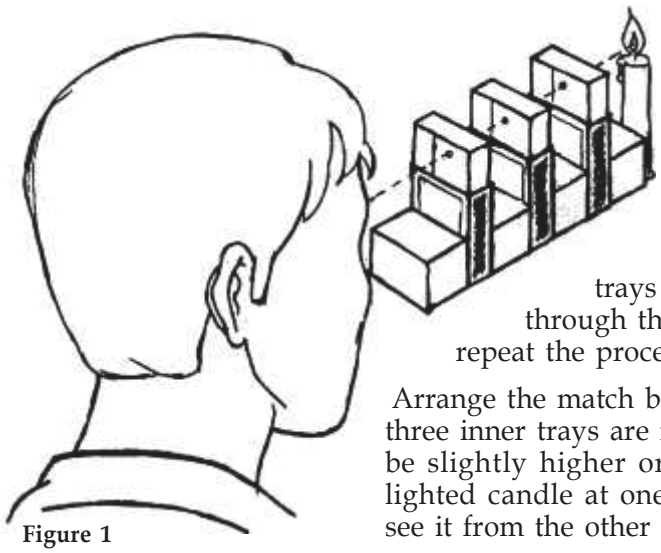


Figure 1

In this experiment, you will have to arrange empty match boxes and wooden blocks in the way shown in Figure 1.

Before you do this, you must first make a hole in the inner tray of each match box in such a way that all three holes are in the same spot in the three inner trays. To do this, hold the first and second match boxes back to back, slide the inner trays out of their covers and pierce a small hole through them with the help of a pin (Figure 2). Now repeat the process with the second and third match boxes.

Arrange the match boxes as shown in Figure 1. Ensure that the three inner trays are not at the same height. Their levels should be slightly higher or lower in relation to each other. Place a lighted candle at one end of the three match boxes and try to see it from the other end. Is the flame of the candle visible?

Now adjust the three inner trays to exactly the same height. To ensure that the three holes are in a straight line, pass a long needle through them. Now look at the burning candle at the other end through these holes. Is it visible?

What does this experiment tell you about the path of light? (1)

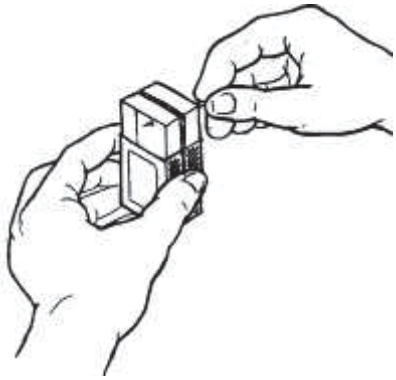
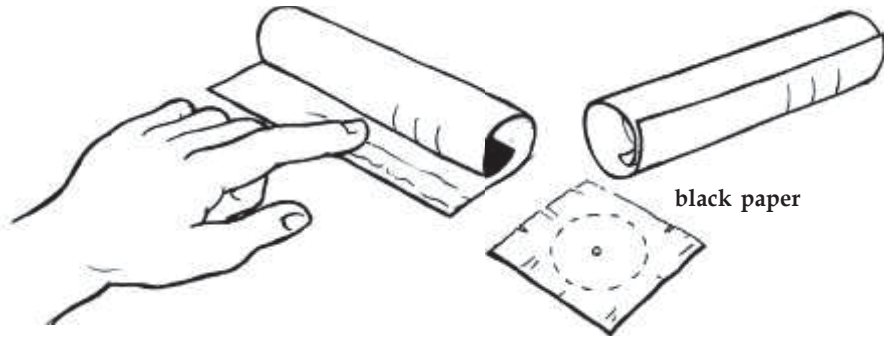


Figure 2

Experiment 2

Make your own pinhole camera:

Take two used postcards and roll them into tubes as shown in Figure 3. One tube should be slightly narrower than the other so that it fits easily into it. It would be better to use fevicol instead of gum to paste the edges of the postcards while making the tubes. Cover one of the open ends of the wider tube by pasting a piece of black paper over it, as shown in the figure. You could



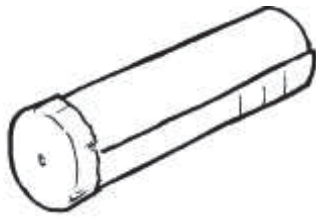
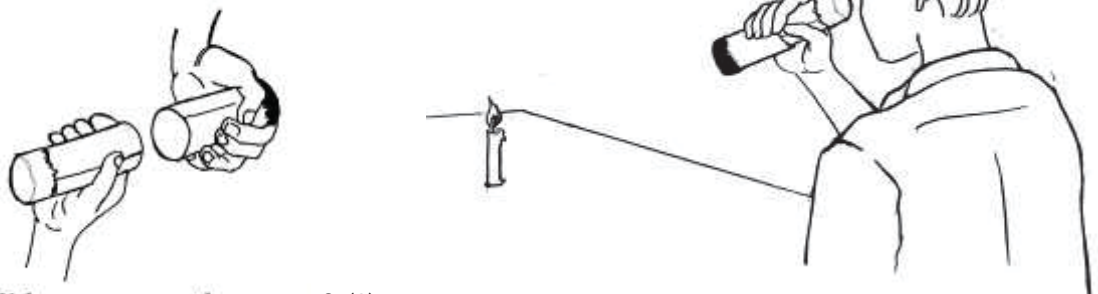


Figure 3

use either glazed or carbon paper. Use a pin to make a hole in the centre of the glazed paper. This is your pinhole tube. Similarly, cover one end of the narrower tube by pasting a piece of white paper over it. Apply some oil on this paper so that it becomes **translucent**. This is your screen tube.

Insert the open end of the screen tube into the open end of the pinhole tube as shown in Figure 4. This is your **pinhole camera**. Place a burning candle in front of the pinhole of the camera and look at it on the screen at the other end.



What did you see on the screen? (2)

Figure 4

Slide the screen tube forwards and backwards and observe the **image** of the flame on the screen while you do this.

What happens to the image when the screen tube is moved forwards and backwards? (3)

Look at other things through your camera, for example a tree or a house. But ensure that there is plenty of light falling on the objects you look at. If scattered light falls on the screen from the sides, cup your hands around the screen to shield it from the light and then look at the object on the screen.

Rays of light

Take a mirror strip from the kit. Cover it with black paper. Cut a 1 mm wide slit in the black paper, as shown in Figure 5.

Hold the mirror strip with the slit facing the sun. You will see some light coming through the slit. Let this light fall on a sheet of paper spread on the ground.

Light coming from such a slit or any other small hole is called a **ray** of light.

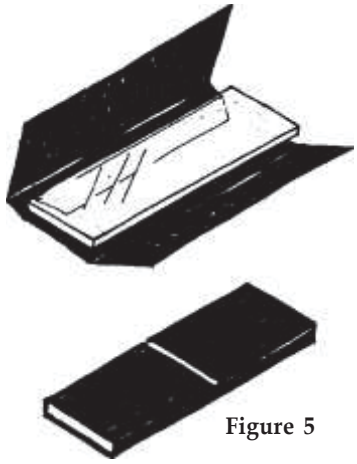


Figure 5

We shall use this mirror strip covered with the slit black paper in the following experiments.

Experiment 3

Reflection - how light returns after striking an object:

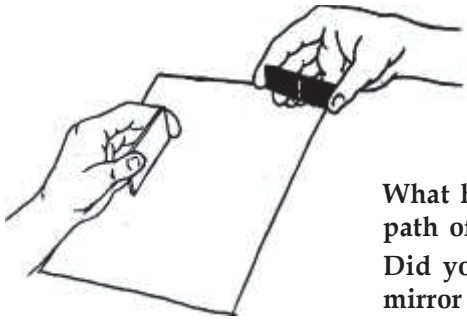


Figure 6

Place a blank sheet of paper on level ground, partly in the sunlight and partly in the shade. Hold the mirror strip with the slit facing the sun. Let a ray of light from the slit fall on the paper. Now take another mirror strip and place it in the path of this light ray (Figure 6).

What happened when you placed the second mirror strip in the path of the light ray? (4)

Did you see any other ray of light, apart from the one from the mirror slit, on the paper? (5)

This effect of the second mirror strip on the ray of light is called **reflection**. The light ray falling on the mirror is called the **incident ray** and the ray returning from it is called the **reflected ray**.

Experiment 4

Laws of reflection

We shall now see whether there is any relationship between the direction of the incident ray and the direction of the reflected ray.

Take a sheet of blank paper. Draw a straight line AC across the middle. Draw another straight line at right angles (90 degrees) to line AC. The second line should bisect line AC at point B. We shall call this line the **normal** (Figure 7).

Draw two lines from point B on the left side of the normal and two on the right side. The lines should be at angles of 30 degrees and 60 degrees respectively from the normal. Number these lines 1 to 4.

Stand a mirror strip vertically on line AC with its reflecting surface facing the normal. Take the mirror strip with a slit and let its light ray fall along line 4, like you did in the earlier experiment,

Did the reflected ray fall on any of the lines you have drawn? If yes, on which line did it fall? (6)

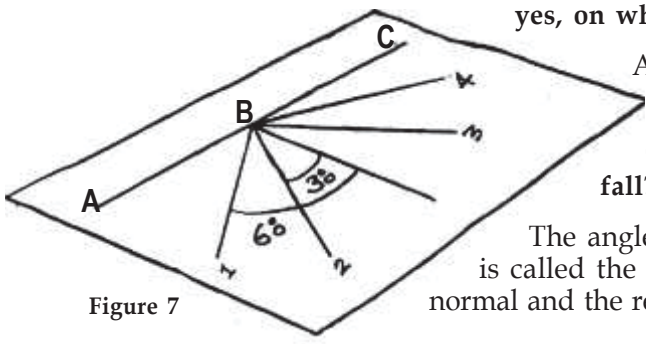


Figure 7

Adjust the mirror strip with the slit so that its light ray falls along line 3.

On which line does the reflected ray now fall? (7)

The angle between the normal and the incident ray is called the **angle of incidence** and the angle between normal and the reflected ray is called the **angle of reflection**.

Draw Table 1 in your exercise book and record your observations in it. (8)

Table 1

S.No	Incident ray	Angle of incidence	Reflected ray	Angle of reflection
1.	On line 3			
2.	On line 4			

Do you see any relationship between the angle of incidence and the angle of reflection? State this relationship in the form of a rule and write the rule in your exercise book. (9)

Let us verify this rule.

If the two incident rays form angles of 20 degrees and 45 degrees respectively with the normal, what will be the angles formed by the reflected rays with the normal? Verify your answer by performing the experiment. (10)

What will happen if the incident ray falls along the normal? Perform the experiment to find out and write your answer in your exercise book. (11)

It is not necessary for you to first draw the angle of incidence on the paper before performing the experiment, like you did in Figure 7. You can make the incident ray fall at any angle at point B and perform the experiment.

Let us use the laws of reflection to construct two gadgets.

Experiment 5

Make your own periscope

Collect the following materials to make your periscope:

empty *agarbatti* (incense stick) box, two mirror strips, candle, blade, match box, scale, glue.

Close both ends of the *agarbatti* box. Draw squares at the two ends of the broad surface of the box, as shown in Figure 8(a). The sides of the two squares should be equal to the width of the *agarbatti* box. Draw the diagonals of these squares and slit the diagonals with a blade. The slits should equal the length of the mirror strips. Fix the mirror strips in these slits as shown in Figure 8(b). The mirror strips should lie parallel to each other, with their reflecting surfaces facing each other. Fix the mirror strips firmly to the box with a few drops of molten wax from a burning candle. You could also use glue or fevicol instead of wax.

Cut out two windows on the narrow sides of the box as shown in Figure 8(c). The windows should open directly on the reflecting surfaces of the mirror strips. Your periscope is ready.

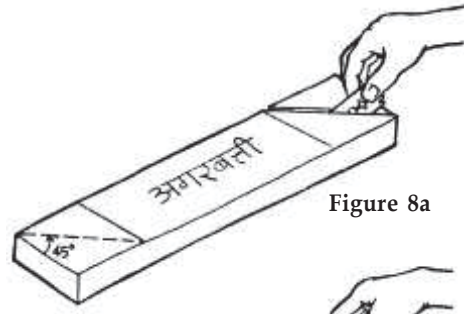


Figure 8a

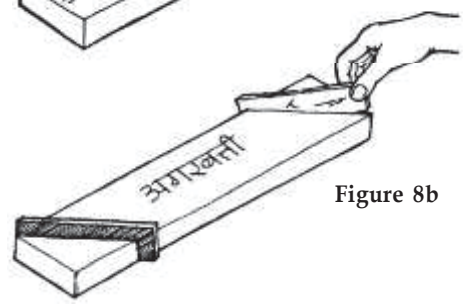


Figure 8b

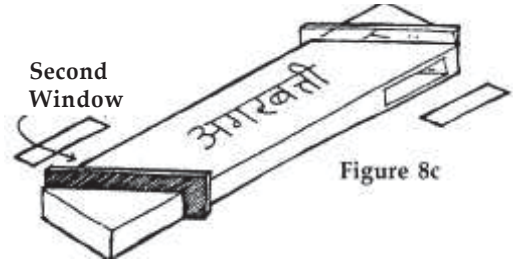


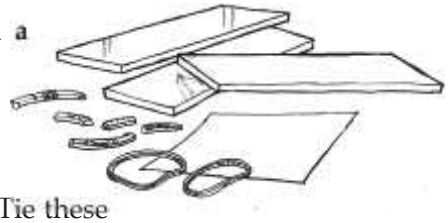
Figure 8c

Figure 9

When you look through Window 2, you will be able to see things lying in front of Window 1. If you hide behind a tree, you can easily see what is happening on the other side of the tree with your periscope. To do this, hold the periscope with one mirror in front of your eyes and the second mirror to one side of the tree trunk . You can also sit in a ditch and see what is happening outside, or look on the other side of a wall without anyone seeing you. (Figure 9)

You may have read about submarines. They move under water. They are fitted with periscopes.

How is the periscope used in a submarine? (12)



Experiment 6

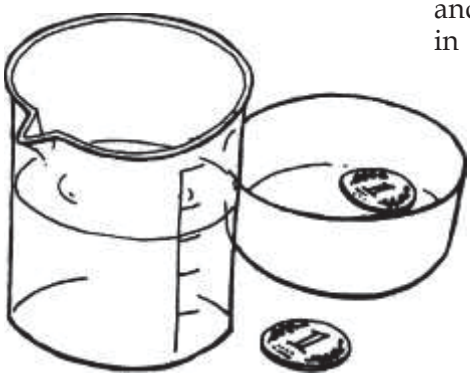
Make your own kaleidoscope

Take three similar mirror strips. Tie these strips with rubber bands to form a triangular tube as shown in Figure 10. While tying the strips together, remember to keep their reflecting surfaces facing each other inside of the tube. Cover one end of the tube with translucent paper with the help of a rubber band. Now put some small pieces of coloured glass bangles inside the triangular tube. Hold the tube so that some light enters through the translucent paper and look at the bangle pieces through the open end. What do you see?

Figure 10

Can you explain why this happens? (13)

Shake the kaleidoscope lightly to rearrange the bangle pieces and look at them again. You can make many beautiful patterns in this way.



A game of magic

Place a coin in a bowl or a large plate. Step back a little, close one eye and look at the coin. Now lower your head until the coin is no longer visible. That means light rays from the coin no longer reach your eyes - they are blocked by the edge of the bowl or plate.

Ask your friend to pour water in the bowl. Do not shift your position or move your head. The water should be poured

slowly so that the coin is not shifted from its position.

Can you see the coin now?

Earlier, the edge of the bowl blocked light rays from the coin. But once water was poured into the bowl the coin became visible. How did this happen? How did the coin become visible? We shall perform another experiment to understand how this happens.

Experiment 7

Refraction

Take 7 or 8 clean glass strips and tie them together in a bundle with a thread or a rubber band.

Stand the bundle along its length on a sheet of paper, as shown in Figure 11. The paper should be in a spot which is partly in the shade and partly in the light. Let a ray of light from a mirror strip with a slit fall on the bundle. Look at the light ray from above the bundle.

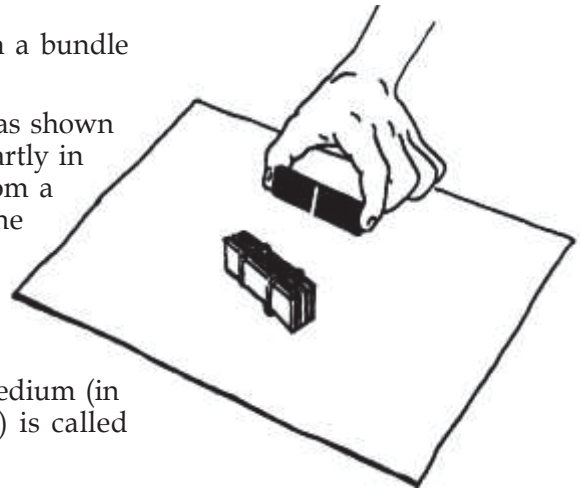


Figure 11

What happens to the ray of light when it enters the glass bundle and when it emerges from it? (14)

The effect on a ray of light when it passes from one medium (in this case, air) to another medium (in this case, glass) is called refraction.

Now think about the coin in the bowl and explain how it became visible when water was poured into the bowl. Write your answer in your exercise book. (15)

Another game with refraction

Take some water in a glass vessel and immerse a pencil halfway into it. The pencil should not be immersed vertically but at an angle.

Now look at the pencil from all four sides of the glass vessel. Does it look straight from all four sides? Draw diagrams to show how the pencil looks in these different positions.

Experiment 8

Refraction through a magnifying glass

Use a magnifying glass to focus the sun's rays on a spot. Move the magnifying glass up and down until you get the brightest and smallest spot possible. The distance of the bright spot from the lens in this position is called the **focal length** of the lens.

What is the focal length of your lens? (16)

Now use your magnifying glass to get this bright spot on a piece of newspaper. Keep your hand steady so that the spot does not shift. What happens? (17)

You can write your name on the piece of paper in this way. Try and do it.

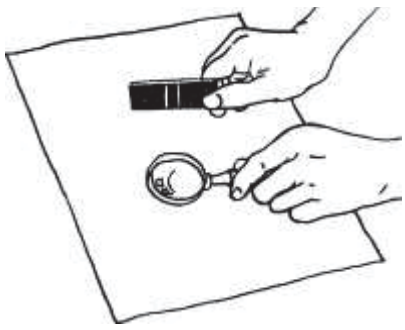


Figure 12

Experiment 9

Cut two 1 mm-wide slits on a piece of black paper. The distance between the two slits should be approximately 1 cm. Wrap this paper on a mirror strip as you did in Experiment 3.

Choose a spot where light and shade meet. Hold a magnifying glass vertically over a sheet of white paper in the shade. Use the two slit mirror strip to throw two rays of light on the magnifying glass. Tilt the magnifying glass a little and move it back and forth until the rays passing through it are clearly visible on the paper (Figure 12).

What happens when the light rays pass through the lens? (18)

Do the two rays cross each other after travelling some distance? (19)

Would this have happened if the lens was not placed in their path? (20)

Measure the distance from the lens to the point where these rays cross each other and compare this distance with the focal length of the lens. (21)

You have two more magnifying glasses with you. Find out their focal lengths using the same method.

In the beginning of this chapter, you had formed an image of a burning candle on a screen with a pinhole camera. Let us see whether a similar image can be formed with a magnifying glass.

Experiment 10

Image with a magnifying glasss

Light a candle and place your exercise book or a sheet of blank paper at some distance from it to serve as a screen. Place a magnifying glass between the candle and the screen and move the screen back and forth until the image of the burning candle is formed on the screen.

You can form images of other objects on your exercise book or on a wall in this way. You can make the image clearer by adjusting - increasing or decreasing - the distance between the lens and the wall.

Are the images you get inverted, like the images in the pinhole camera?

Our eyes, too, form images in the same way a magnifying glass does. Let us try to understand how the eye works.

How do we see?

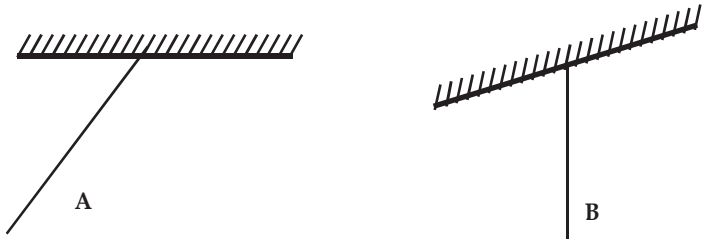
Look carefully at the eye of your friend and compare it with the figure given below. The eyeball is white in colour. There is a brown circle at the centre of the eyeball. It has a small black circular spot in its centre. This black circle is called the **pupil**. The pupil is actually a hole and it has a lens behind it. Behind the lens lies a screen called the **retina**. The retina is sensitive to light.

When an object comes in front of the eye, its image is formed on the retina. This image is inverted, like the image in the pinhole camera. However, we see the image in its upright position. The process by which we see the correct image and not the inverted image that falls on the retina is very complex. The brain plays a crucial role in this process.

On the basis of your answer to Question 19, explain why it is dangerous to look directly at the sun. (22)

Some questions for revision

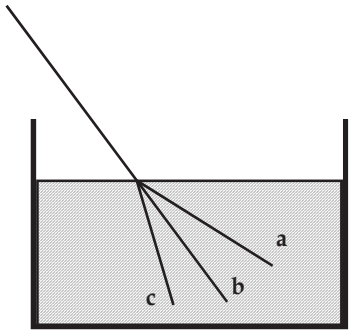
1. **Why can't you see your friend who is sitting in the next classroom in your school?**
2. **Figure A and B given below show incident rays falling on two mirror strips. What is the angle of incidence in each case? Draw the reflected rays in the figures.**



3. **Take two mirror strips and a candle. Place the mirror strips facing each other and put the burning candle between them. How many images are formed?**

   In some museums large mirrors are fixed on opposite walls of a room. If you stand in the middle of such a room, how many images of yourself would you see?
4. **A transparent cubical box is filled with water. A ray of light falls on it from one side as shown in the figure. Three refracted rays are shown in the figure. Which is the correct one?**

   Confirm your answer by performing this experiment. If you want to see the light ray more clearly, add 2 to 3 drops of milk to the water.



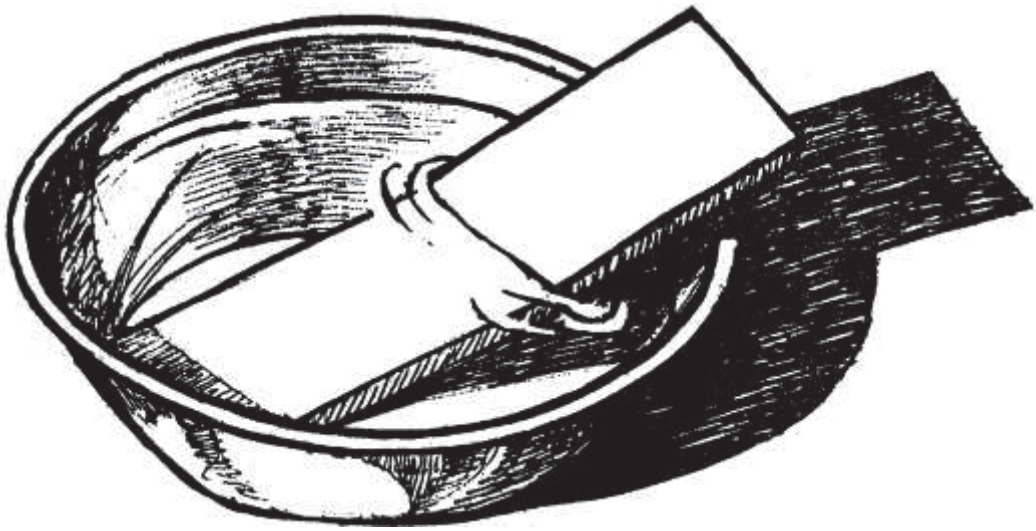
New words

Ray	Incident ray	Reflected ray
Angle of incidence	Angle of reflection	Normal
Image	Reflection	Refraction
Translucent	Focal length	Pinhole camera
Periscope	Kaleidoscope	Retina
Pupil		

MAKE A RAINBOW

You must surely have seen a rainbow in the sky. Why don't you try making one at home?

Take a bowl with a wide mouth and fill it almost to the brim with water. Rest a mirror strip along the inner edge of the bowl with its reflecting surface facing upwards.



Now place the bowl in a spot where the sun's rays can fall on the mirror strip. Observe the image created by the reflection of sunlight from the mirror strip on a distant wall or on your exercise book. If the image is not clear adjust the position of the mirror to bring it into focus.

Did you see the colours of the rainbow? The arrangement of colours in sunlight is called the "spectrum".

ELECTRIC CIRCUITS AND CELLS

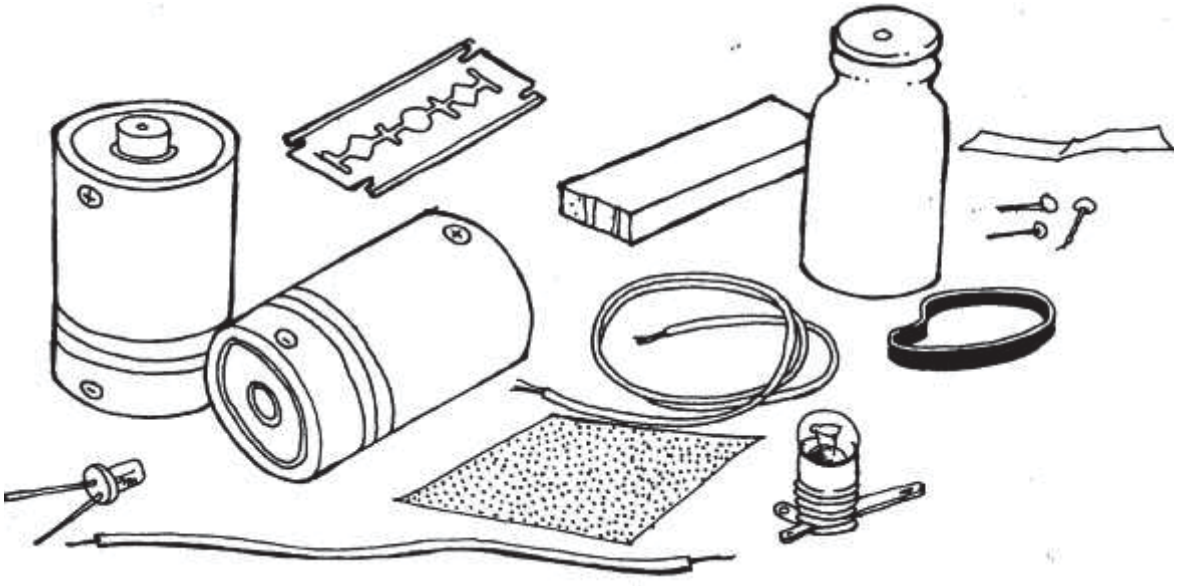
Chapter 16

The day: September 4, 1882. The place: New York, USA.

A crowd has gathered at Pearl Street in the city. The air is filled with excitement and curiosity. Thomas Alva Edison and his coworkers are busy, trying to fulfill a promise that seems impossible to fulfill. They have been working on the problem for the past few months and have fixed a time in the evening to show their wonder to the world.

As evening nears, the excitement rises. The crowd watches as Edison turns on a switch at the scheduled time. Some 14,000 bulbs light up simultaneously in around 9,000 houses. The crowd roars with joy. Edison has succeeded in keeping his promise. For the first time in human history, electricity from a powerhouse has been supplied to people's homes. A new age of progress and development has been ushered in.

Many countries began using electricity for domestic purposes after that day. Today electricity is a common household commodity.



You, too, must have used different kinds of electrical appliances at home in your daily life. Have you ever thought how electricity makes these appliances work? You learned something about electricity in Class 6. Let us learn a little more by performing a few experiments. But, first, let us try and remember all that we learned during the previous year, before we go ahead with our experiments.

Answer the following questions. You could look up your last year's exercise book and workbook, if you can't remember the answers.

Draw a diagram to show how you can light a bulb with the help of a cell and wire. (1)

Try and light your bulb in the way you have shown in your diagram. Did the bulb glow? If it did not, discuss the matter with your friends, find your mistake and correct it.

Fill in the blanks:

(a) The bulb glows when current from the cell reaches it through the ……..

(b) This path of electricity is called a ……..

(c) When current flows in a circuit it is called a ……. or ……. circuit. Otherwise, it is called an …… or ……. circuit. (2)

How can you test whether or not a current is flowing in a circuit? (3)

Don't ever do these things

Always bear the following precautions in mind. We discussed these precautions in Class 6, but we are repeating them here because they are very important.

1. All our electricity experiments will be performed with the cells we use in torches and radios. Never experiment with the electric current flowing in the wires at your home, school or fields. Doing so could be dangerous. You could be killed.
2. Never connect the positive (+) terminal of a cell directly to its negative (-) terminal. The cell gets discharged quickly if you do so.

Make your own switch

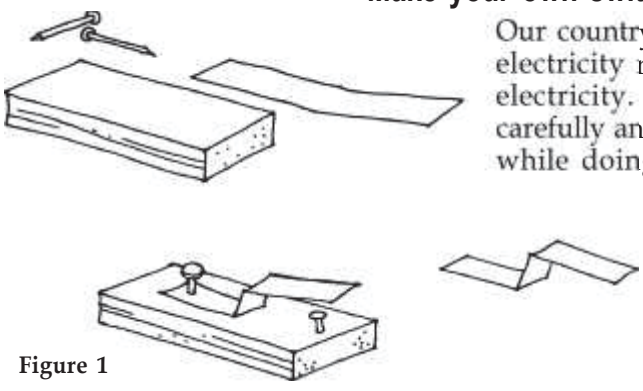


Figure 1

Our country faces a shortage of electricity. So wasting electricity means you are depriving someone else of electricity. Your bill also goes up. So use electricity carefully and only when it is needed. Keep this in mind while doing the following experiments. You should let current flow in a circuit only as long as it is needed. If you allow current to flow continously and unnecessarily, the cell gets discharged very fast. So let the current flow only as long as you need to make your observations.

Can you remember what you did last year to turn the current in a circuit on or off? (4)

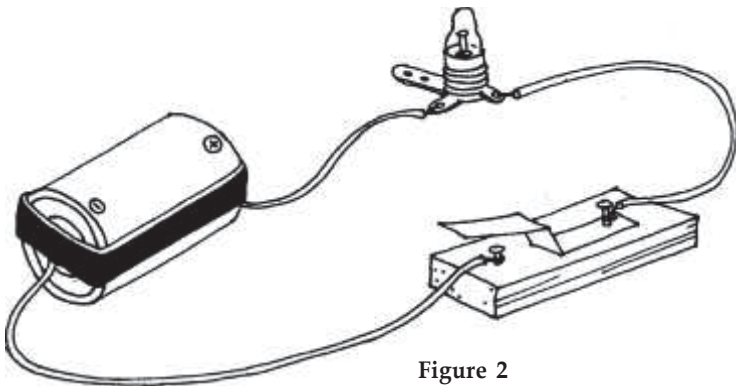


Figure 2

This time we shall use a **switch** to turn the current on or off. You may have used different kinds of switches to turn your household electric appliances on or off. Switches help us to start or stop these appliances safely and easily.

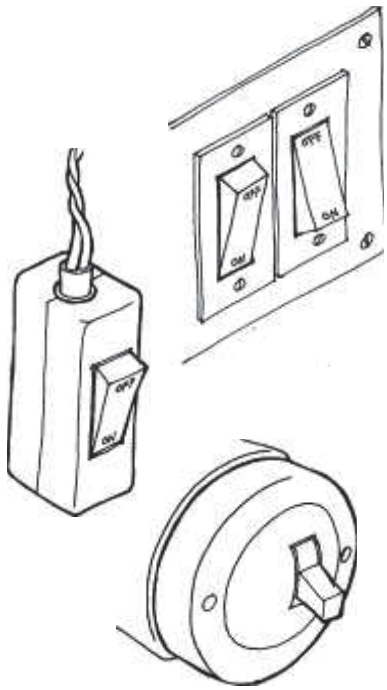
Let us make a switch for our circuits. Take a 10 cm-long iron strip. Bend it twice as shown in Figure 1. Now drive a nail into one end of a wooden block. Nail one end of the iron strip to the other end of the wooden block so that its free end rests just above the first nail without touching it. Your switch is ready.

Would you like to test your switch? To do so, first set up the circuit shown in Figure 2.

How would you use the switch to open or close the circuit? (5)

If the bulb in your circuit glows when the metal strip of your switch is pressed on the nail, and turns off when it is not, then your switch is working. You can use it in any circuit.

The switch you made is a simple one. You may have seen many different types of switches on switchboards and appliances at home and school. These switches are designed according to their usage, convenience and safety. But all of them work on the same principle.



Your teacher will show you different kinds of switches.

Find out how a circuit is closed or opened with these switches. (6)

Circuit diagram

The circuit you made with your switch is a simple circuit. It is not difficult to draw a realistic diagram of this circuit. Maybe you can even draw a better picture than the one in Figure 2. However, later on in this chapter we shall make more complicated circuits. The electrical appliances you use at home have even more difficult circuits. Can you draw realistic diagrams of such circuits which contain many bulbs, cells, switches and other components? It isn't easy.

Scientists have tried to make the job easier. They have adopted simple symbols for different components in a circuit. We can easily draw circuit diagrams using these symbols.

The symbols for bulbs, cells and switches are shown in Figure 3.

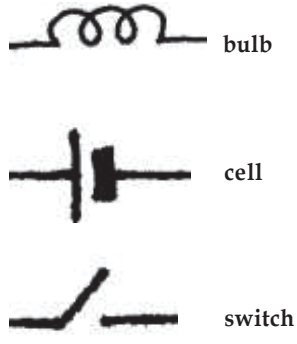


Figure 3

For a cell, the longer line denotes the **positive (+) terminal** and the short line the **negative (-) terminal**.

How can you identify the positive and negative terminals of a cell? (7)

Circuit 1

We shall use these symbols to show components in the circuits we draw. Such diagrams are called **circuit diagrams**. If we redraw the circuit diagram given in Figure 2 with symbols, it would look like the figure at the left.

An exercise: Draw circuit diagrams

You saw how a circuit diagram is drawn using symbols. Let us practice drawing a few such diagrams.

Figure 4 shows some circuits. Draw their circuit diagrams using the symbols you have learned.

Understanding a circuit

A teacher asked her class to make a circuit. All the groups used the same components to make their circuits. However, the circuits looked different. In some, the cell was erect, while in others it lay flat. One group used short wires to join the bulb while another used longer wires. One group kept the cell on the left side of the bulb while another kept it on the right.

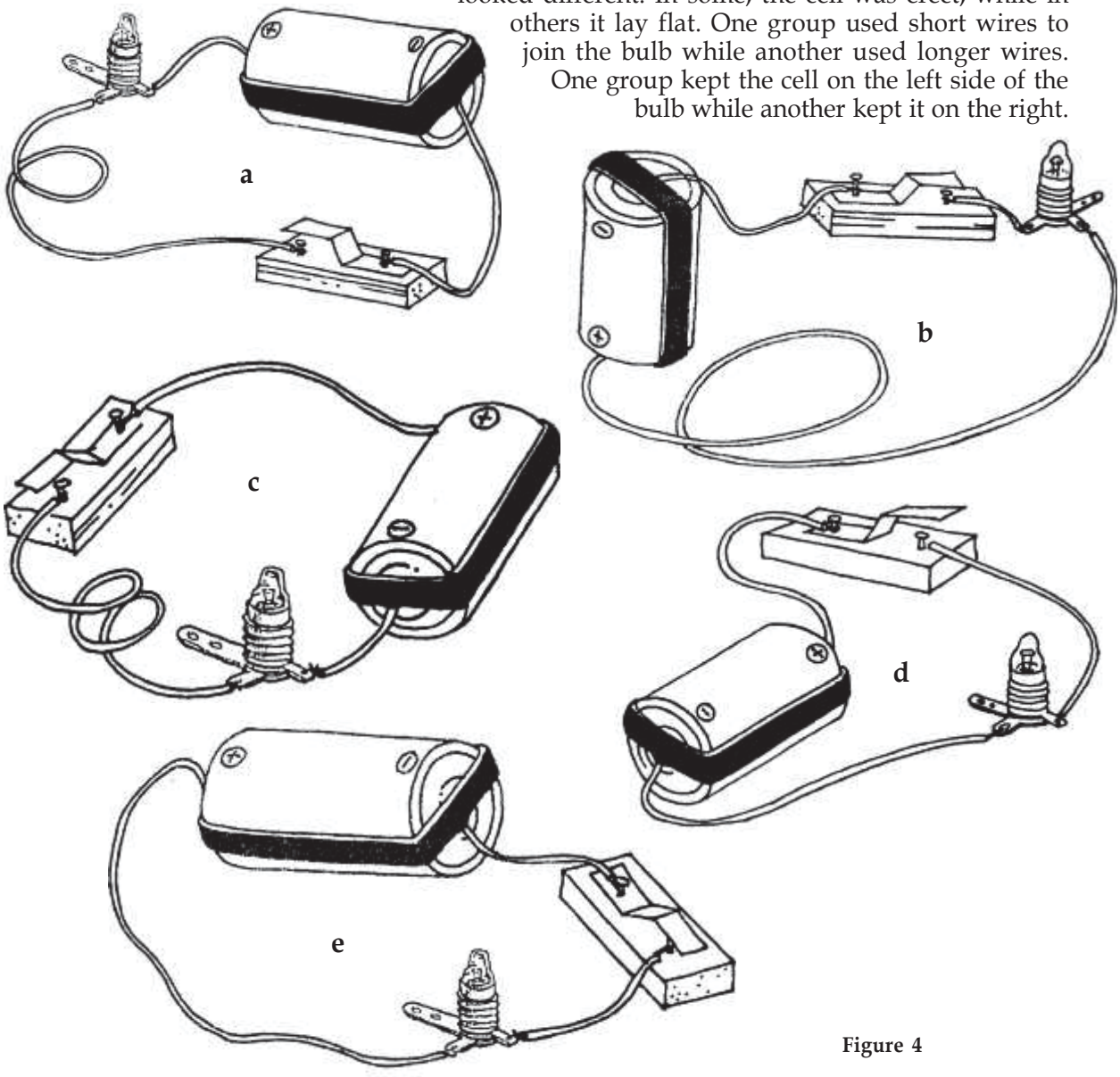


Figure 4

But were all the circuits actually different? How would you spot the differences between circuits? Let us try and understand this point by performing an experiment.

Experiment 1

Make a circuit like the one shown in Figure 2.

Does the bulb light up when the switch is turned on? (8)

Draw a circuit diagram of your circuit. (9)

Observe the sequence in which the cell, bulb and switch are connected in your circuit. To do so, place your finger on the positive terminal of the cell and move it along the wire across the entire circuit. Note the sequence of components as your finger crosses them and list them in your exercise book. For example, the sequence of components in Figure 2 will be as follows:

positive terminal of the cell → wire → bulb → wire → switch → wire
negative terminal of the cell → positive terminal of the cell

Now move the bulb to the other side of the cell without disconnecting the wires. The wires, cell, bulb and switch should remain firmly connected.

Does the bulb still light up as before? (10)

Did the place of the bulb in the sequence change because its position was shifted? What is the sequence of components in the circuit after shifting the bulb to its new position? (11)

Draw the circuit diagram again. (12)

Is your diagram different from the one you had drawn earlier? (13)

Now shift the cell to the left, then to the right, front and back of the bulb.

Was there any difference in the glow of the bulb when you shifted the cell?

Was there any change in the sequence of components in the circuit?

Draw a new circuit diagram every time you shift the cell. Compare each diagram you draw with the earlier one?

Does the circuit change when you merely shift its components here and there? (14)

How can you tell whether two circuits which look different are actually the same or different? (15)

Different kinds of circuits

In the last experiment we made a circuit with a bulb and a cell. We can make only one kind of circuit with a cell and a bulb. But we can make many types of circuits if we have more than one

bulb or cell by connecting these components in different ways. The properties of different circuits are different.

In the following experiments we shall examine the properties of different types of circuits and compare them.

You should remember some points before we begin our experiments. Remember to connect a switch in all your circuits. Your cells will last longer if you use a switch. Also, make sure that the cell and bulb are properly connected to the wires. Remember what you learned in your earlier classes about connecting wires firmly. Your observations could be incorrect if your connections are loose.

Experiment 2

A series circuit with two bulbs

Two kinds of circuits can be made with two bulbs and a cell. In this experiment we shall make one of them and study it.

Look at the circuit with two bulbs, a cell and a switch given here (Figure 5).

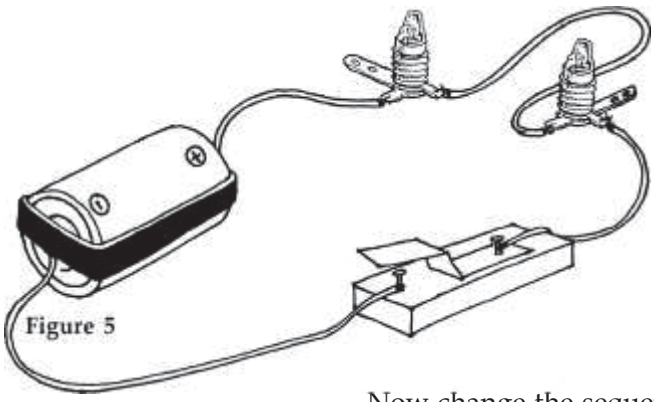


Figure 5

It is clear from the circuit diagram (Circuit 2) that the two bulbs are connected one after the other. The circuit diagram shows the sequence of the bulbs and cell, not their real position. The way in which the bulbs have been connected in this circuit is called a series connection.

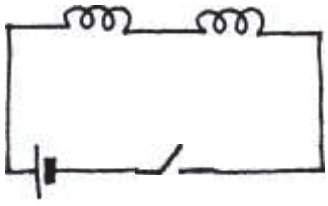
Now make this circuit by joining the two bulbs and cell.

Do both bulbs light up? Do both glow equally brightly? (16)

If one glows less brightly, will it shine more brightly if we change its place in the sequence? Take a guess. (17)

Now change the sequence of bulbs and judge whether your guess was correct or not.

Does changing the order of bulbs in a circuit affect their brightness? (18)



Circuit 2: Series Circuit

Sometimes, bulbs that appear to be similar can differ from each other. So similar looking bulbs do not always glow equally brightly when connected in series.

This circuit can be broken at several places. For example, between the cell and bulb, between the two bulbs etc. Try breaking the circuit at different places.

Can you break the circuit in such a way that one bulb continues to glow while the other does not? (19)

How is the current affected when the circuit is broken at any place? (20)

How many paths are there in this circuit for the current to flow? (21)

You have made and observed a series connection. Let us explore another type of connection.

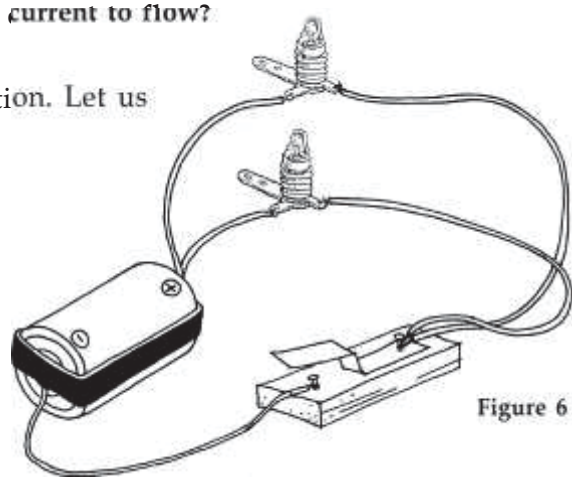


Figure 6

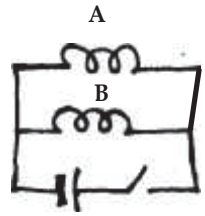
Experiment 3

Parallel circuit

Circuit Diagram 3 (Figure 6) shows a circuit in which two bulbs are connected in a different way. This is a second type of circuit.

The bulbs in this circuit are said to be connected in **parallel**, and such circuits are called parallel circuits.

Take the bulbs you used to make the series connection and connect them in a parallel circuit.



Circuit 3: Parallel Circuit

Did both bulbs light up when the switch was turned on? (22)

Is there any difference in the brightness of the bulbs as compared to the previous experiment? (23)

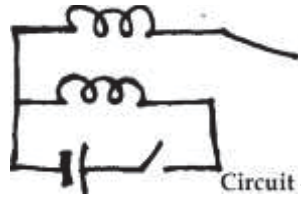
If the connection of Bulb A in Circuit 3 is broken (as shown in Circuit 4), will the bulb still light up? Take a guess and then test to see whether your guess was correct. (24)

What would happen if the connection of Bulb B is broken at one end? Test your answer by actually breaking the connection. (25)

Is it correct to say that if a parallel circuit is broken at any point, at least one bulb will always continue to glow? (26)

Examine the parallel circuit and find out if there are places where current flows through more than one path. (27)

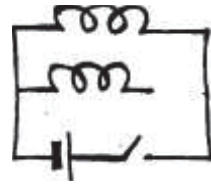
What similarities and differences did you notice between a series circuit and a parallel circuit? List them in your exercise book. (28)



Circuit 4

The lights and fans in your home are connected to a single main connection. You can switch any one of these on or off, whenever you wish, while the others continue to work.

Can you guess how these electrical appliances are connected to each other, in series or parallel? (29)



Circuit 5

A puzzle

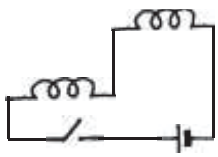
Some circuit diagrams are shown below. Observe them carefully and say which ones are series and which are parallel. (30)

Experiment 4

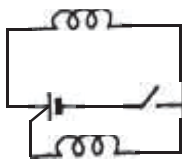
A circuit with two cells

Figure 7 shows two circuits, each with two cells.

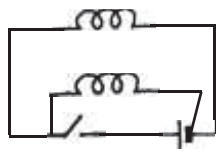
In Circuit Diagrams 11 and 12, are the cells connected in series or parallel? (31)



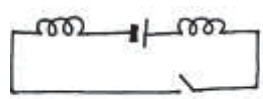
Circuit 6



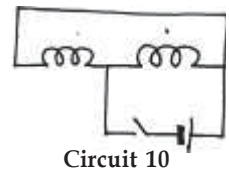
Circuit 7



Circuit 8



Circuit 9



Circuit 10

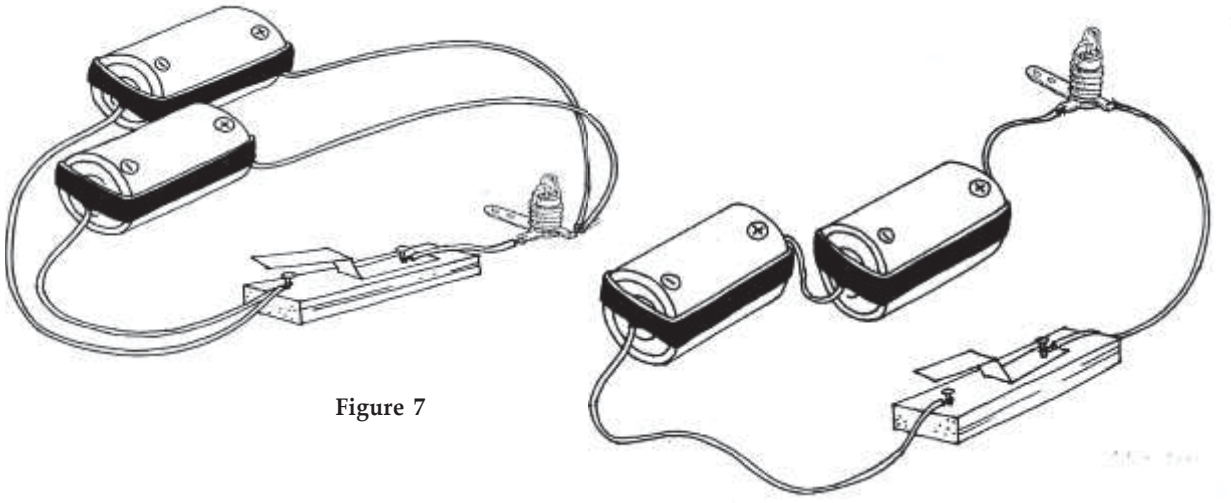


Figure 7

Will the bulbs in these circuits light up? Take a guess. (32)

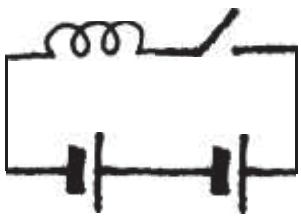
Test whether your guess was correct by doing the experiment. Use the same bulb in both the circuits.

In a series circuit with two cells, current flows only when the positive terminal of one cell is connected to the negative terminal of the second cell, as shown in Circuit Diagram 11. This is known as a direct connection. If one cell is inverted, as shown in Circuit Diagram 12, and the same terminal of both cells are connected (positive to positive or negative to negative), then the cells are said to be connected in reverse order. No current flows in a circuit if cells are connected in reverse order.

Last year, you studied the circuit of a torch by opening it up.

Do you remember how the cells in the torch were connected? (33)

When a torch is not used for some time, how should the cells be kept inside to protect them from getting discharged? (34)



Circuit 11

Once again, make Circuit Diagrams 1 and 11 and light a bulb.

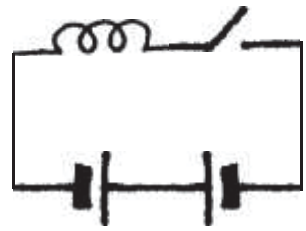
What is the difference in brightness of the bulbs in the two-cell Circuit 11 and the single-cell Circuit 1? (35)

In the above experiment, the cells were connected in **series**. The cells could also be connected in parallel, to give different results. You will learn more about parallel connections in later classes.

One more puzzle

If one of the two cells of Circuit 12 is reversed, the bulb starts glowing. But can you light the bulb without reversing the cells, with the help of a piece of wire? Pay attention to the second precaution given at the beginning of the chapter while doing so.

Make a diagram of this new circuit. (36)



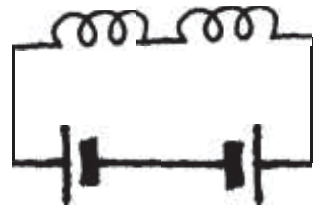
Circuit 12

Liquid: conductor or insulator

Last year, you did some experiments to find out whether a solid is a conductor of electricity or not. Do you remember these experiments?

In what way does a conductor differ from an insulator? (37)

On what basis did you decide whether a solid is a conductor or an insulator? (38)



Circuit 13

If you have forgotten the answers to these questions, refer to your Class 6 exercise book.

Can a liquid also be a conductor or insulator of electricity? Let us find out.

Experiment 5

In this experiment, we shall use the same test that we used for solids to determine whether a liquid is a conductor or an insulator. However, we shall use a new kind of bulb called an **LED**.

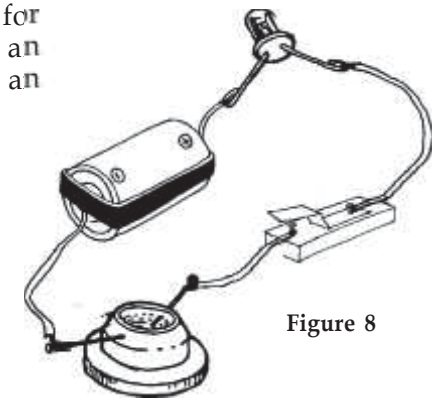


Figure 8

Observe the LED carefully. It has two thin wires sticking out. These are like the two terminals of the bulbs we used so far. An LED is connected to a circuit just like a bulb. Make a simple circuit with an LED and see if it glows. If it does not light up, ask your teacher to help you make the circuit.

Take the rubber cap of an injection bottle. Invert it and pierce two pins into it so that their points are close to each other in the central hollow (Figure 8). Make sure that the points do not touch each other.

Now make the circuit shown in Figure 8. Pour the liquid to be tested in the central hollow of the rubber cap. Pour just enough liquid to immerse the pin-points. Turn the switch on to complete the circuit and see if the LED glows. If it does, the liquid is a conductor. If it does not, the liquid is an insulator. Begin by testing the conductivity of water.

Did the LED glow when the switch was turned on? (39)
On the basis of your observation, is water a conductor of electricity or an insulator? (40)

Repeat the process with the liquids listed in Table 1 on next page. Before you change the liquid in the cap hollow, clean it and the pins thoroughly. Find out which liquids are conductors and which are insulators.

Table 1

S. No.	Name of liquid	Conductor or insulator
1.	Water	
2.	Salt solution	
3.	Onion juice	
4.	Blue vitriol solution (Copper sulphate)	
5.	Mustard oil	
6.	Kerosene oil	
7.	Lemon juice	
8.		
9.		
10.		

Make this table in your exercise book and write down your observations.

How the first cell was made

You have used many cells in your experiments till now. Some of them may have been fully discharged by now. Would you like to know how the first cell was made? It is a very interesting story.

Some 400 years ago, scientists in Europe began experimenting with electricity. They generated electricity in different ways and conducted various experiments. However, they faced one major problem in studying and understanding electricity in depth. They did not have a stable and permanent source of electricity.

This may seem like a minor problem today, but it took scientists nearly 200 years to find a solution.

That solution came in 1780. And it came almost by chance. A biologist named Luigi Galvani from Bologna, Italy, once noticed a frog's leg hung from a copper hook twitching violently when it touched another metal. It seemed as if the frog's leg had suddenly come to life.

Galvani did many more experiments with the legs of dead frogs. He finally came to the conclusion that frogs' legs twitched every time electricity flowed through them. Galvani thought he had discovered living or biological electricity. He presented his theory to the world, saying that all living beings contained electricity and it was this electricity that was their main source of life.

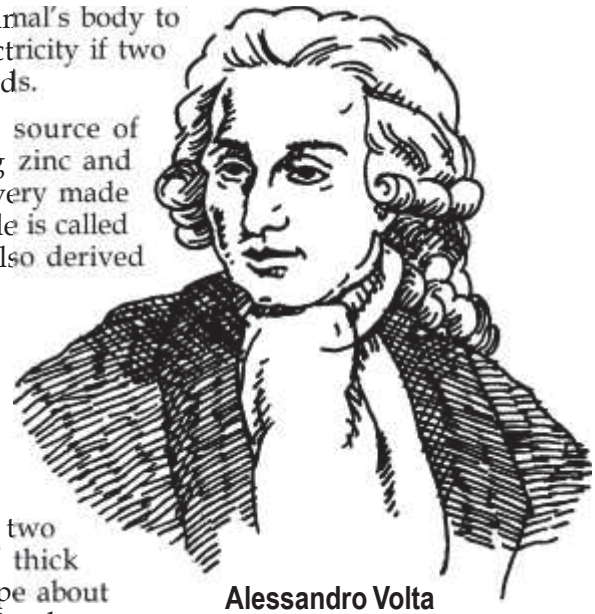
Galvani's experiments took the whole of Europe by storm. Many scientists began performing similar experiments with various species of animals. Among them was Alessandro Volta of Italy. He, too, performed experiments with frogs' legs. However, he discovered that if a frog's leg hung from an iron hook and was touched with another iron rod, it did not twitch. Volta was a bit puzzled.

If the reaction in a frog's leg occurred because of the electricity in its body, why were two different metals required to make it twitch, he wondered? After a lot of thinking he arrived at the conclusion that electricity did flow through the frog's leg when two different metals touched it. However, this electricity was not contained in the leg of the frog but was generated by some other process.

Volta repeated his experiment using different liquids instead of

frog's legs. He found that it did not require an animal's body to generate electricity. It was possible to generate electricity if two different metals were placed in some special liquids.

These experiments showed the way to a steady source of electricity. Volta made his first cell in 1800 using zinc and copper plates dipped in sulphuric acid. His discovery made him famous in the realm of science. The cell he made is called a **Volta cell** in his honour. The word **voltage** is also derived from his name.



Alessandro Volta

Let us make a cell with the same metals and chemicals used by Volta.

Experiment 6

Make your own cell

You will need a few things to make a cell. First get two injection bottles. Then cut two 3 cm-long bits of thick copper wire from your kit. Use sandpaper to scrape about 1 cm of the coating off both ends of the wires. Break open a discharged dry cell and remove its outer metal covering (made of zinc). Cut two 2 mm-wide and 3 cm-long strips from this zinc plate. Insert the copper wires and zinc strips separately into the rubber caps of the injection bottles as shown in Figure 9. Ensure that the copper wires and zinc strips do not touch each other.

Now take a wire and connect the zinc plate of one bottle with the copper wire of the other bottle.

Fill both bottles with sulphuric acid from your kit. Carefully close the bottles with the caps in which the copper wires and zinc strips are inserted.

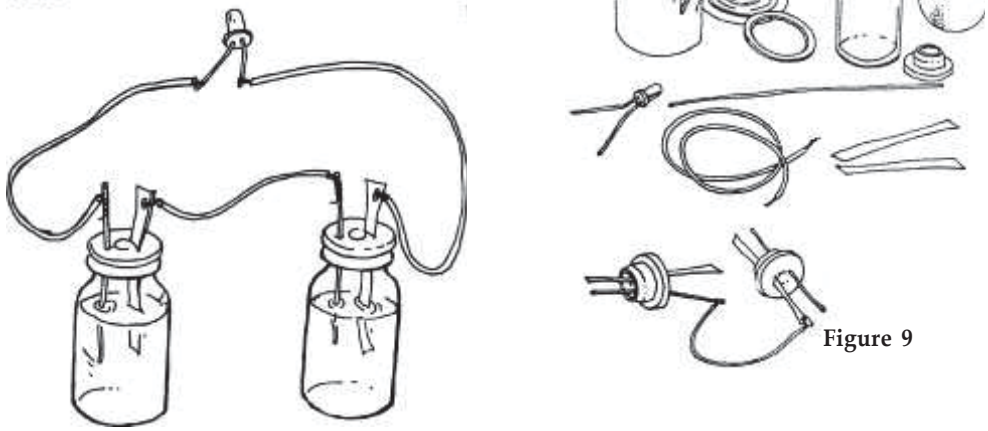


Figure 9

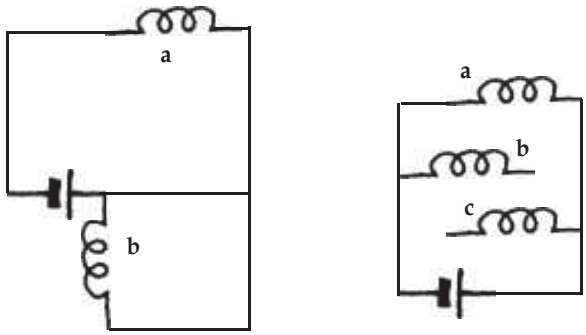
Your cell is ready. How will you test it? Take an LED from your kit. Attach two wires to its two terminals. Touch the wire from one terminal to the copper wire of the first bottle and the wire from the other terminal to the zinc plate of the second bottle. Did the LED light up? In case you face any problem, consult your teacher.

Do the following experiment

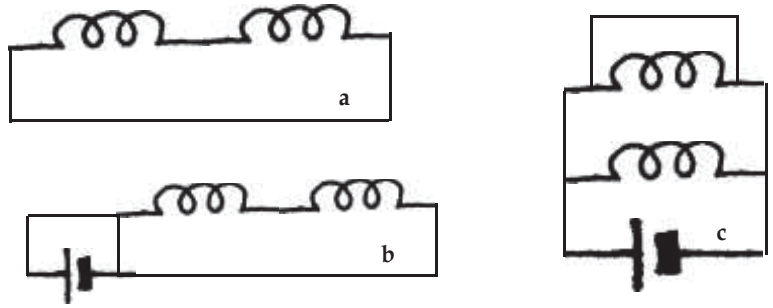
Repeat the previous experiment using lemon juice, tamarind juice and tomato juice, one by one, instead of sulphuric acid, to make your cells.

Questions for revision

1. **In which of the following circuits will the bulbs light up and in which will they not? Give reasons and verify your answers by making the circuits.**



2. **Find the mistakes in the following circuits and draw the correct circuit diagrams.**



3. **Harbhajan made a circuit by connecting a cell and two bulbs in series. One bulb glowed but the other did not. Sushma said the bulb was fused? Do you agree with her? Give reasons for your answer.**
4. **Find out how bulbs in the decorative lighting used during festivals are connected.**
5. **On what basis did Volta come to the conclusion that an animal's body is not needed to generate electricity?**
6. **You have seen and used many electrical appliances. List them. Each has some information written on it - for example, its voltage, wattage etc. Note these in your list as well. Consult your teacher or some knowledgeable person to find out their meaning, and what they tell you about the appliance.**

New words

Series	Parallel	Voltage	LED
Circuit diagram	Switch	Volta cell	

SENSITIVITY OF LIVING ORGANISMS

Chapter 17

In Class 6, you did experiments on touch, smell, vision, etc in human beings. Are other living organisms also sensitive? In this chapter, we shall try and find the answer to this question by discussing some of our daily life experiences as well as the results of some experiments we shall perform. But you must remember one thing. Plants and animals cannot tell us how or what they feel, so we must decide whether they are sensitive or not by observing and judging their reactions during these experiments.

In the first part of the chapter, we shall discuss sensitivity of animals and in the second part sensitivity of plants.

PART I

Sensitivity of animals

Touch and observe

You may have touched different kinds of creatures, big and small. If you have not, touch the following animals and observe how they react:

cow, silverfish, earthworm, cricket, snail (1)

Did they react because you touched them? Are you sure? Is it possible that they reacted because they saw you or your finger?

Suggest an experiment which can definitely show that an organism is sensitive to touch. (2)

Give the names of five other animals that are sensitive to touch. Explain how you can find out the sensitivity of each of these animals. (3)

The effect of heat and cold

Give some examples, from your own experience, where you have observed the sensitivity of organisms to changes in temperature. (4)

When pests infest stored wheat, we dry the wheat in the sun. The pests leave the wheat. Have you ever wondered why they

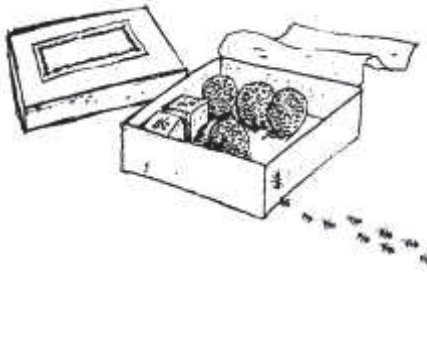
flee? Is it because of the heat of the sun? Or is it because of the brightness of the sunlight?

Suggest an experiment to verify this. (5)

Have you observed that the behaviour and activities of some animals change with changes in the weather?

On the basis of your experience, list the changes you observe in the behaviour of dogs during summer, and winter. (6)

An experiment: a problem



You may have observed ants marching in a straight line. Try and find a colony of ants moving in a straight line. Take a wet cloth and wipe the trail clean between two ants. If they are marching on sand, it is enough if you just scatter the sand between them with your finger. Be careful not to kill any ant while doing so.

What effect does this have on the ants that follow behind? Note your observations in your exercise book. (7)

Discuss why this happens in your class. Write a brief summary of the discussion in your exercise book. (8)

Now consider one more thing. Ants can find their way into a closed box of sweets. How do they do it? They cannot see the sweets. Nor do they know that the box contains sweets. There could be two ways they get to know:

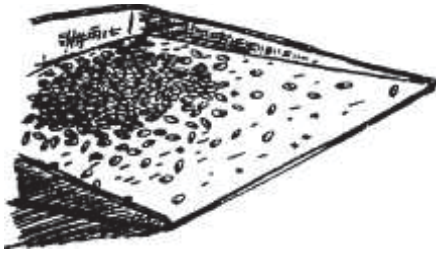
- They wander around and stumble on the sweets by chance.
- They smell the sweets.

Which of these two possibilities do you think is more likely to be correct? Give reasons for your answer and also suggest an experiment to verify it.(9)

Mosquitoes reach you in the dark to suck your blood. How do they know where you are? (10)

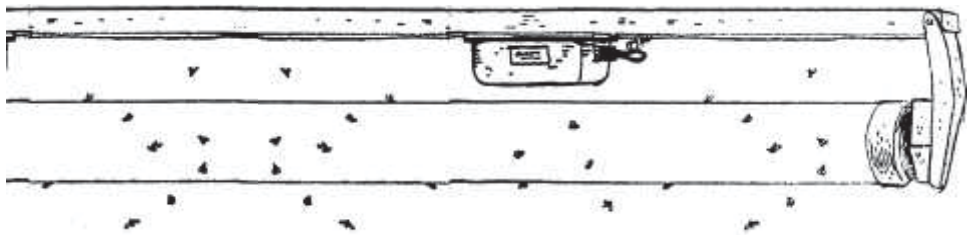
You might find the following information useful in answering this question. Several different kinds of ointments are sold in the market. When we apply these ointments to our body mosquitoes do not come near us. Some people use mustard oil for the same purpose.

Yet another interesting bit of information was obtained from an experiment. A person wore a pair of unwashed socks for several days. He found a host of mosquitoes hovering around his socks.



In another experiment with mosquitoes, two iron rods were kept in a room. One was at room temperature, while the other was slightly heated. There were more mosquitoes hovering around the heated rod than the unheated rod.

Now try and answer Question 10 on the basis of this additional information.



Attraction and repulsion to light

You may have seen insects hovering around a tubelight or bulb in your house during the monsoon season. The light seems to attract them. On the other hand, there are some creatures that prefer to stay in dark places even in daylight.

Give the names of some creatures that are attracted to light at night. (11)

Give the names of some creatures that prefer to stay in the dark even during the day. (12)

What effect does light have on the following creatures?

- Cockroach

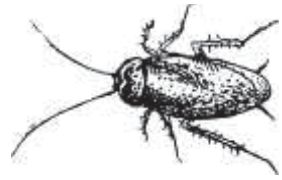
- Earthworm

- Housefly

- Mosquito. (13)

How did you find out about the effect of light on these creatures? (14)

An interesting fact



How many creatures have you seen that have antennae or feelers? Actually these antennae/feelers are used in many ways. They are sensitive to touch, pressure, sound, smell, taste, temperature and moisture.

A question to ponder over

In this chapter, you may have noticed that we asked you several times, how you found out about something or the other. There is a reason for asking. In the introduction to the chapter, we had said that living creatures cannot tell you what they feel. We have to observe them and decide whether or not they are sensitive to a particular thing. But during an experiment, many things may change at the same time.

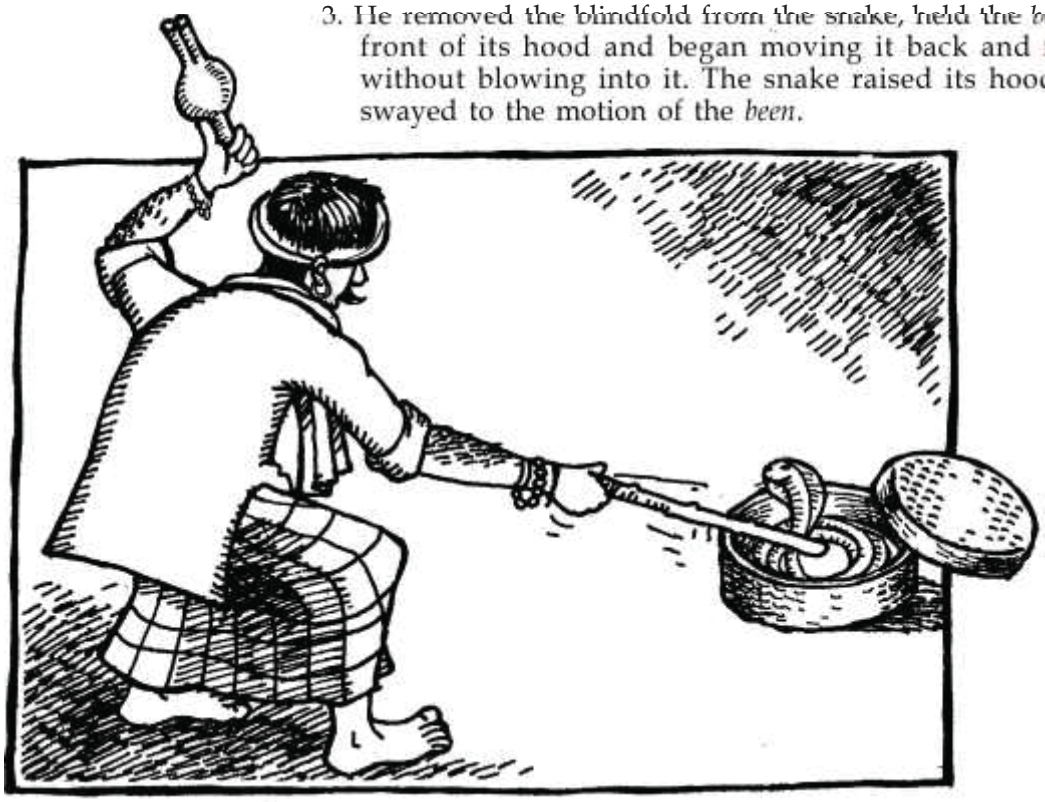
For example, if we light a candle and an insect is attracted to it, what conclusion can we draw? A candle gives light, so can we say the insect is attracted to the light? But a candle also produces heat. Is it not possible that the insect came near the candle because it was attracted to the heat? To avoid such confusing situations,

we need to take care in choosing experiments. We should try and ensure that only one thing changes at a time.

Take the example of the scientist who experimented with snakes to find out more about their sensitivity.

He did the following things and noted his observations:

1. He blindfolded the snake and played a *been* - an instrument snake charmers use to make snakes dance to their tune. The sound of the *been* had no effect on the snake.
2. He then dragged a chair without lifting it. The snake spread it's hood.
3. He removed the blindfold from the snake, held the *been* in front of its hood and began moving it back and forth, without blowing into it. The snake raised its hood and swayed to the motion of the *been*.



4. Instead of the *been*, he now took a stick and moved it in the same way, pretending to blow into it. Again the snake swayed to the motion of the stick.

On the basis of these experiments, answer the following questions:

Does a snake dance when it hears the sound of the *been*? (15)

How did the snake know a chair was being dragged? (16)

What kind of sensitivity causes the snake to dance to the motion of the *been*? (17)

On the basis of the observations from these experiments, what can you conclude about the sensitivity of snakes? (18)

Based on the discussion so far what can you say about the

sensitivity of living creatures? Discuss the subject in your class and write the answer in your own words. (19)

PART II

Sensitivity of plants

Are plants also sensitive? You may have seen the touch-me-not plant. Its leaves close when you touch them. After a while they re-open on their own.

Fill in the blank:

The leaves of the touch-me-not plant are sensitive to ..... (20)

Have you seen plants whose leaves close at night? Discuss some examples in class and note down the names of these plants. (21)

Find the names of some flowers whose petals open during the day but close at night. (22)

Collect information about flowers that remain closed during the day and open only at night. Write their names in a separate list. (23)

What are these leaves and flowers sensitive to? (24)

In which season do trees shed their leaves? Can we take the shedding of leaves as an example of a plant's sensitivity to something? To what is it sensitive? (25)

Discuss the following questions in class:

1. In which month do flowers begin to appear on a mango tree?

2. During which season does the *jowar* plant flower?

3. When does the *palaash* tree bloom? (26)

Find the names of some plants that flower in:

- winter

- summer

- monsoon/rainy season

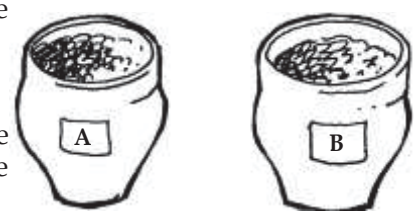
- throughout the year. (27)

Most plants flower during a particular season. This shows that they are sensitive to the weather/seasons. This sensitivity affects their cultivation. We shall talk about this link between plants and weather/seasons in the chapter on "Crops".

Experiment 1

Plants and light

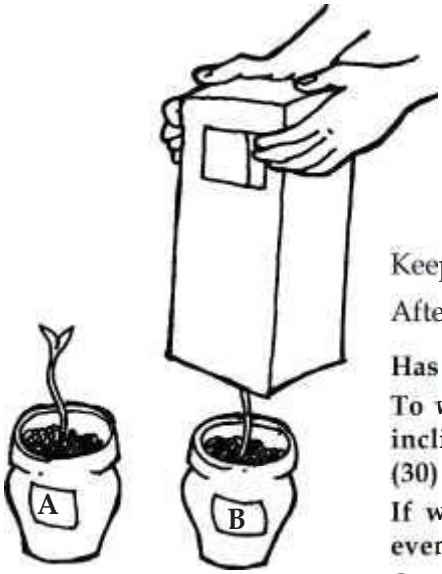
Take two paper or earthen (*kulhad*) cups and fill them with soil from a field. Add a little cow dung to the soil. Make sure the cups have a hole at the bottom. Label them A and B.



Put some *moong* seeds in both cups and water them daily.

As soon as the *moong* seeds sprout, select a shoot each from the two cups. The two shoots should be the same height. Remove all the other shoots from the cups.

You will need a rectangular box with a small window in one of its sides. A shoebox would be ideal. Cut a 1 x 1 cm window in one side.



When the shoots are 10 cm long, cover the plant in Cup B with the box. Each group in the class should place their box facing in a different direction from the window. Keep Cup A uncovered.

Before placing the box on Cup B, make a diagram of the exact position of the plant in the cup. (28)

Keep both cups in an open place with plenty of sunlight.

After 2 to 3 days, look at the plants again.

Has the position of the plant changed in any cup? (29)

To which side has the plant in Cup B inclined? Has this plant inclined in the same direction for all the groups in your class? (30)

If we continue to keep Cup B under the box, will the plant eventually emerge from the window? (31)

On the basis of this experiment what can you say about the sensitivity of plants? (32)

The plant gets two things through the window in the box - air and light. That means the plant bends towards the window for either of these two factors.

Can you think of an experiment which could confirm why the plant bends towards the window? (33)

A mental exercise

In Class 6, you learned that the main shoot/stem of a plant always emerges from one side of the seed. This place is fixed for each kind of seed. But while sowing, farmers simply scatter the seeds in the field. So the seeds fall in different positions on the ground. In spite of this, the roots of all plants always grow downwards into the soil.

Why does this happen? Think well before answering. (34)

Can you think of an experiment to verify this fact? (35)

Some questions for revision

1. **It is said that a crow sees with only one eye. Can you suggest an experiment to verify this?**
2. **Bats are blind. Find out how they fly and are able to find their food without any problem.**

LET'S MAKE CRYSTALS

Chapter 18

In the chapter "Solubility", you learned that urea is soluble in water. You also observed that on heating a solution of urea, more urea can be dissolved in it.

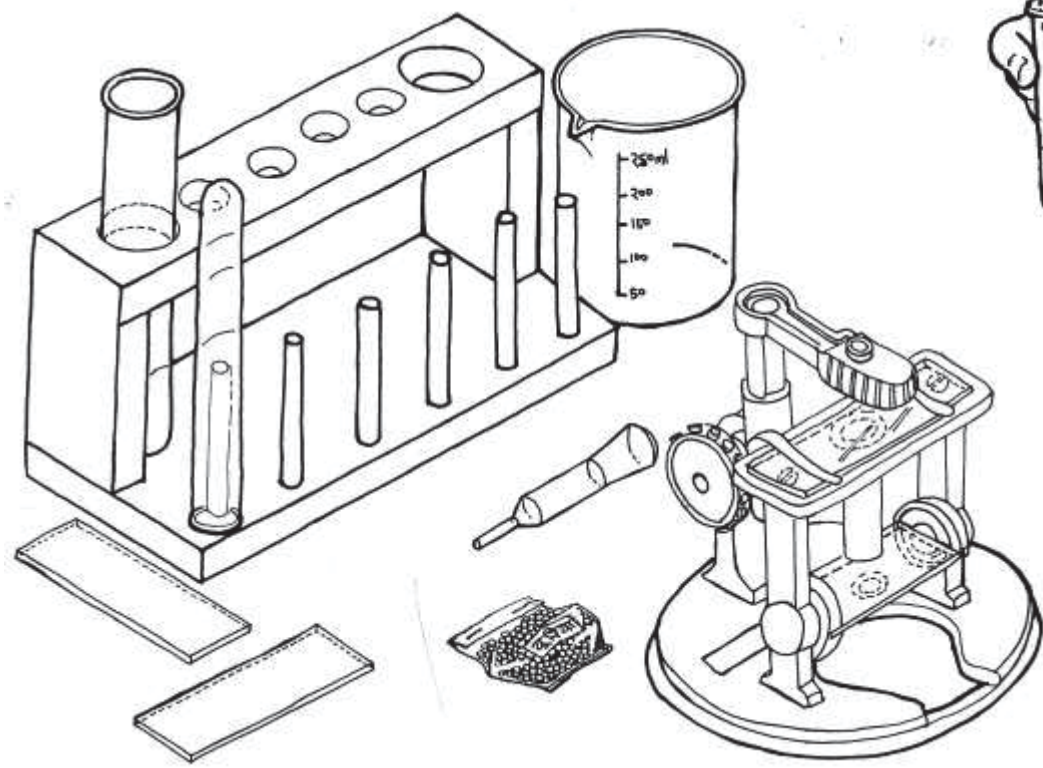
When the solution is cooled, the excess urea solidifies in the solution. This process is called **crystallisation**. To make good **crystals**, we have to control this process.

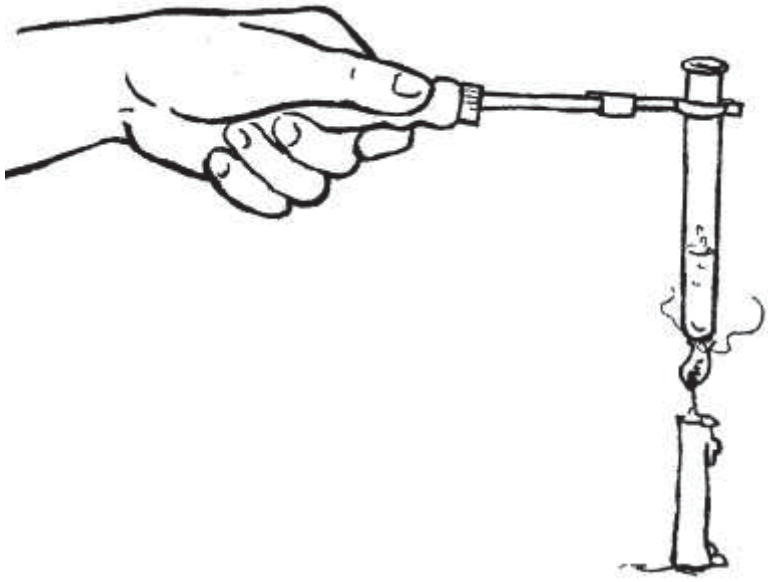
So let's try making crystals with urea and some other substances.

Experiment 1

Urea crystals

Pour about 5 ml of water in a test tube. Add about 8 gm of urea to it.





Did the urea dissolve completely?

If it did not, then heat the test tube till all the urea dissolves.

Let the solution cool for some time. Check the test tube after about half an hour.

Can you see any urea crystals in the solution? (1)

Examine the crystals carefully. If necessary, use a magnifying glass.

What is the shape of the crystals? Make a diagram of a urea crystal. (2)

Is the shape of the crystals the same in every group? (3)

Experiment 2

Benzoic acid crystals

Pour about 30 ml of water in a glass beaker. Add about one gram of benzoic acid to it. Heat the beaker to dissolve the benzoic acid in the solution. After about half an hour, observe the crystals of benzoic acid that have formed.

What is the shape of the benzoic acid crystals? Make a diagram of a crystal. (4)

Are the shape and colour of the crystals the same for all the groups? (5)

Experiment 3

Alum crystals

Pour about 5 ml of water in a test tube. Add about 1 gram of alum to it.

Did all the alum dissolve? (6)

If it did not, then heat the solution until all the alum dissolves. Then place the test tube in a beaker containing cold water. Observe the test tube carefully.

Did crystals of alum form in the solution? (7)

What is the shape of the crystals? (8)

Compare the crystals of urea, benzoic acid and alum. (9)

There is one other way of making crystals. In the chapter "Separation", you saw that it is necessary to evaporate the water in a salt solution to obtain salt from it. Crystals of some other substances can also be obtained from their solutions in this way.

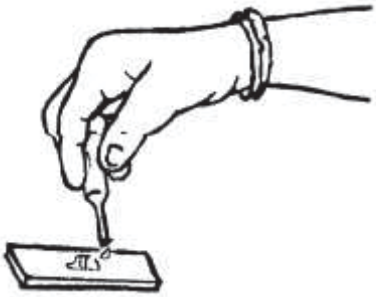
Let's make some crystals using this method.

Experiment 4

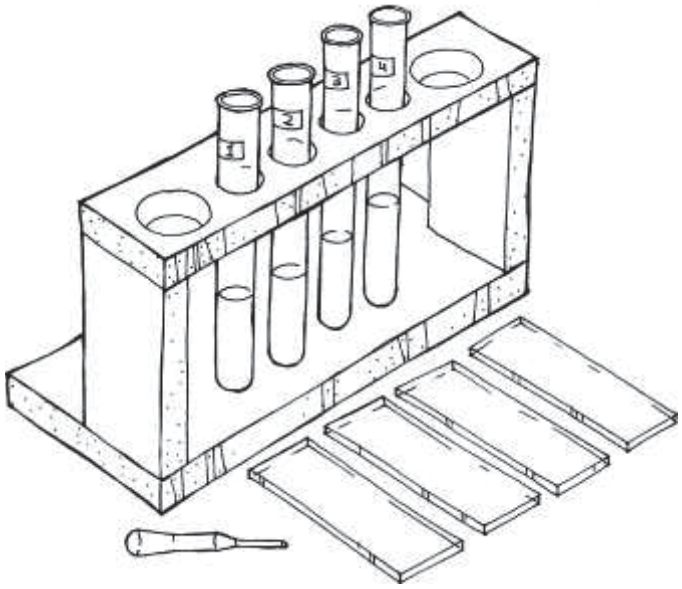
Crystals by evaporation

Take four test tubes and label them 1 to 4. Pour 10 ml of water in each test tube. Add one gram of copper sulphate to the first test tube. Then add one gram each of oxalic acid, urea and salt to test tubes 2, 3 and 4 respectively.

Wash and dry four glass slides. Number these 1 to 4. Use a dropper to put 4 to 5 drops of copper sulphate solution on slide 1. Put 4 to 5 drops each of oxalic acid, urea and salt solution on slides 2, 3 and 4 respectively. If you use the same dropper for all the solutions, wash it properly before adding each solution.



Observe the slides after about an hour.



Where did the water in the solutions on the slides disappear? (10)

Examine the crystals formed on the slides with a microscope and record your observations in the table given below. (11)

Are the shapes of the various crystals different? (12)

Compare the crystals of copper sulphate made by your group with those of the other groups.

Table

Substance	Colour of crystals	Shape of crystals
Copper sulphate		
Oxalic acid		
Urea		
Salt		

Is the shape of these crystals the same for all the groups or is it different? (13)

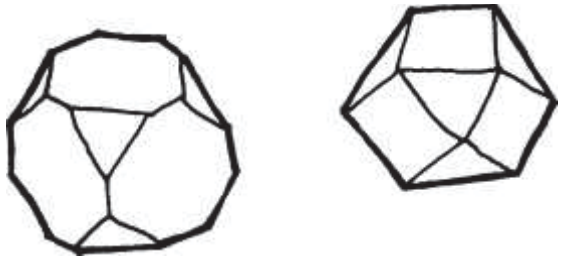
Similarly, compare the shapes of the crystals of other substances formed by all the groups.

Questions for revision

1. ***Mishri* is nothing more than crystals of sugar. Try and find out how *mishri* is made.**
2. **In Experiment 3, you cooled the solution slowly to form alum crystals. What would happen if the solution is cooled quickly, for example by plunging the test tube in cold water? Do the experiment and find out.**

New words

Crystals Crystallisation



OUR CROPS

PART 1

Chapter 19

The crops we grow are part of our lives. You may already know a lot about these crops. You may have seen how the land is tilled and how crops are grown on the farms near your home. In this chapter, we shall try and look for answers to some questions about these crops. Some information is given in this chapter, but there is a lot of other information which you will have to collect.

You can collect information about crops from different sources. These include:

1. A student from a family of farmers.
2. A farmer.
3. The grain market.
4. Newspapers.
5. The Agriculture Department.
6. Books and booklets on agriculture.
7. Your teacher.

We shall analyse the information to find answers to some of the questions about our crops.

The cropping seasons - Kharif and Rabi

You know that different crops are grown in different seasons. The two main seasons are called **kharif** and **rabi**. The kharif season is the monsoon season and the rabi season is the cold season.

Classify the crops you know about into the following four groups:

1. **Kharif crops**
2. **Rabi crops**
3. **Summer crops**
4. **Crops that grow in all three seasons (1)**

After studying these groups, can you conclude that most crops have a particular season in which they grow? (2)

The first question

Have you ever wondered why different crops grow only in a particular season? Let us find out why this is so. Let's take the example of wheat. (If you wish, you could also choose rice, soyabean, *tuar*, *kutki* or any other crop as an example.)

Do all farmers grow wheat only in the rabi season? (3)

The question is, why is this so?

To find an answer to this question, we must first see what differences there are between the rabi and kharif seasons**.**

There are many ways in which these two seasons can be compared. Make a table in your exercise book to list the differences between them. The format of the table is given below. Enter the differences in the table as you identify them.

First of all, which months do the rabi and kharif seasons fall between? (4)

Table 1

Name of season	Duration (months)	Cloud cover	Rain		Light		Heat/ Cold	Length of night	
			Light	Heavy	Less	More		Long	Short
Rabi									
Kharif									

In which season is there more rainfall - rabi or kharif? (5)

In which season is the sky more cloudy? In which season do crops receive more heat (light) from the sun? (6)

Which season is hotter - rabi or kharif? (Before answering this question, think in which season you wear warm clothes, cover yourself with quilts, etc.) (7)

There is one more difference between these two seasons.

You know that the length of the night changes during the course of the year. In the summer season, the nights are shorter and in the cold season they are longer. The graph below shows how

the length of the night changes over the year in Central India.

Let us identify one more difference between the rabi and kharif seasons from this graph.

How long (many hours) are the nights in July? (8)

How long (many hours) are the nights in November? (9)

On the basis of the answer to these two questions, can you tell whether the length of the nights, increases or decreases during the kharif season? (10)

In the same way, can you tell whether the length of the nights increases or decreases during the rabi season. (11)

Enter your answers in Table 1

Write a summary

On the basis of the information in the table, list the differences between the rabi and kharif seasons. (12)

Now that you have identified several differences between the rabi and kharif seasons, let us try and understand why wheat is cultivated only in the rabi season.

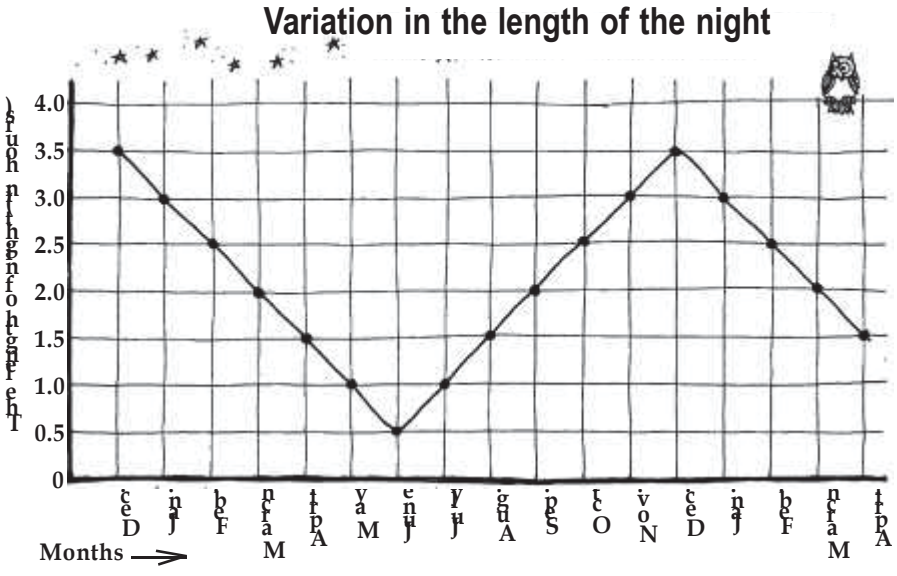
You know that we grow wheat to harvest its grain. The wheat grain is the wheat seed.

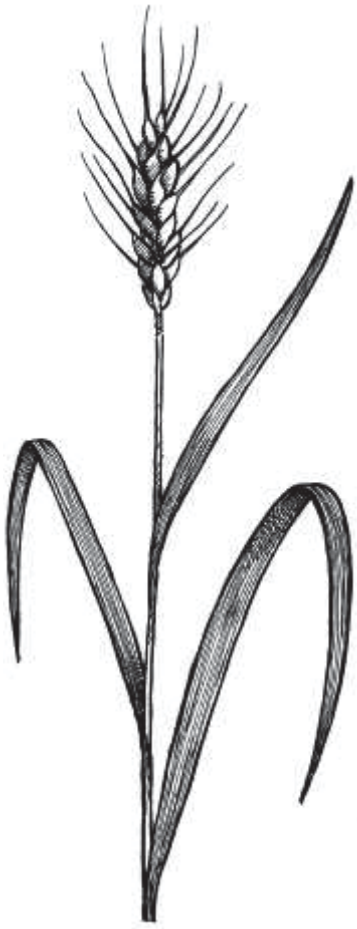
Can a plant produce seeds without flowering? (13)

Two conditions for flowering

Scientists did a lot of experiments with plants and discovered some interesting facts about flowering. They found out that plants can flower only if two important conditions are met with.

The first important condition is that a plant flowers only when it has reached a particular stage in its growth. For example, the plant should cross a particular height before it flowers. In some





plants, flowers appear only after the stem of the plant has developed a particular number of segments. Similarly, the wheat plant can flower only after 7 to 9 leaves emerge from its stem, not before. Only after this condition of minimum growth is met with, is the wheat plant ready to flower.

It takes about 8 to 10 weeks after the wheat seed is sown for 7 to 9 leaves to grow. In other words, the wheat plant is ready to flower after 8 to 10 weeks. But there is one more condition to be met with, before the flowers appear.

This second condition is related to the length of the night. Flowers appear on the wheat plant only when the nights are shorter than 12.5 hours. As long as the nights are longer than 12.5 hours, the wheat plant does not flower.

Look at the graph and find out when this condition is met with. That is, when is the length of the night less than 12.5 hours? (14)

Suppose a farmer sows his wheat seeds in September. Can he expect flowers to appear on the wheat plant after 8 to 10 weeks, that is, in December? Give reasons for your answer. (15)

Another farmer thought that since the wheat plant blossoms only when the nights are shorter than 12.5 hours, why not sow the wheat seeds in January?

Do you think the wheat plants will flower in February? Give reasons for your answer. (16)

If wheat is sown in kharif, what would happen?

Can you now say why wheat cannot be sown in the kharif season? (17)

Let us examine this question in a little more detail.

For the wheat plant to flower, the nights should be shorter than 12.5 hours.

Check in the graph to see in which months this condition is met with. (18)

Suppose a farmer sows wheat in July. It requires 8 to 10 weeks of growth to be ready to flower. This situation would occur in October.

Look at the graph and say whether the nights in October are longer or shorter than 12.5 hours. (19)

Under these circumstances, can wheat be grown in July? (20)

One more fact

While studying the differences between the rabi and kharif seasons, you had also seen which season is hotter and which is colder. If the temperature is high, the growth of the wheat plant is affected. In the early stages of growth, the wheat plant requires cool weather. If the temperature is high, the wheat seeds may not germinate.

If wheat is sown in July, will the seeds face any problem? (21)

We have studied and analysed why wheat is grown in the rabi season. So you can see that farmers too, study and analyse crops before deciding which crop to grow when.

We saw what problems would occur if we sowed wheat in July. There is one more problem. The wheat plant requires higher temperatures for the grain to form. Suppose the wheat is sown in July and the plants flower in October.

Which season follows after October - the hot season or the cold season? (22)

So, can the wheat grain form after it flowers in October? (23)

Can you now explain in your own words, why the wheat crop should be sown in the rabi season? (24)

The length of the night and flowering

We saw in this chapter that there are two important conditions for a plant to flower. One is the stage of growth of the plant and the other is the length of the night. The effect of the length of the night is different for different plants.

Some plants flower only when the length of the night is less than a particular limit. We saw that this limit is 12.5 hours for wheat. Such plants are called **short-night plants**. There are some plants which flower only when the night is longer than a particular limit. If the nights are shorter than this limit they do not flower. Cotton is an example of such a plant. They are called **long-night plants**. In addition, there are other plants which are not affected by the length of the night. They flower throughout the year or at different times of the year. Soyabean is an example of such a plant. They are called **night-neutral plants**. Can you say what kind of plants the following are:

Mango	Sunflower	*Gulmohar*	Marigold
Flame of the Forest	*Gokhru*	*Chandni*	*Gultevdi*
Neem	Tamarind		

In this chapter, we studied one question related to our crops. In Class 8, we shall try to find an answer to another important question about plants. That question is: What are the ways of increasing the productivity of crops?

Some questions for revision

1. **In Madhya Pradesh, the nights are shorter than 12.5 hours from February. In Uttar Pradesh, this situation comes a little later in March. On the basis of this information, can you tell when wheat is ready for harvesting in these two states?**

New words

Rabi Kharif Short-night plants Long-night plants Night-neutral plants

OPTICAL ILLUSIONS

Can you tell whether one cube is placed on top of two cubes or whether two cubes are placed over one cube in Figure 1? Look carefully at the figure for sometime before you decide.

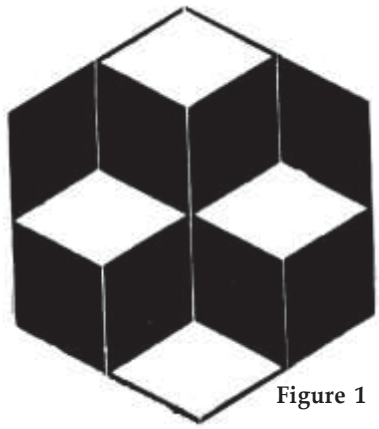


Figure 1

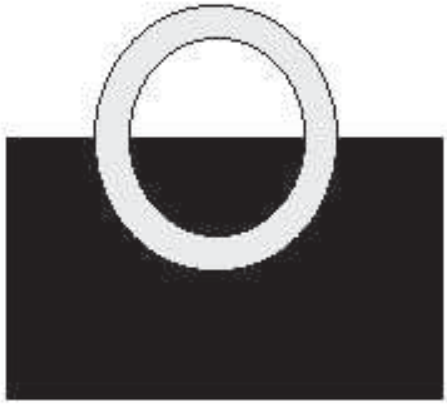


Figure 2

Look at the gray circle in Figure 2. Does it have the same colour throughout? Now stand a ruler on its horizontal edge along the top edge of the black rectangle. Look at the gray circle right from on top of the ruler. Does the colour of the circle look the same all over now?

Figure 3 contains some black squares. White lines divide these squares. But wait! Are these lines pure white? What is their colour at the intersections?

Figure 3

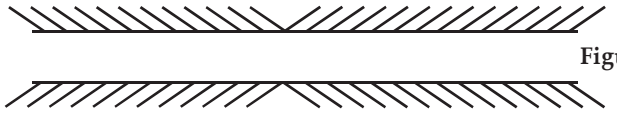


Figure 4

Look at Figures 4 and 5 carefully. Are the long lines drawn in them straight lines? Are they parallel lines? First take a guess. Then use a ruler to check whether your guess is correct or not.

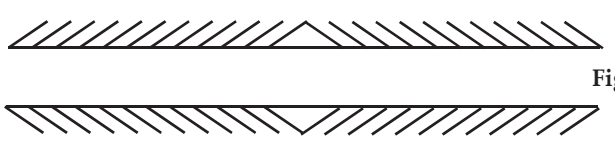


Figure 5

CHEMICAL REACTIONS

Chapter 20

Milk curdles if something sour is put into it. If you put a little curd in milk, all the milk slowly converts to curd. The water in the milk separates from the solids. When a candle is lit, it burns and goes up in smoke. In these examples, something new is formed. Every day a number of such processes take place in which one thing is converted into another.

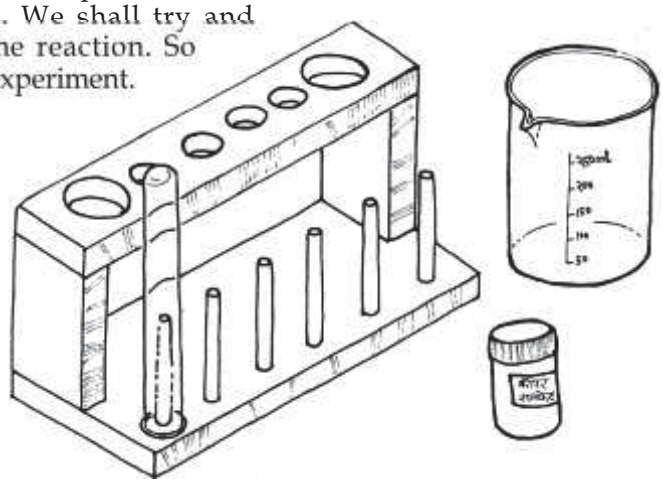
We often mix or dissolve things. Is something new formed every time we do this? When we dissolve sugar in water or switch on a bulb or mix water in milk, is a new substance formed?

Sometimes, a substance forms a new substance if it is heated, or even if it is just left standing. For example, sugar turns black when it is heated.

Think of other such examples where a new substance is formed from a single substance or by mixing more than one substance. Each group in the class should give at least one example. You should explain how you found out that something new was formed. (1)

There are many ways in which we can tell whether a new substance is formed. But there are also some cases in which we may not even know that a new substance has been formed.

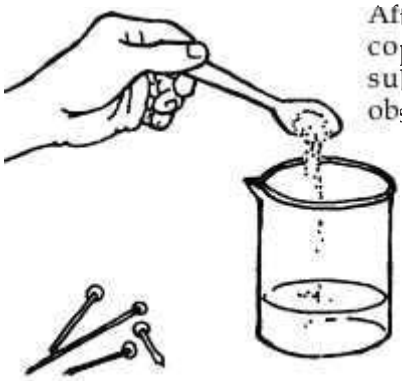
Processes in which new substances are formed are called chemical reactions. In this chapter, we shall perform some experiments to study chemical reactions. We shall try and identify the changes that occur during the reaction. So carefully observe all that happens in each experiment.



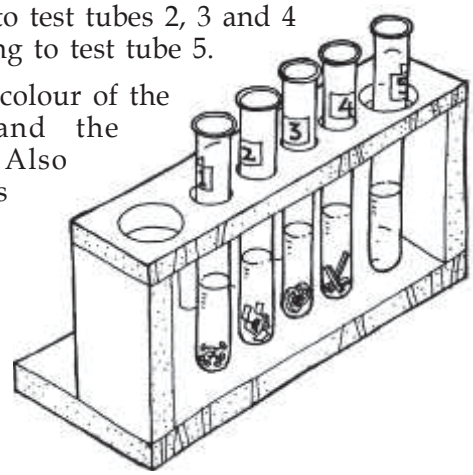
Experiment 1

Copper electroplating

Pour 50 ml of water in a beaker and dissolve about half a teaspoon of copper sulphate in it. Add 1 ml of sulphuric acid to the solution. Take five test tubes and label them 1 to 5. Pour equal amounts of copper sulphate solution into each test tube. Add iron nails or pins to test tube 1. Similarly, add aluminium foil, a plastic



substance and a piece of wood to test tubes 2, 3 and 4 respectively. Do not add anything to test tube 5.



After half an hour, observe the colour of the copper sulphate solution and the substances in each test tube. Also observe whether these substances have undergone any change in colour or whether any new substance is deposited on them.

Record your observations in Table 1. (2)

In which test tubes did the copper sulphate solution become lighter in colour? (3)

In which test tubes did you observe any change in the substances they contain? (4)

On the basis of your observations, can you explain in which test tubes a chemical reaction occurred? Give reasons for your explanation. (5)

Can you guess what new substance was formed in these chemical reactions? (6)

Table 1

Test tube No	Object added to solution	Change in colour of solution	Changes in object
1	Iron nails or pins		
2	Aluminium foil		
3	Plastic		
4	Wood		
5	Nothing		

A problem to ponder over

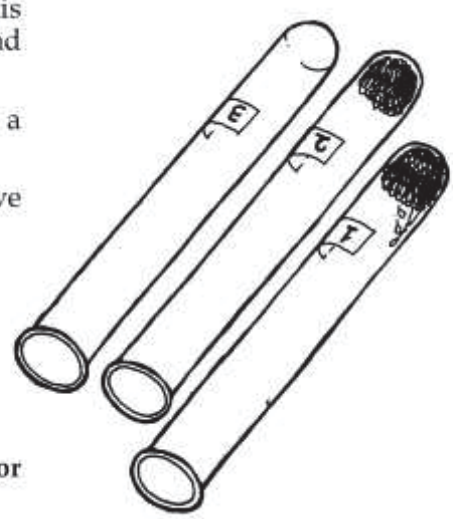
Is there any test tube in which the colour of the solution changed, but nothing happened to the substance it contained? (7)

Is there any test tube in which the substance was affected, but the colour of the solution did not change? (8)

Is there a relationship between the change in colour of the solution and the effect on the substance it contains? (9)

Experiment 2

Let us now see another example of a chemical reaction. In this experiment we shall mix solutions of two different substances and see whether a new substance is formed.



Fill one-third of a test tube with water. Dissolve about half a teaspoon of urea in it and shake well.

Take another test tube with the same amount of water and dissolve half a teaspoon of oxalic acid in it and shake well.

Are both substances, urea and oxalic acid, soluble in water? (10)

Pour the oxalic acid solution into the urea solution. Explain what happens when the two solutions are mixed. (11)

Did an insoluble substance form when the two solutions were mixed? (12)

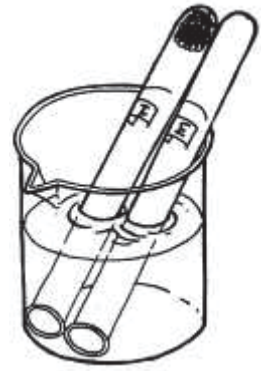
Can we say that a new substance was formed? Give reasons for your answer. (13)

How is the new substance different from urea and oxalic acid? (14)

Experiment 3

Rusting of iron

In the earlier experiments, we learned how to recognise whether a new substance had formed during a chemical reaction. Let us now see another example. You may have observed that a coating of rust forms on iron. We shall perform an experiment to see what changes take place when iron rusts. This experiment will take some time so you should be patient and make arrangements to ensure that the apparatus is not disturbed for the duration of the experiment.



Take three test tubes, two beakers and an iron brush used for cleaning utensils. Label the test tubes 1 to 3. Pull out two strands of wire from the brush, each about half a metre long. Roll these wires into two small balls. Dip one ball in water and drop it in test tube 1. Put the other dry ball in test tube 2. The balls should be large enough to be packed at the bottom of the test tubes so that they don't fall out if the test tubes are inverted. Nothing should be done to test tube 3.

Fill one-fourth of a beaker with water. Invert test tubes 1 and 3 in the beaker. Test tube 2 should be inverted in another dry beaker.

Note the water level in test tubes 1 and 3. You will see that the water level is the same as that in the beaker. Place the two beakers with the test tubes in a safe place where they can remain undisturbed. Observe the test tubes every day for the next three days. Don't take them out of the water to make your observations. Note the changes you see in the iron balls and the water level in the test tubes.

Record your observations in Table 2. (15)

In which test tube did you notice a change in the iron ball? (16)

In which test tube did the water level change? (17)

What could be the reason for the change in water level? Discuss with your teacher before writing your answer. (18)

Table 2

Sr. No.	Test tube	Changes in water level in test tube	Effect on iron
1.	Wet iron		
2.	Dry iron		
3.	No iron		

In which test tube did you find evidence of a chemical reaction and what was the evidence? (19)

In the above three experiments, we saw that there were different indicators to show that a chemical reaction was taking place or a new substance was being formed.

In the chapter "Our food", you tested various substances to find out if they contained fat, protein and starch.

In which of these tests was a new substance formed? Give reasons for your answer. (20)

Take some lime water in a test tube. Blow air into the lime water using a glass tube.

Did you notice any changes in the lime water after you blew air into it for some time? (21)

Does your breath cause a chemical reaction to take place in the lime water? (22)

Which of the following can be called a chemical reaction?

- Extraction of lime juice
- Burning of wood
- Breaking of glass
- Tearing paper into pieces
- Ripening of a mango (23)

In the chapter "Gases", you will perform experiments in which chemical reactions take place to form gases and you will test the properties of these gases. Next year you will learn how to measure the rate of a reaction. You will also see what factors affect chemical reactions.

Questions for revision

1. Which of the following processes are chemical reactions? How would you conclude that they are chemical reactions?

- Making a salt solution
- Evaporation of water
- Adding hydrochloric acid to marble
- Melting of wax
- Separating colours by chromatography
- Melting of ice
- Colourless phenolphthalein indicator solution turning pink

2. In the chapter "Respiration", you learned the difference between inhaled and exhaled air. On the basis of what you learned, explain whether a chemical reaction takes place inside our body during respiration.

3. In Experiment 3, we used three test tubes. Would we face any problem in drawing conclusions if we use only one test tube? Give reasons for your answer.

NUTRITION IN PLANTS

Chapter 21

A farmer sows about one to one-and-a-half quintals of wheat seed in a hectare of cultivated land. After three to four months, he harvests 20 to 25 quintals of wheat. He also gets a lot of straw.

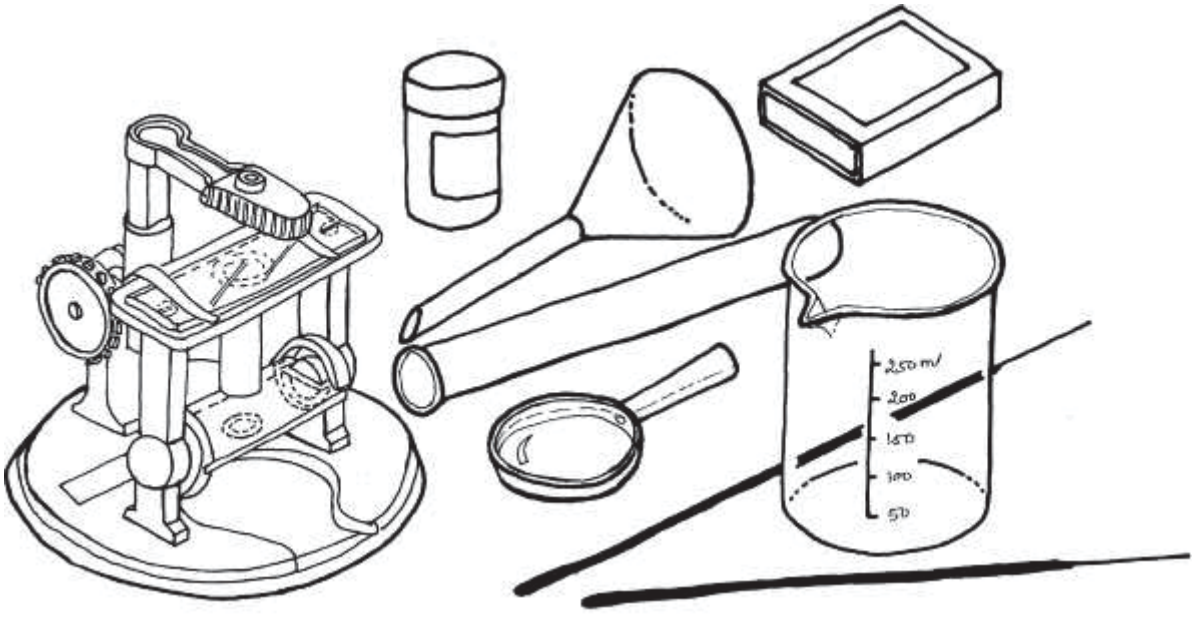
A mango seed grows into a mighty mango tree that yields hundreds of juicy mangoes within a few years.

Have you ever thought where all that wheat and straw comes from? How did the mango tree get so many leaves and grow such a thick trunk and branches?

In the case of human beings, we know that a child eats food every day and grows into an adult.

But how do plants become big without eating or drinking anything? How do they produce so much wheat or mangoes? From the soil? Or from the water used to irrigate them? Or from the air?

People have been thinking about this question from ancient times.



At first they thought plants got everything they needed to grow from the soil. The Greek philosopher-scientist Aristotle believed that, unlike animals, plants did not have organs for digesting food. So they absorbed rotting substances dissolved in the soil. But no one thought of testing this theory until many, many years later, a man from Belgium decided to check whether it was true or not. His name was Jan Baptista van Helmont and he conducted an experiment that continued for five years. The experiment was performed 350 years ago in 1648. Let us see what van Helmont did.

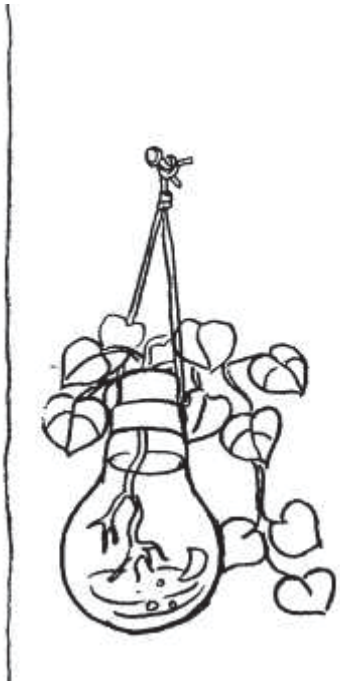
Van Helmont's five-year experiment

Van Helmont took a large pot and filled it with 90 kg of soil. He planted a cutting of a willow tree in it. It weighed 2.268 kg. He irrigated the cutting with distilled water for five years. The pot was large and was buried in the ground. Van Helmont took care to ensure that the soil in the pot remained in contact with air, but he saw to it that no outside dust got in by covering the pot with a metal lid punched with fine holes.

Gradually, the sapling grew into a small tree. After five years, van Helmont uprooted the tree, cleaned it and weighed it. The tree weighed 74 kg. He then dried the soil in the pot and weighed it. Its weight was 89.944 kg, against 90 kg at the beginning of the experiment. He calculated that the soil was reduced by only 56 gm in those five years while the weight of the plant increased by 71.732 kg.

What conclusion can you draw from this experiment? Would it be correct to say that the material needed for the plant to grow came from the soil? Give reasons for your answer. (1)

Van Helmont took five years to conduct his experiment, but a similar experiment goes on in many households even today. You may have heard about the money plant. It is a decorative plant that people grow in their homes. It is kept in a bowl of water and grows quite comfortably without even a bit of soil. So where does the money plant get its nutrition from?



Have you seen plants floating on water in a tank or river, without any contact with soil? If you have, tell your classmates about these plants.

So, is soil necessary for the growth of all plants? (2)

Is water the food of plants?

Van Helmont drew two conclusions from his experiment:

1. The substances needed for the growth of a plant do not come from the soil.
2. The plant grows because of the water it gets.

Were van Helmont's conclusions correct? We shall find out later in this chapter.

Priestley's first experiment

For at least a hundred years after van Helmont conducted his experiment, no one paid any attention to the subject of nutrition in plants. In 1771, Joseph Priestley conducted some experiments that yielded a lot of new information. Actually, Priestley did not conduct these experiments to study plant nutrition. He wanted to find out what gases are present in the air.

You have already performed one of Priestley's experiments in the chapter "Gases". When a lighted candle is covered with a beaker, its flame is extinguished after some time.

Why is the flame extinguished? (3)

We know that oxygen is consumed when a candle burns and carbon dioxide is formed.

When Priestley performed his experiment, no one knew about carbon dioxide and oxygen. Priestley concluded that the process of burning makes the air inside the beaker impure. The candle is extinguished because it cannot burn in impure air.

Priestley's second experiment

Priestley then conducted a second experiment. He covered a small mouse with a beaker. After some time, he saw that the mouse began suffocating. Priestley concluded that the mouse's respiration also makes the air impure.

To sum up, Priestley said that a respiring animal and a burning candle spoil the air in some way. The air can no longer support life or a flame.

You, too, performed the experiment with the candle. Was your conclusion the same as Priestley's? (4)

These experiments set Priestley thinking. There are so many animals in the world and so many fires burning - why doesn't all the air in the world become impure?

Animals, insects, birds and other living things breathe in oxygen and breathe out carbon dioxide all the time. So shouldn't all the oxygen be consumed after some time, leaving only carbon dioxide? But this does not happen. Why?

What do you think is the explanation? (5)

Priestley's third experiment

Priestley

Priestley managed to partially answer this question in August 1771. He performed an extraordinary experiment. He kept a beaker over a lighted candle. As expected, the flame was extinguished after some time. Priestley then placed a sprig of mint inside the beaker. While doing so, he took care not to allow outside air to mix with the air inside the beaker .

After 10 days he lit the candle again. It started burning. He did not remove the beaker to light the candle but used a lens to light it from outside.

Why was the flame extinguished the first time the candle was lit? (6)

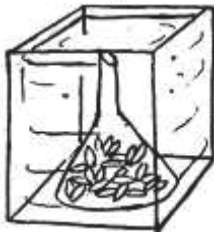
Which gas filled the beaker while the candle was burning? (7)

Why did the candle light up the second time? From where did it get the oxygen needed for burning? (8)

Where did the carbon dioxide in the beaker go? (9)

Write, in your own words, a summary of all three experiments performed by Priestley. (10)

On the basis of these experiments what would you say is the role of plants in maintaining the composition of air in the atmosphere? (11)



Can you imagine how important this experiment must have been in those days?

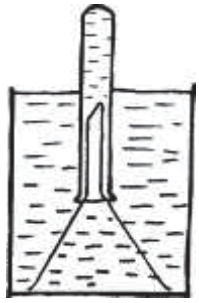
Priestley concluded that the mint sprig made the air pure again. Today we know that oxygen is consumed when a candle burns and carbon dioxide is formed. The mint sprig absorbs this carbon dioxide and releases oxygen. That is why the candle can be lit again.

Priestley showed through his experiment that all green plants have this property of purifying the air.

An experiment similar to Priestley's

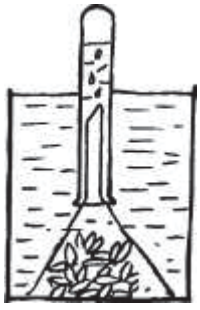
Let us do an experiment similar to Priestley's, with slight modifications.

Experiment 1



You will need a beaker, test tube and funnel for this experiment. Both the beaker and funnel should be transparent. Get some sprigs of an aquatic plant. Keep these sprigs in water while bringing them to class to prevent them from drying up. Fill the beaker with water and add some baking soda (sodium bicarbonate). Now arrange some sprigs inside the funnel as shown in the figure. Fill a test tube with water and invert it over the funnel. Take care not to allow any water to spill out of the test tube while doing so.

Place the apparatus in the sun.



Set up a similar arrangement, but do not put sprigs in the funnel this time. Keep this apparatus in the sun as well.

Do you see bubbles coming from the plant sprigs? (12)

Do bubbles form in the apparatus without sprigs? (13)

Let both sets of apparatus remain in the sun for about an hour. Once the test tube is more than half filled with bubbles, we shall try and identify the gas in these bubbles.

Cork the test tube firmly. But ensure that it remains inverted and its mouth is under water while you are doing so. If you do not have a stopper, use your thumb to close its mouth. Keeping the mouth closed, turn the test tube right side up.

Light an incense stick and dip its smouldering tip into the test tube, without letting it dip into the water in the test tube.

What happened? What gas is in the test tube? (14)

Where did this gas come from? What role does the plant play in the entire process? (15)

We used an aquatic plant in this experiment because it was convenient to do so. But Priestley's third experiment shows that all plants perform this activity.

Problems with Priestley's experiment

Priestley's experiment with the mint sprig was not just extraordinary, it was very important as well. When a scientist performs an experiment of such importance, other scientists try to verify it by repeating the experiment themselves. But, when scientists tried to repeat Priestley's experiments, they ran into many unexpected problems. The experiment was successful in some cases but failed in others. In many cases, the scientists could not get the results Priestley obtained. What went wrong? What was the problem?

A scientist named Jan Ingenhausz tried to find out. He repeated Priestley's experiment under a variety of conditions.

Ingenhausz noticed that only the green parts of plants (the leaves) perform the function of purifying air. He also noticed that leaves purify air only if they are kept in a lighted place. When they are kept in the dark, they too make the air impure.

In other words, Ingenhausz discovered that green leaves take in carbon dioxide and give out oxygen in the presence of light. In the absence of light, they do what animals do - they respire, inhaling oxygen and exhaling carbon dioxide.

Ingenhausz thus showed that Priestley's experiments could be repeated and similar results could be obtained if the experiments were performed under exactly similar conditions. It is essential to keep this in mind while verifying experiments done by others.

Experiment 2

The effect of light

In Experiment 1, you saw that plants release oxygen. Change the experiment slightly by placing the apparatus in the shade instead of in sunlight.

Was there any change in the rate of formation of bubbles? (16)

Cover the beaker with black paper or cloth.

Check after some time to see whether bubbles are still being formed. (17)

Food from air?

We learned about several different experiments conducted by scientists. First was van Helmont's experiment, which concluded that plants get their food from water. Then there were the experiments of Priestley and Ingenhausz. These showed that green leaves take in carbon dioxide and give out oxygen in the presence of light.

If we combine the two conclusions we can say that green plants take in water and carbon dioxide to prepare their own food in the presence of light. Imagine, plants survive on air and water!

Food from air and water

More experiments were performed and, gradually, it became clear to scientists that green leaves use water and carbon dioxide in the presence of sunlight to make starch.

This process can be written in the form of an equation:

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{in the presence of sunlight and chlorophyll}} \text{starch} + \text{oxygen}$$

Not only is starch formed but oxygen is also released. This process is called **photosynthesis**.

Synthesis means formation of a new substance by a chemical reaction between two or more substances. Because this process takes place only in the presence of sunlight, it is called photosynthesis (photo means light). In nature, the presence of the green substance in leaves is essential for photosynthesis to take place. This green substance is called **chlorophyll**.

What is needed for photosynthesis

Photosynthesis is an important process. It is how plants make their food. They grow and gain weight. We would have no food if there was no photosynthesis. Do you now understand how 20 to 25 quintals of wheat are produced by sowing just 1 to 1.5 quintals of seed?

You also now know that four things are needed by plants to make their own food (photosynthesis):

1. Water
2. Carbon dioxide
3. Light
4. Green substance present in leaves (chlorophyll)

Where did the water come from?

We know that von Helmont was right when he concluded that plants get their food from water. But that was not the whole

truth. Plants get their food from air, too.

That raises an interesting question. Plants get water from the soil through their roots while the process of photosynthesis takes place in the leaves. So how does the water reach the leaves from the roots? What path does it follow?

Let us do an experiment to find out.

Experiment 3

For this experiment we shall use a plant with small white or light coloured flowers, like *sada bahar*, parthenium (*gajar ghas*) or balsam. If possible, get a plant in bloom.

Carefully uproot two such plants of the same species. Remove the soil clinging to their roots. Ensure that the roots are not damaged while you uproot and clean them. Place the plants in a vessel containing fresh water. Do this immediately after uprooting them.

Take two empty bottles or glass tumblers and fill one-third of them with water. Add about four teaspoons of red ink to the water in one bottle. Tie the two plants to two separate dry twigs. Take care not to damage their stems while tying them. Place one plant in the red ink solution. The twig should stand erect in the glass. In the same way, put the other plant in the glass containing plain water. Keep both glasses in the shade for about an hour.

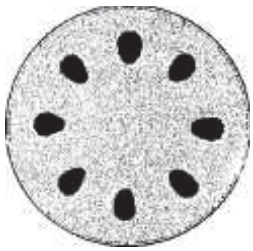
Study both plants and record your observations in Table 1. (18)

Cut the stems of both plants horizontally with a blade. Examine the dissected section with a magnifying glass.

Can you see red colour anywhere in the stem?

Table 1

S. No	Question	Observation	
		Plant in plain water	Plant in red ink solution
1	Examine the leaves of both plants. What difference do you see?		
2	Examine the flowers of both plants. Do you see any change in their colour?		



Are the spots of red colour arranged in the way shown in the figure?

On the basis of your observations, trace the route by which the red water reached the flowers and leaves. (19)

On the basis of this experiment, what conclusion can you draw about the functions of the root and the nutrition of plants? (20)

Farmers sprinkle urea in their rice or wheat fields whenever the leaves turn yellow. The leaves soon become green again.

Why do they irrigate the fields after sprinkling urea? Think it over and give reasons for answer.

How does the sprinkled urea affect the leaves of the plant?

This experiment and the information about urea tell us how and from where plants get water and other nutrients dissolved in the soil.

Exchange of air

Plants get water from the soil through their roots. They absorb carbon dioxide from the air. This job is done by the leaves. The leaves have tiny holes through which the exchange of air takes place. These holes are so minute you can only see them with the help of a microscope. They are called **stomata**. The air exchange takes place continuously through the stomata.

We know that plants take up water through their roots and air though the stomata of their leaves. We also know that the leaves contain the green substance called chlorophyll. What else is needed for photosynthesis?

Examine the conclusions of Experiment 2.

Did bubbles form when the plant did not get sunlight? (21)

Can you conclude on the basis of this experiment that plants absorb carbon dioxide and give out oxygen only in the presence of light? (22)

The next question is whether the process of forming starch by combining carbon dioxide and water also requires light. Let us try to find out.

If light is absent

A description of an experiment is given here. Read it and try and find out what effect light has on the formation of starch in leaves. The experiment was done with a plant called *chandni*, but it can be performed with any plant.

You need to find out if starch is present in the leaves. You already know how to test for starch, but a problem arises if you try this test on leaves. Leaves are green in colour. When iodine solution is put on a leaf, it should turn blue if starch is present. However, the green colour of the leaf disguises the blue colour. So you must first remove the green colour of the leaves if you want to

test whether they contain starch. The way to do this is to first put the leaves in boiling water and then boil them in alcohol. This is a bit difficult. You need to be careful while boiling leaves in alcohol.

In the experiment described here, 4 to 5 leaves of a *chandni* plant were plucked in the afternoon. After removing their green colour in the way described above, they were put in an iodine solution. The leaves turned black.

Why did this happen? (23)

In the second part of the experiment, 4 to 5 leaves on the same plant were covered with black paper. The way the black paper was cut and fixed to the leaves is shown in the figure.

Black paper attached to a leaf

These leaves were plucked two days later. Their green colour was removed and they were dipped in iodine solution. The leaves turned black in the pattern shown in the figure given below.

Can you tell by looking at the figure where starch is present in the leaf and where it isn't? (24)

Did the entire leaf get light after it was covered with black paper? If not, which part of the leaf did not get light? (25)

Did starch form only in the part that got light? (26)

On the basis of this experiment, what connection do you see between light and starch formation? (27)

The colour of the leaf after iodine is applied

Do plants produce only starch?

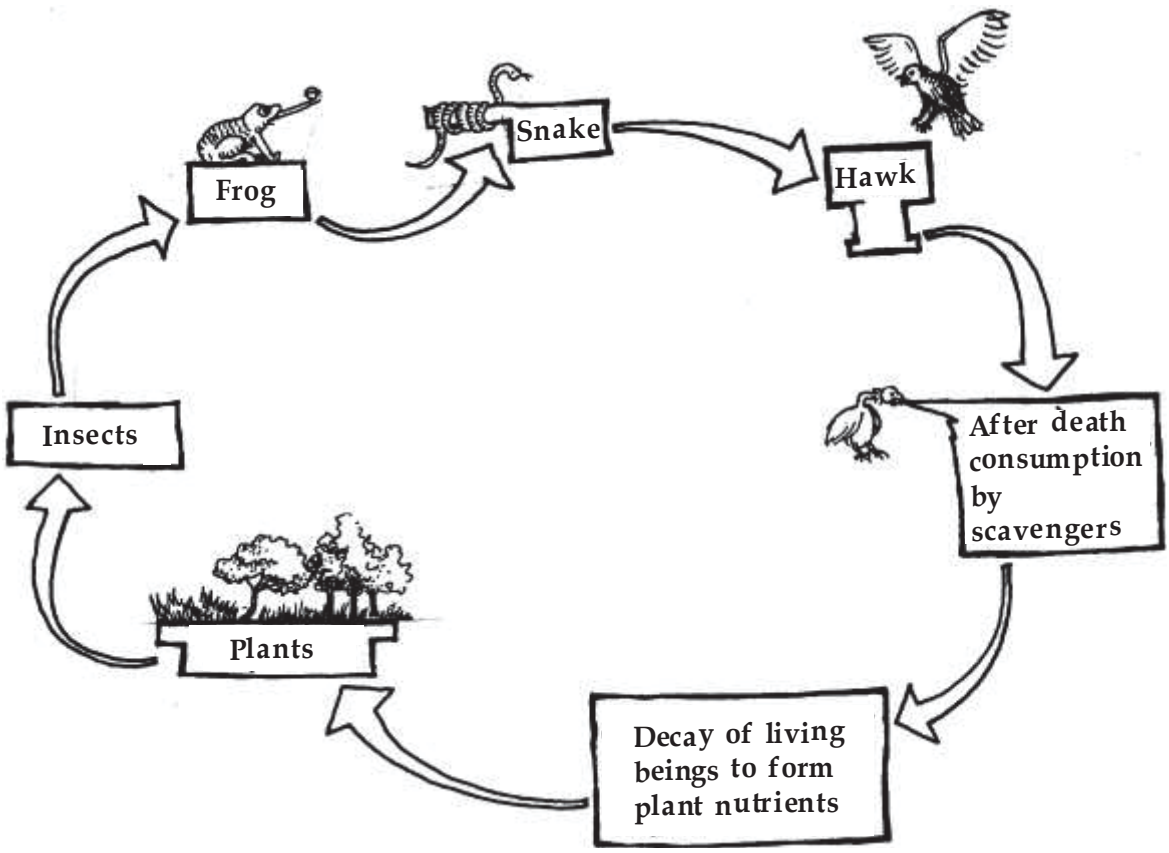
In the chapter "Our food", you read that food contains starch, fats and proteins. They are also present in plants. Where do these substances come from? Once starch is formed, the plant produces the other substances from it. But plants need other nutrient elements to do this. The main nutrients needed are nitrogen, potassium and phosphorus. Plants require many other nutrients as well, but these are needed only in minute quantities. Hence, they are called **micronutrients**. Plants absorb these nutrients from the soil through their roots. However, we cannot perform any experiment to study these nutrient elements at this stage.

Food chain: The link between plants and animals

It is, indeed, remarkable that plants prepare food not only for themselves, but for animals as well. Food is what links animals and plants. This relationship can be explained with the help of a diagram.

Animals and plants are also linked through photosynthesis and respiration.

Both animals and plants respire. Yes, it is important to remember that plants also respire and their respiration is exactly like that of animals. This means plants also inhale oxygen and exhale



carbon dioxide during respiration. This process goes on 24 hours of the day and night. The quantity of carbon dioxide in the atmosphere keeps increasing because so many living beings are respiring all the time. During the day, plants use the carbon dioxide with the help of chlorophyll and release oxygen into the atmosphere. This process of photosynthesis proceeds at a rapid pace. So we do not notice plants respiring during the day.

Questions for revision

1. **In Experiment 1, we used two similar beakers, but only one of them held a plant. Why was a beaker without a plant used?**
2. **State, on the basis of Priestley's second and third experiments, how we can keep the mouse in the beaker alive for a longer time.**
3. **A potted plant is kept in the light for a day and one of its leaves is tested for starch. The same plant is kept in the dark for two days and another leaf is tested for starch. Will there be a difference in the results of the two experiments? Give reasons for your answer.**

New words

Photosynthesis
Chlorophyll
Micronutrients
Stomata
Food chain

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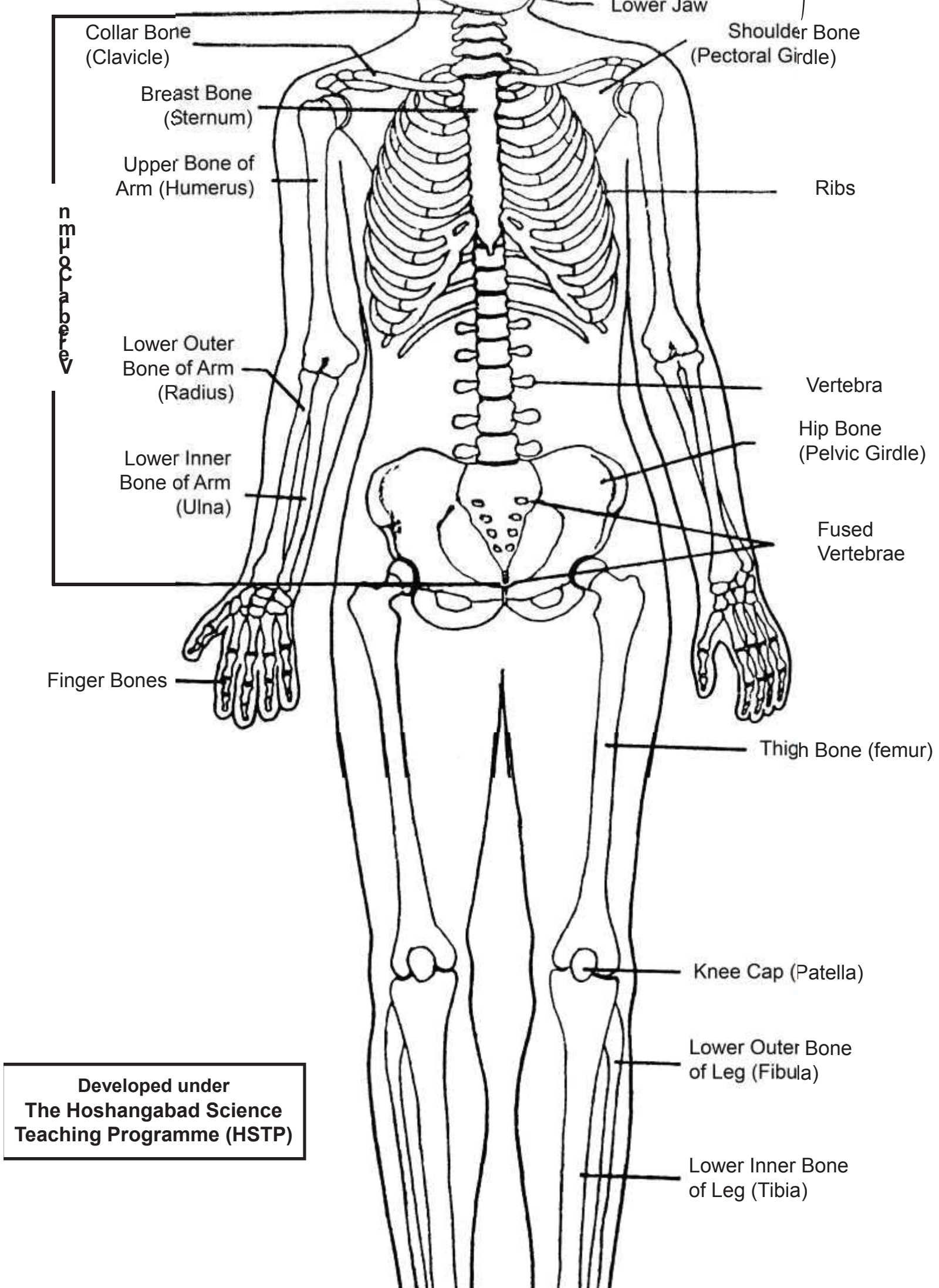

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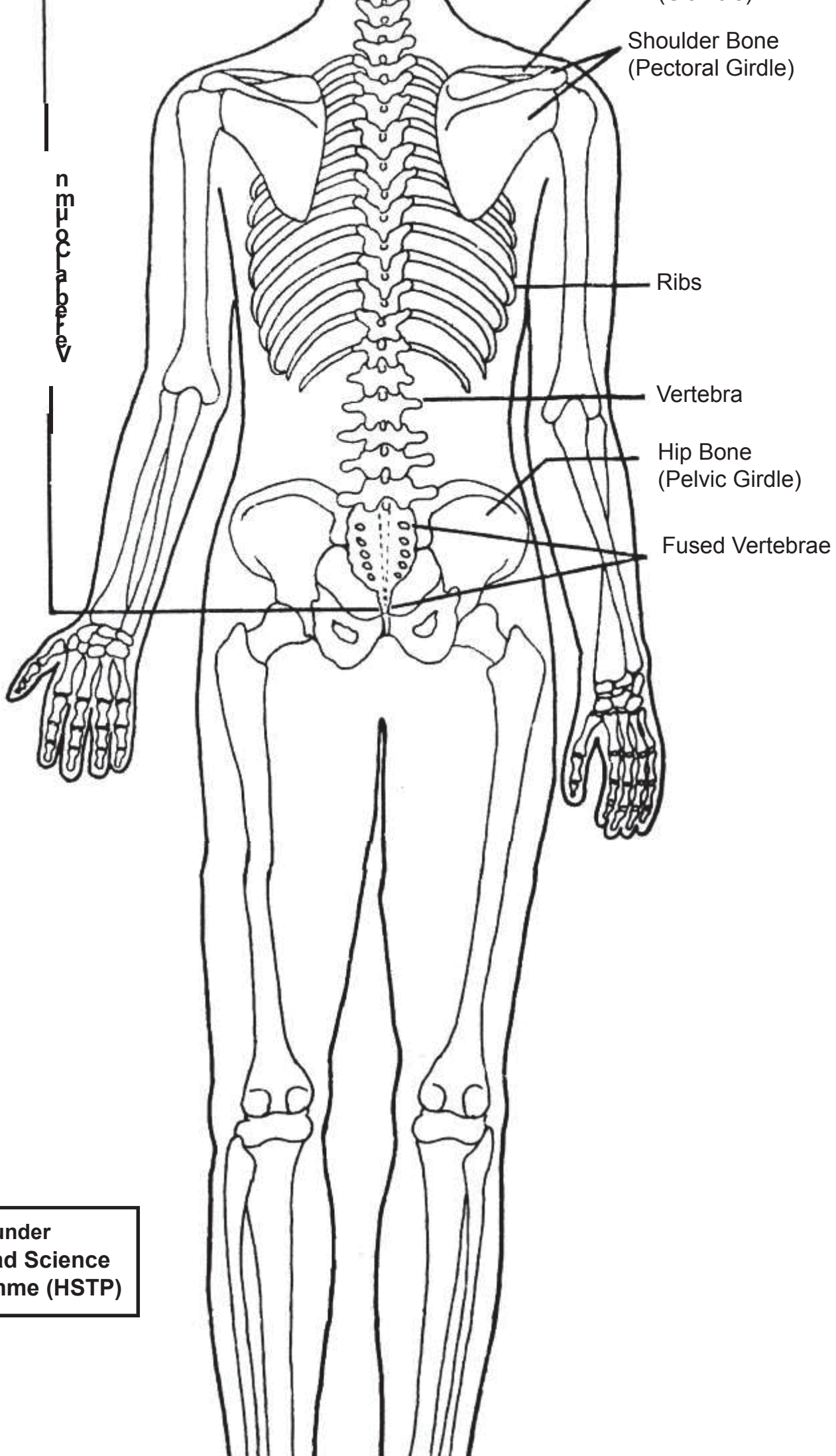

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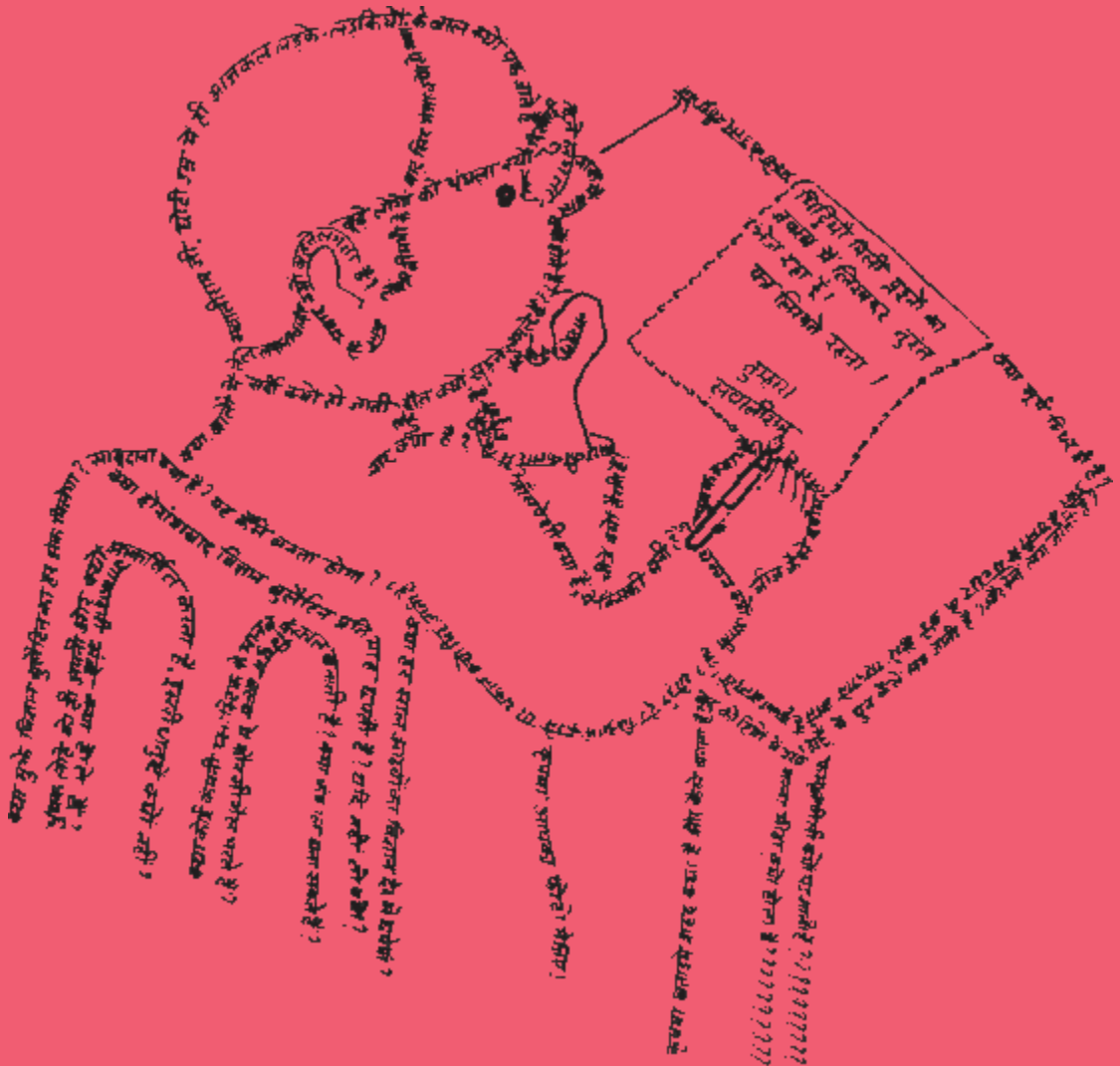

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