Chapter-1

FUN AND GAMES

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.

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 the stable and firm and which are not. Just press them between your finger and thumb.

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

Figure 1 **Figure 2** **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).

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.

The shape shown in Figure 5 a is a **tetrahedron**. This is the sturdiest shape found in nature and a 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 staves. This stand is in the shape of a tetrahedron.

Figure 4 **Figure 5** **a** **b** **c** **d** **e**

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).

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 6 **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.

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.

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

You see many living creatures around you. Some are small and some are big. Which is the biggest animal you have seen till now? Which is the smallest?

In this chapter we shall study some animals that are easy to capture and bring to the class. While doing so, we shall learn more about the methods of observing and studying animals. We shall also look at different parts of their bodies and study their structure.

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

Your teacher will inform you a day before we begin this chapter to bring an earthworm, grasshopper and fish to school. It would be best if these animals are brought live to the classroom.

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

STUDYING THE EARTHWORM

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

Is its skin dry or wet? Touch the skin to find out. (2)

What is its colour? (3)

Is there a difference in the colour of its skin in the upper and lower (touching the ground) parts of its body? Explain any difference you may observe (4)

You have seen many other animals. Is there a difference in colour in the upper and lower surfaces of these animals as well? (5)

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

If you find it difficult to answer Question 6, look at the picture at the end of this chapter. It shows three ways in which animals without legs crawl forward. Again observe how the earthworm moves and see which of these three methods it uses.

SEGMENTED BODIES

Examine the body of your earthworm. Is the body divided into circular band-like structures? (7)

A body that is divided into such band-like structures or rings is called a segmented body.

MAKE A SPECIAL EFFORT

To study your earthworm more closely, place it in a transparent glass bottle or a plastic jar or beaker. Then use a hand lens to make the following observations.

1. Look at the circular band-like structure on the body of the earthworm that is of a slightly different colour than the other bands. You can easily spot this structure in a large earthworm.

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

The place of this structure is fixed in the earthworm. There number of segments between it and the mouth are fixed.

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

2. Examine the mouth of the earthworm with the hand lens.

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

3. Turn the bottle or beaker in which the earthworm is kept towards the light. Now look at its body.

You will see a long tube inside its body with 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 that it has eaten.

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

SOME INTERESTING INFORMATION ABOUT EARTHWORMS

Experiments have shown that the earthworm shies away from light. If a bright light is shone on its face, it moves away from the light. The earthworm does not have eyes. So how does it know if there is light in a place 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 your group has brought to the 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 here 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)

Figure Head Breast Stomach

THE FIRST SEGMENT: THE HEAD

Examine the head of the grasshopper with a hand lens. There are two long structures emerging from the front of the head. The grasshopper finds out about changes occurring in its environment with the help of these two structures. For example, temperature and smell.

These structures are called antennae.

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

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

Does the antenna have a joint in it or not? (19)

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

Which animals that you see around you have antennae? (21)

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

THE SECOND SEGMENT: THE BREAST

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

How many legs does a grasshopper have? (23)

Are all the legs the same length or are some long and some short? (24)

Is there hair 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 does not have joints in its legs what problems would it face? Discuss the matter in class before writing your answer. (28)

Make the following observations about the wings of the grasshopper:

1. How many wings are there?

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 STOMACH

The entire portion behind the breast is called the stomach.

Examine the stomach of the grasshopper with a hand lens.

Does any organ emerge from this portion? (30)

Is the stomach segmented or not? (31)

STUDYING A FISH

Each group should bring one fish. Sit in your own 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 the tail. Then run your finger from the tail to the head.

Did it feel the same both ways? (34)

Which structures on the skin did you find out about while doing so? (35)

If you cannot see these structures, use the hand lens to observe them.

These structures are called scales.

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

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

Open the mouth of the fish and see whether it has teeth and 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 it dies, the gills slowly become darker and dull coloured. A person who buys fish can tell whether the fish is fresh or stale by looking at its gills.

Discuss the similarities and differences among the fishes of all the groups. List these similarities and differences in your exercise book. (41)

A FIELD TRIP

You learned how to study animals by observing 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 get more information on animals by observing them in their natural habitat. You could catch these animals and put them in a broad-mouthed jar for some time so that you can observe them more closely. Once you have studied them release the animals into their habitat.

PREPARING FOR THE FIELD TRIP

1. Before leaving on your field trip, draw Table 1 in your exercise book. Take the book along with you.

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

The students should observe different animals. For example, one could study a bird and another an insect. In this way, the class can get observations of many different animals. Note your observations in the table. If you get some new information about any animal, write that down in your exercise book.

In this way, you will 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	How many legs it has	How many wings it has	Way it moves	Sound it makes

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.

AFTER YOU RETURN TO THE CLASSROOM

Make the following groups on the basis of the information in your table:

1. Animals with wings

2. Animals that crawl (42)

Does the information in your table include any animal that does not have joints in its legs? (43)

WHAT ANIMALS EAT

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

Which are the animals in your list that eat only plants/trees or things obtained from them (fruit, flowers, grain, the nectar of flowers etc)? (45)

These 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)

These animals are called **omnivores**.

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

These animals are called **parasites**.

List the names of some parasites. (48)

If your table doesn't contain any such animal, ask your teacher and write down 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 chart on a drawing sheet. Draw pictures of each animal with its name, what it eats and where it lives. Hang the chart in your classroom. (52)

OUR BODY: AN ABODE OF ANIMALS

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

You must be familiar with lice. They live between 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 bodies. Like in the hair on the chest of males.

Many people suffer from dandruff in their hair. Dandruff is caused by a fungus. This fungus is a saprophyte. It causes the upper layer of the skin on the scalp to become dry and flake off. The dried skin that sheds is 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 bodies. 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 bodies. You may have heard of children suffering from worms in their stomachs. The roundworm is one such worm. Other worms like the roundworm find their way into our alimentary canal. They consume the digested food there.

Some microorganisms cause diseases after entering our bodies. Some examples are 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.

Figure Lice Worm that causes elephantiasis

Figure Roundworm

SOME QUESTIONS FOR REVISION

1. Which of the following facts are true or false? Tick 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 as well.

c) Herbivores and carnivores together are 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 hand lens. Group them according to the number of legs they have.

3. Make a list of ten omnivores, ten carnivores and ten herbivores that live in your vicinity.

4. Observe the way frogs, wall lizards and squirrels eat their food and describe what you see in your own words.

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 decreased considerably 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 worms omnivore

carnivore segmented body antennae microorganism gills bacteria virus

Figure Three ways of crawling Direction of movement

Direction of movement

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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)

These animals are called **omnivores**.

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

These animals are called **parasites**.

List the names of some parasites. (48)

If your table doesn’t contain any such animal, ask your teacher and write down 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 chart on a drawing sheet. Draw pictures of each animal with its name, what it eats and where it lives. Hang the chart in your classroom. (52)

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Some microorganisms cause diseases after entering our bodies. Some examples are 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.

Figure Lice Worm that causes elephantiasis

Figure Roundworm

SOME QUESTIONS FOR REVISION

1. Which of the following facts are true or false? Tick 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 as well.

c) Herbivores and carnivores together are called omnivores.

d) Fish have eyelashes.

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

2. Make a list of insects that live in our homes. Examine these insects with a hand lens. Group them according to the number of legs they have.

3. Make a list of ten omnivores, ten carnivores and ten herbivores that live in your vicinity.

4. Observe the way frogs, wall lizards and squirrels eat their food and describe what you see in your own words.

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 decreased considerably 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 worms omnivore

carnivore segmented body antennae microorganism gills

bacteria virus

Figure Three ways of crawling Direction of movement

Direction of movement

3

GETTING TO KNOW FLOWERS

Mention the word flower and the picture that leaps to your mind is of roses, marigold, jasmine and lilies. All beautiful, colourful and fragrant flowers. But do you think every flower is attractive? There are many flowers that don't look like flowers. You may not even accept them as flowers. Do you think the following plants 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. Choose one of these flowers to study its different parts. If you chose a *besharam* or *dhatura* flower, you will have to cut it open to see its internal parts. So first study its external parts carefully before you dissect it. The way to dissect the flower is shown in Figure 1. You will not face this problem with the 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 of the flower 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.

Figure 2 External and internal parts of a flower

(Petal, Stamen, Pistil, Sepal, Thalamus)

Could you locate all the parts shown in Figure 2? (2)

Write down the names of these parts in your diagram. (3)

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

Identify the thalamus in your flower and locate 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 write the names of its different parts. (5)

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 ?

Figure 3

(Pollen sac, Filament)

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

Observe these grains through the 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 are 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

(Stigma, Thalamus, Style, Ovary)

(Stigma, Thalamus, Style, Ovary)

(Stigma, Thalamus, Style, Ovary)

(Stigma, Thalamus, Style, Ovary)

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. 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.

Study the internal structure with the help of a hand lens. Ask your teacher where the ovules and chambers in the sections are located and draw a diagram of whatever you see.

GOING ON A FIELD TRIP

You have studied a flower and its internal parts in detail. Do all flowers have similar parts located in the same way in the same places or are different flowers different? 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 hand lens, some envelopes or polythene bags and a wet cloth while going on the field trip.

Go out with your teacher to farms, gardens and forests.

During the field trip try to collect flowers that you have not seen before. For example, grass, wheat, maize, *tulsi* etc. Also try to collect the following flowers: *besharam*, brinjal, china rose, *bhindi*, *dhatura*, pumpkin, *gilki*, cow pea (*chawla* or *barbati*) and tomato.

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

It is important to remember one thing when going on a field trip. Our sole aim is to collect 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

Divide the flowers you have collected in separate groups. You are free to choose the characteristics for each group. For example, you could have bell-shaped flowers, fragrant flowers, thorny flowers, colourful flowers 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, right up to the innermost whorl? (11)

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

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

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	No	Present or absent

Answer the following questions on the basis of the data in Table 1

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

Did you find any flower in which the parts are 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? (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 more than four whorls of parts. Note their names if you did. (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 all four whorls - 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. Unisexual flowers are of two types:

a) Male flower - it has the androecium, but no gynaecium.

b) Female flower - it has the gynaecium, but no androecium.

Bisexual flower: A flower that has both the androecium and the gynaecium.

Asexual flower: A flower that does not have the androecium or the gynaecium.

Draw Table 2 in your exercise book and fill it in on the basis of the data 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 flowers like sunflower and marigold. We usually think the sunflower or marigold is a single flower. But they are not actually single flowers. They are 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 and place these pages between two cardboard sheets. Keep turning the newspapers over every two to three days. After the flowers become completely dry, paste or stitch them on card sheets. 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 answer.

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, too, are 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	thalamus	style	transverse section
gynaecium	filament	stigma	ovary
pollen sac	labelled diagram	ovule	pollen grain
chamber	bisexual flower	unisexual flower	asexual flower
complete flower	incomplete flower		

4.

SOUND

After a scorching summer, the sound of thunder in the black monsoon clouds brings joy to the heart. The delightful sound of birds chirping in the early morning brighten your day. The sweet, lilting notes of a flute are so 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.

But how is sound produced? Why are some sounds high pitched and some low pitched? Let us perform a few experiments to find answers to these and other questions.

EXPERIMENT 1

HOW IS SOUND PRODUCED?

Hang your school bell at a spot where it does not bang against anything else. Ring the bell with a hammer.

Did the bell stop ringing shortly after the hammer struck it? (1)

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

Did you feel a vibration? (2)

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

Did the bell continue to ring as before when you grasp it? (3)

Touch the bell again after the sound stops.

Did you feel the vibrations now, like you did before? (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, then clutch it tight so that the sound stops.

Touch the plate gently again. Do you still feel any vibrations? (6)

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

What conditions are needed for the plate to produce a sound? Think well before answering. (8)

Picture/Figure 1

EXPERIMENT 3

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

Figure 1.

Blow the whistle.

Which part of the whistle vibrates? (9)

Touch the whistle gently while you blow it.

What did you feel? (10)

MAKE YOUR OWN WHISTLE

Take a strip of paper about 13 cm long and 7 cm wide. Fold it as shown in Figure 2b and make a hole in its centre. When you open the folds the paper strip should look like Figure 2c. Hold it as shown in Figure 2d and blow your whistle.

THE VIBRATIONS OF YOUR VOICE

Ask a friend to say aaaaah and feel his throat with your hand.

Did you feel his throat vibrating? (11)

Our throat has muscles. When we speak, these muscles vibrate.

Figure 3

In the experiments you have done till now, you saw several ways of producing sound.

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

In which methods did you actually see the process? In which methods did you only feel it by touch? Make a table and record your observations in it. (13)

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

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

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

You may have blown into a pen cap or 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 examples of sound produced by vibrations of air, such as a flute, a scout's whistle etc.

You hear many sounds every day - the droning of a mosquito or fly, the beat of a drum, birds singing, frogs croaking, the rustle of leaves, crickets chirping etc. These sounds are produced by some kind of vibration. 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 more high pitched 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 high pitched sound from one side and a low pitched sound from the other. In a harmonium, too, the keys on the right side produce high pitched notes while the ones to 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. When a person speaks, we often equate high and low pitch with how loud or soft the person speaks. But a low pitched sound can be loud as well as soft. Similarly, a high pitched sound can also be loud or soft.

EXPERIMENT 4

Take a narrow wooden plank. It should be about 80 cm to 90 cm long and at least 5 cm wide. Hammer pegs at both ends of the plank, leaving a little gap from the edge. Tie a thin steel wire tautly between the two pegs. Slide two plastic boxes under the wire at either end as shown in Figure 4. Pluck this 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). Take care that the wire does not become loose. Its length between the two blocks should not change.

Figure 5

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)

What effect did it have on the sound produced? Was the sound more high pitched or low pitched than before? (19)

On the basis of this experiment, can you explain the relationship between the tension of the wire, its vibrations and the sound it produces?

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 from the table's edge. Press the end of the scale which is on the table with both hands.

Figure 6

Ask your friend to press the projecting end lightly and release it.

Does it make a rattling sound?

If it does, that means you are not pressing the scale at the correct point. Find the right point so that 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)

The number of vibrations of any object in a given period of time is called its frequency. In this experiment, the up and down movement of the scale can be taken as its vibration.

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.

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

What is the difference in 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, feel the frequency of the vibrations by 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 produce vibrations.

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 ears close to the scale to be able to hear a sound.

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

Were you able to observe the frequency of 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 pegs in a wooden plank and stretched a steel wire between them. Take the same plank and slide one or two blocks under one end of the wire to make it taut. At the other end, slide a hollow cardboard box with a wooden block over it (Figure 7).

Figure 7 a b

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 to the sound carefully.

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 at each length.

What change 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)

You saw the relationship between the length of the scale and the frequency of its vibrations in Experiment 5.

Based on the conclusions of that experiment and your observations in Experiment 6, what is the relationship between the length of the wire, the frequency of vibrations and the pitch - low or high - of the sound produced? (31)

A thing must vibrate to produce sound. These vibrations reach our ears and the ear drums begin to vibrate. That is how we hear sound. There must be something to carry the vibrations of a body or thing 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, the air acts as the medium between our ears and the vibrations produced. 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 match sticks and thread, make the toy shown in Figure 8.

Figure 8

Two students should hold the trays with the thread stretched taut between them. One student should say something softly into the tray while the other student holds the 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 matchbox tray.

Did both students hear the voice?

If not, then who heard what was said?

Why did this happen? (37)

If more than one student wishes to hear what is being said on the matchbox telephone, then what arrangement could you make?

DEVISE AN EXPERIMENT

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

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

EXPERIMENT 9

Take two brass spoons. Tie them at 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.

Ask your friend to clang the two spoons together.

What sound did you hear? (39)

Remove your fingers from your ears and ask your friend to clang the spoons together again.

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

You can perform this experiment with a glass, bowl or other utensil. You will have to bang them 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 ask your friend to pluck the taut thread again.

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

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

Sound is also connected to our ears. Our ears are sensitive organs that can hear even soft sounds. But people who live in a noisy environment, like those living in big cities or working in a factory, are not as sensitive to sound. When you are surrounded by loud noise all the time it affects your ears and also causes other physical as well as mental problems.

Extremely loud noise, 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, the sound stops. Why?

2. Why doesn’t a cycle bell ring properly if you hold it with your hand?

3. Two wires are stretched taut on a wooden plank. The tension of both wires is the same but they are of different lengths. If they are plucked, can you identify which is the longer and which the shorter wire by the sound they produce?

4. A steel wire hangs from a nail. It has a 10 kg weight attached to it. The wire produces a sound when it is vibrated. What must you do to make the sound produced more high pitched?

5. Take an empty test tube. Blow it like a whistle. Add 2 ml of water to the test tube and blow the whistle again. Keep adding 2 ml of water each time and blow the whistle. What difference does the level of water make to the sound? Can you explain why this happens?

NEW WORDS

vibration frequency of vibration

tension medium

5.

WATER : HARD AND SOFT

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 in your daily life, you must have also observed many of its properties.

Make a list of the properties of water.

In this chapter we shall study a special property of water. Before we do that, can you say whether you have ever used water in which soap does not lather? Where did this water come from?

We shall try to understand why soap does not lather well in water collected from some places and how we can change the quality of water so that it can produce more lather. But 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 decide whether it produces more or less lather.

The standard we shall use is the lather formed with rain water.

DISTILLED WATER FROM RAIN

The experiments we shall do now require distilled water. Each group will need at least a glucose bottle 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 from the 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 shut its mouth with a cork. This is your distilled water.

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

PREPARING A SOAP SOLUTION

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 half full 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 filled a third with water.

You now have all the items needed 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 take three precautions while doing this experiment:

- Take equal amounts of water from each sample for comparison.
- Add an equal number of drops of soap solution to each sample.
- 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 at the right. 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 1/3 test tube of water, fill the test tube to this mark.

Fill a test tube one-third with distilled water. Add 5 to 10 drops of soap solution to it and shake well. We shall use this test tube as the standard for comparison. Label it and place it on the 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. 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 enter your observations in the table:

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

(-) sign for less lather than distilled water .

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

Table 1

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

Repeat the experiment with the tap water and well water samples. 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 formed with distilled water) is called **soft water**.

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

Is distilled water soft?

EXPERIMENT 2

We shall repeat Experiment 1 with some more water samples. But we shall prepare these samples ourselves by mixing different kinds of 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 it 1/3 with distilled water. Put a tiny bit of calcium chloride - equal to a grain of rice - in it 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 your standard test tube of distilled water and record your result in Table 2, like 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. Based on the data you record in Table 2 , answer the following question.

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

Classify the salts on the basis of the data in Table 2 and record your classification in Table 3. (6)

Table 3

Salts that do not make water hard	Salts that make water hard	Salts that give 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 form 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, try the next experiment.

EXPERIMENT 3

You saw in Experiment 1 that some samples of water, when mixed with soap, gave less lather compared to distilled water. Such water is called 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 with hard water? (15)

EXPERIMENT 4

MAKING HARD WATER SOFT

There are many ways to make hard water soft. We shall try one of these methods.

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

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 eight drops of soap solution each to test tubes A and B. Shake them well. Observe the lather formed and compare the amount in both test tubes.

Is the amount of lather formed 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 done, can you suggest some other ways of making hard water soft? (24)

SOME QUESTIONS FOR REVISION

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

The chemical name of the common salt we eat at home is sodium chloride. Does water become hard on adding common salt?

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.

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

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

NEW WORDS

standard	distilled water process	soft water	
detergent	sample hard water	precipitate	salt

6.

REPRODUCTION IN PLANTS

In the chapter 'Seeds and their germination' in Class 6, you learned how an entire plant develops from a seed. But do 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*, radish. (1)**

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

As we saw earlier, different plants grow 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 grow in some other way.

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 formed.

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. You will have to collect five different species of flowers and fruits of the same species. For example, if you get a flower from a ladysfinger (*bhindi*) plant, you must get 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 see the ovary, style and stigma of the pistil.

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

Do you see any similarity between the shape and structure of the ovary and the fruit? (6)

Let us now compare their internal structures. Slice the ovary of one flower horizontally and the second flower of the same species vertically. You learned how to make a horizontal section in the chapter 'The structure of flowers'. Figure 1 shows this process for your assistance. The method of making a vertical section is also shown in the figure.

Similarly, slice one fruit vertically and the second horizontally.

After slicing them vertically and horizontally study the internal structure of the ovary and the fruit. Use a hand lens, if necessary.

Figure 1 Vertical section Horizontal section

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

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

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

Slice all the species of flower and fruit you have collected vertically and horizontally and draw diagrams of their sections. (10)

Answer the questions given below:

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

On the basis of the similarity between the ovary and the fruit can we 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 this comparison, can you say whether a plant that bears no flowers will bear fruits? (14)

BEFORE WE PROCEED FURTHER

In the chapter 'The structure of flowers' you saw 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 have either the male or 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 flowers develop into fruit. (16)

FROM FLOWER TO FRUIT

You had earlier compared the ovary and fruit and assumed that the ovary develops into the fruit while the ovules develop into seeds. What should we do to confirm this assumption?

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

Let's accept that the fruit develops from the ovary and the seeds from the ovules.

But did you notice any differences between the ovary and fruit while comparing their horizontal sections?

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

Many changes occur during the process of the ovary developing into a fruit.

Table 1

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

Can we say the ovary develops into a fruit on its own in a few days? (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 try answering question 19.

EXPERIMENT 2

This experiment can be performed with any flower. But it is easier to do it with a unisexual flower.

You know that flowers of gourds (*lauki*) are unisexual. That is, the male and female flowers are separate. The students of a school conducted the following experiment on a *lauki* creeper in a kitchen garden.

They first learned to identify the male and female *lauki* flowers.

Would you be able to recognise the male and female *lauki* flowers by looking at Figure 2? What differences do you see between them? (20)

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

male bud female bud male flower female flower

The students selected 10 female buds that seemed likely to bloom in a day or two. heir petals were closed when the experiment began. The students covered each of these buds with a polythene bag and loosely tied the mouths of the bags (Figure 3). They marked the date the experiment began (August 2, 2002) on a piece of paper and put the paper inside the bag before tying it up. The teacher instructed them to poke tiny holes in the bags with a pin.

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

The students returned to school after completing their preparations. Two days later, on August 4, they went to the garden. They found that most of the female buds covered with bags had bloomed. The teacher told them to spray pollen grain on the stigma of five of these female flowers.

They selected four to five male flowers to collect the pollen grain. They plucked the stamens of these flowers and shook loose their pollen grains on a sheet of paper. They made a brush by twisting cotton wool over the tip of a matchstick. They used this brush to collect the pollen grains.

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

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

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

The students went to the garden on August 10 and checked the 10 covered flowers. They observed the following results:

Table 2

	Number of flowers	**How many survived**	**How many bore fruit**
Pollinated flowers	5	4	4
Unpollinated flowers	5	5	0

Figure 4

Answer the following questions:

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

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

Why was the experiment performed on 4 to 5 buds? Couldn't we get a result by pollinating a single bud? (25)

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

Which kind of flowers bore fruit? Refer to the table and 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 above experiment, we used a brush to sprinkle pollen on 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 are another agent of pollination. You may have seen honeybees, beetles, birds etc hovering over flowers. These insects suck the nectar from flowers. But while sucking nectar, pollen grains from the stamen stick to their wings, legs, stomach etc. When they go to another flower these pollen grains stick to the stigma of that flower. Thus pollination takes place.

On which flowers have you seen insects hovering or sitting? (29)

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

AFTER POLLINATION

The pollen grains reach the stigma through the process of pollination. What happens to them now? Let us do an experiment to find out.

EXPERIMENT 3

Do this experiment with the pollen grains of either *besharam* or periwinkle (*sada bahar*) flowers. Take two glass slides. Put 2 to 4 drops of water on both slides. 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 after 30 minutes. Cover the drops of water on the slides with a piece of polythene before placing the slide under the microscope. This will prevent the water from touching the lens.

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

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

Pollen grains undergo the same process on the stigma as well. There are some substances on the stigma in whose presence the pollen grains begin to germinate. During germination a tube develops from the pollen grain. This tube reaches the ovary through the style.

In the above experiment, the pollen grains will germinate if we use the juice of a crushed style instead of sugar grains.

Describe in your own words what you have learned 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.

Let’s do some experiments on asexual reproduction.

ASEXUAL REPRODUCTION

In the beginning of the chapter you saw that reproduction in plants occurs not only through seeds but through other processes as well. Reproduction through any process other than seeds is known as asexual reproduction. We shall see 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 bryophyllum (*patharchatta*, *ajooba* or *khatumara*). Perhaps, you have also seen the plant.

Can we say that asexual reproduction takes place through the leaves of the bryophyllum? (34)

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

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

REPRODUCTION IN THE POTATO PLANT

Take a potato. Observe it carefully. A new potato plant develops from the potato. Farmers call it the potato seed.

On the basis of what you have learned about the relationship between the flower, fruit and seed 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. Chop the potato into pieces, with an eye in each piece. Remove the eyes from some of these pieces. Fill two cups or *kulhads* (earthen cups) with soil. Plant the pieces with eyes in one cup and those without eyes in the other. Water both cups.

Water the cups daily and observe the potato pieces.

In which cup do potato plants sprout? (37)

Find out how the following plants reproduce and the part of the plant involved in the process: 1. banana 2. sugarcane 3. ginger 4. seedless lime or grapes. (38)

QUESTIONS FOR REVISION

1. From what you have learned 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 pollination

artificial pollination

7

AREA

WHOSE FIELD IS BIGGER?

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

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

Figure 1

It's not easy answering that question just by looking at the map. So how do you find out whose field is bigger or smaller? We can use a simple method to do this. But before learning the method let's perform 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 these shapes out separately.

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 breadth or length? (5)

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

We often need to make such comparisons. But we cannot tell if a thing is bigger or smaller than another by measuring only its length or breadth. For example, we may have to find out the following:

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 some 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 will need more seeds to sow a field with a larger surface spread than a smaller one. Similarly a larger courtyard would require more tiles because its surface spreads more.

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 fixed distance as the unit of measurement. For example, metre, centimetre, millimetre etc. We then find out how many of these units the distance is equal to. For example, if the distance is 12 cm that means 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 the face of a cube with a 1cm-long side. The area of each face of such a cube is 1 square centimetre. So the unit of area in this case is one square centimetre. A square centimetre is also written as centimetre^2 (or cm^2).

Your science kit contains a plastic cube. Each face of this cube is 1 cm^2. Cover the surface whose area 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 1 cm^2 cubes.

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

Figure 3

ACTIVITY 3

MEASURING AREA WITH A SHEET OF SQUARE-LINED PAPER

We can measure area with a sheet of squared-lined paper. Such a sheet is shown in Figure 4.

Figure 4

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

How many 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 square-lined paper is equal to the area of the figure in square centimetres.

Two figures are drawn on the square-lined paper.

Find the area of both these figures. (16)

All the squares contained in the two figures in Figure 4 are full squares. Look at the figures drawn on the square-lined paper 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)

Figure 5

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 distances. Just as you made approximations of distances up to the nearest unit, you can make a similar kind of approximation while measuring the area.

These approximations are made while counting the squares. 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 of 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 half or more than half covered by it.

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

LENGTH, BREADTH AND AREA

You were able to find the area of various figures with the help of cubes and a sheet of square-lined paper .

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

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

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 areas of A and B the same? (24)

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

What is the reason for the difference in area 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 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 cubes and note your measurements in Table 1. (29)

Table 1

Rectangle	Length cm	Breadth cm	L x B cm^2	Area cm^2
A				
B				
C				

Now measure the area of A, B and C with the help of 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)

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 formulas for other regular shaped figures. But remember one thing - these formulas can be used only to find the areas of regular figures.

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).

Figure 9 A B C A B C D

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 in your Bal Vaigyanik workbook and a page in your exercise book. (35)

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

For example, if a photograph is to be mounted on a frame, the length of wood (in cm) for the frame will depend on the boundary or perimeter of the photograph. On the other hand, the size of the glass to cover the photograph will depend on the area of the photograph. 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 the perimeter and the 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 around 16cm 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)

Is it possible that different figures with the same perimeter can have different areas? (39)

AN EXERCISE

Figure 10 is a diagram of a triangle.

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)

Figure 10

ACTIVITY 8

SAME AREA, DIFFERENT PERIMETERS

You made shapes with the same perimeter but different areas.

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.

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

Measure the perimeters of these shapes. (44)

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

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

Figure 11

Figure 12 A B C D

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 area of this folded paper and note these in Table 3. (46)

Unfold the folded paper twice, as shown in Figure 13b.

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

Now open the paper fully (Figure 13c).

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

Figure 13 a b c

Table 3

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

Answer the following questions on the basis of Table 3:

When the length of the side of a square doubles, the perimeter and area increase, but in different ratios. What is the difference in ratio? (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, the 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 a b c

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

There is one thing you must remember - the relationship between the length of the sides, perimeter and area does not apply in all situations. This relationship holds good only if the shape does not change while reducing or enlarging the figure. 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

So far you have used sq cm to measure area. There are other units to measure area.

When measuring distances you used units like cm, m and km. You saw that it is better to measure small distances in cm. However, for longer distances (for example, between two villages or towns) km is a more appropriate unit.

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 used to measure area.

ACTIVITY 10

Take a meter scale and draw a square with a 1 m-long side 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 on one side of a square measuring 1 sq m? (54)

How many 1 cm cubes can you place on 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.

UNIT TO MEASURE A FIELD

The area of a field is commonly known as its *rakba*. The patwari uses a unit called a decimal to show 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. Wrap a paper around your pencil and find its surface area.

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 the 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. 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 difficulties would you face?

NEW WORDS

perimeter rakba decimal khasra-khatauni

8.

HOW TO DRAW A MAP

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 did Raju give directions to Venkat? (1)

We need to give directions to others many times in our daily life. 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 telling someone about the location of a place or an object. Such methods are used in science as well. We shall discuss one method here.

SYMBOLS THAT SHOW POSITION

Figure 1 shows where 24 girls appearing for an examination are seated in a classroom.

Suppose you had to tell you friend where Basania is seated, what would you say? (2)

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

Did everyone in your class give similar answers to these questions? (4)

If the answers different what could be the reason for these differences? (5)

Suppose we decide to number the lines of girls in Figure 1 from left to right and the rows of girls from front to back, will the answers given by everyone be the same? Let's try to understand this with the help of a sheet of square-lined paper (Figure 2).

Figure 1 **Figure 2**

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

Where is Laxmi sitting? (7)

Did everyone give similar answers now? (8)

We can use symbols to tell the position of the girls. So, Gauri's position would be fourth line, second row.

Write the position of the following students using these symbols:

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

Identify the students from the following symbols:

a) Third line, third row

b) First line, fifth row (10)

USING NUMBERS AS SYMBOLS OF POSITION: COORDINATES

If we want to write these symbols of position in a shorter form what should we do? Can we use numbers? Numbers are more convenient than words. It takes less time to write them.

So we can now give Gauri's position (fourth line, second row) as (4, 2). All we have to remember is that the first number gives the line and the second number 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 that 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 coordinates of position we always write the number for the X-axis first and the number for the Y-axis last.

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 square-lined 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 in sequence with straight lines.

What figure did you get? (19)

REDUCING AND ENLARGING FIGURES:

CHOOSING THE CORRECT SCALE

That's enough of coordinates for the moment. Let's 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 square-lined sheet of paper. Every line in Figure 4 should be exactly half its length in the reduced figure.

The length and breadth of the sides of each square in the sheet of square-lined paper is 1cm.

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

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

What is the width of the stomach of the cat? (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 Figure 4?

It is necessary to select the correct scale for reducing or enlarging a figure and it is important that each part of the figure is reduced of 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.

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

Let's try one such method.

Figure 4

ENLARGING FIGURES WITHOUT USING SQUARES

We need to enlarge each side of triangle ABC in Figure 5 to twice its length. The method to do this is given below.

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 outside the triangle. Now measure the length of line XA. Double this length and mark it on the extended line XA. The new point you get on the line is A^1. The length of XA^1 is twice that of XA. A^1 is read as A-dash or A-prime. Similarly draw lines XB^1 and XC^1 which are twice the length of lines XB and XC respectively. If you now join A^1, B^1 and C^1 with straight lines you get triangle $A^1B^1C^1$.

Figure 5

On the basis of what you learned in the earlier chapter on '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.

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)

Figure 6

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 selecting a proper scale.

SELECTING THE SCALE

Assume that the field is 20m long and 16m wide. To draw a map of this field you require a sheet of graph paper at least 24cm long and 20cm wide. Then your scale could be 1m = 1cm. With this scale 1m of the field would be 1cm on the graph paper. You should note this scale on your map:

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

This is the scale of the map. Anyone reading the map will take 1cm to equal 1 m of the field.

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

What should be the scale for drawing the map of this field? (27)

Selecting the scale depends on the length and breadth of the field and the sheet of paper.

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. This point, called the origin, could be at any other place in the field as well. Place a table or stool at this point and put a flat wooden board on the table. Tape a sheet of graph paper to the board with cellotape.

Use a sharp pencil to mark a point X on your graph paper which more or less corresponds to the position of the origin in the field. Fix a pin or fine nail 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 be useful in making your map. You must ensure that the graph paper remains taped to the board and that it does not shift its position or orientation. You are now ready to draw the map.

Figure 7

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 point along the boundary of the field that you would like to mark on the map. Drive a stake into the ground at this point or ask a friend to stand on that spot. Bring your eye close to the edge of the board and look at your friend (or the stake), keeping the pin fixed at the origin in the middle.

You must now mark a point on the graph along the 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 should shift the pencil over the graph paper to bring it in line. It would be easier to do this if you look through the paper tube (or straw) fixed at the origin. When all three - the origin, pencil and your friend - are in a straight line, mark the point where the pencil is on the graph paper and draw a small circle around it (Figure 8).

Figure 8

Draw a straight from this point to the origin. This line shows the direction of the point you chose on the boundary of the field from the origin.

Suppose the field you want to draw a map of 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 one point, say A, the first thing you need to do is measure the distance between O and A. You can use a metre scale or a long string to do this. Suppose the distance between O and A is 16 m and 40cm. You will now have to select a scale to show this distance on the graph paper. If you take a scale of 1m of the field to equal 1 cm of the graph paper, the length of the line between O and A on the graph paper will be 16.4cm.

Mark point A’ on the line drawn earlier from O to A at 16.4cm from origin. Point A on the graph paper shows the correct location of point A on the boundary of the farm.

To complete the map, take the other points along the boundary one by one and mark their direction and correct distances on the map using the same method you did with point A. Name the points B’, C’, D’, E’ and F’.

Don’t forget to write the scale on your map.

Figure 9

HOW TO SELECT POINTS ALONG THE BOUNDARY

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

If the the boundary on one side forms a straight line, you can select the two end points to show on the map. For example in Figure 9, the edge AB is straight. Hence by showing points A’ and B’ on the map and joining them with a straight line you get the boundary. The same would hold true for the edges EF, FG and GA, which are straight.

If the edge is not straight you will have to select more points to be able to reflect the contours of the boundary correctly on your map.

For example in Figure 9 the boundary between B and E is curved. To show the curvature on the map, two more points C and D have been taken.

You can decide where you would need more points to reflect the curvature or contour more clearly on the map.

To complete the map on the graph paper join all the points you have marked. Once all the points are joined, you get the map of the field or any other place you have selected.

COMPLETE YOUR MAP

There are many more details you will need to fill in the map, apart from the boundary of the field. For example you would have to show features like trees, the well, houses, streams, electricity poles etc. 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 below.

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 the figure into m, using the scale of the map.

Do all your calculations in your exercise book and also note the distance. (30)

Is the distance between points A and F along the boundary of the field equal to the distance between points A’ and F’ on the map? (31)

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

Find the area of your map. (32)

Could you calculate the area of the field by using the scale that you have chosen? (33)

Figure 10

EXERCISE 3

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

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

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

SOME QUESTIONS FOR REVISION

1. Mark the following points on a square-lined sheet:

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 square-lined paper.

Mark the following eighteen coordinates in the order they are given in.

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 same order.

Write the name of the figure you get.

3. Enlarge the figure you got 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

X-axis Y-axis scale coordinates origin ratio

9.

INTERNAL ORGANS OF THE BODY

PART I

Vehicles like cars, tractors, motorcycles, scooters etc have a number of different parts. You may have noticed that these small parts perform different functions. But they all work together in harmony to move the vehicle forward.

Have you ridden a bicycle? It has handlebars, front and a rear wheels, chain, brake and several other parts. If these parts did not work in harmony, what would happen? Try and imagine such a situation. The handlebars would turn the bicycle in one direction, the front wheel in another direction and the rear wheel in a third direction. Can the bicycle move forward or backwards if this happens?

Our bodies too have many small parts that work together in harmony. If there is no harmony between the parts of our body, what do you think will 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 very easily observe and study them. But most of the body's organs are situated inside the body. They are called our internal organs. We cannot see them. So how can we study them and understand how they work? Medical students study internal organs by dissecting dead bodies. But it is not possible for us to do this. So we shall have to find some other way of studying our internal organs.

Many big and small animals have organs that are similar to those of human beings. The rat is one such animal. Rats are easily available and they are small enough to be easily dissected. We can dissect a rat and study its internal organs and learn something about the internal organs of human beings.

Thus there are mainly three ways of studying the internal structure of the human body:

1. By observing the internal organs of a dissected rat and comparing them to the internal organs of human beings.

2. By identifying those internal organs that we can see or sense from outside.

3. By collecting information about some specific diseases that affect our internal organs and thus finding out about the functions of these organs.

We shall study some internal organs in Class 7 and the remaining internal organs in Class 8.

SECTION I

ORGANS THAT HELP THE BODY TO MOVE:

OUR MUSCLES AND MUSCULAR SYSTEM

On your way to school from home you sometimes climb the mango tree to pluck mangoes. In school, you sit down, get up, write with your pen and do experiments. To do all this work, you move your hands and legs, turn your neck, bend your waist and so on. All this movement is done with the help of organs that lie beneath our skin. We cannot see these organs, but we can sense and see the way they move beneath our skin. Like we cannot see a person hidden beneath a blanket, but we know the person is under the blanket when he or she moves. If you observe a cow, bull or horse walking or running, you can see some fleshy structures moving beneath the skin around their shoulders and hips. These tender fleshy structures are called **muscles**.

We shall perform a few experiments to find out how these muscles help the various parts of the body to move. We shall also see what 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.

Fold your forearm in the way shown in Figure 1, moving your palm towards your shoulders. When your palm touches your shoulders, 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 and see and feel how the muscles of your arm move.

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

Were you able to do this?

Figure 1

EXPERIMENT 2

Hold one of your hands in front of you in the manner 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.

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

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

Could you identify the different muscles?

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

Figure 2 (a) (b)

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 the sole of that foot rapidly up and down.

Do you feel the muscles in your calf moving?

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

Figure 3

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).

Do you feel the muscles of your thigh moving?

Now try and swing your foot forward and backwards without moving your thigh muscles.

What happened?

You moved several parts of your body and felt the movement of the muscles while doing so.

Figure 4

Write in your own words what connection there is 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 must move your muscles. In other words, it is only by the movement of muscles that we are able to move various 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.

Hospitals and other medical organisations administer polio vaccine to children. This medicine protects - or vaccinates - the child against polio.

You may have heard about the Pulse Polio Campaign. In this campaign an attempt is made to administer polio vaccine to all children. If all the children are vaccinated in this way, polio can be eradicated in our country.

TENDONS

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

Figure 6 Tendons

EXPERIMENT 6

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 in the manner shown in Figure 7. Fold 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 your tendon.

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 the foot 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.

NEW WORDS

dissection muscular system dissected polio muscle tendon

campaign Pulse Polio

SECTION 2

You learned about the muscular system in the previous part of this chapter. In this part you will learn many things about your bones by moving various parts of the body in the way you did earlier.

When a person's bones are injured, a doctor takes an x-ray of the injured bone. The shape and structure of the bone are clearly seen in the x-ray. The doctor can see where the bone is cracked or broken or dislocated.

If possible, try and bring a x-ray films of broken bones to the class and show them to everyone.

Can you identify the broken bone from the x-rays? Is there an x-ray which shows a broken bone that has not been rejoined properly? If a broken bone in your hand is not rejoined properly what effect will it have on the functioning of your hand? Try and guess.

If you know of any person whose broken bones have not healed properly, try and find out what effect it has on that part of the body and the work it does.

THE SKELETAL SYSTEM

Bones help our body to move. They maintain the shape and structure of the body and protect some tender organs from injury.

The different bones in different parts of the body combine together to form a single structure or system. This structure is called 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 from the front and the other from the back.

Try and feel and identify different bones in your body. As you identify various bones, colour them in the diagram.

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

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

Now hold the joint of one finger between the thumb and forefinger of your other hand and move that finger up and down. (Figure 10-c).

Figure 10 (a) (b) (c)

Is there only a single bone from your shoulder to the fingertip? If not, move or rotate the different parts of your arm and try to count as many bones as 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).

Figure 11: The ligaments of the knee

Thigh bone Ligament Muscle Muscle Calf bones

THE JAWBONE

Ask your friend to open her mouth and move her lower jaw up an down and sideways.

Observe her face carefully.

Did you notice any joint in the bone in the space below the ear?

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

Now try and examine this joint in your own lower jaw.

Press your fingers on either side of your face at the spot where you have identified the joint to be. Open your mouth and move your lower jaw in the same way your friend did (Figure 12).

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

Figure 12

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 below your neck towards your shoulder. Try and locate a raised bone there.

This bone is called the clavicle.

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

Look at the diagram showing the frontal 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 of the skeleton 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 the place where all the ribs join at the back. The diagram of the skeleton shows that all the ribs join the spinal cord at the back. Barring the lowest two ribs, all the other ribs join together in a long flat bone in the chest in front called the sternum. In this way, the ribs together form a cage. Observe the rib cage carefully in both the frontal and rear view diagrams of the skeleton.

Observe the picture of rat A given in your kit copy and guess which important organs of the body are protected by the rib cage.

Write the names of these organs in your exercise book. (3)

Figure 14

THE HIP BONE

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

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

These two bones are the two ends of a single large bone. This large bone is the hip bone. Look for the hip bone in both diagrams of the skeleton.

THE BONES OF THE LEGS

How many joints can you identify by moving your legs?

Compare the bones in the leg that you have located with those shown in the frontal view diagram 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 frontal view diagram of your skeleton.

THE FEET

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

Show which bones you have been able to locate on the frontal view diagram of the skeleton.

Why can't you feel the remaining bones in your feet? (4)

THE SPINAL CORD

Take the rear view diagram of the skeleton.

Ask your friend to stand up and then bend his body at the waist and try and touch the ground with his hands (Figure 16).

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

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

Look at this bone carefully in the rear view diagram of the skeleton.

This bone is called the spinal cord. The small bones it is made up of are called vertebrae.

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

What would happen if you had a single bone in place of all these separate vertebrae ? (5)

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

Look at both diagrams of the skeleton and find out the relationship of this triangular bone with the hip bone.

Press your lower back with your fingers and see how hard and strong the bone in this area is. This strong bone is formed by the joining of the fused vertebrae and the hip bone. Figure 17 shows how the spinal cord, hip bone and thigh bones are joined.

Now explain in what different ways the hip bone is used in the body. (6)

Ask your friend to stand in the way shown in Figure 18, with his hands on the wall.

When he puts pressure on his hands, do you see two bones raised in his back, just below his shoulders?

These bones are called the shoulder blades.

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 in the bones in 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)

You must have coloured the bones you have identified till now in the diagrams of the skeleton. Your friends must have also done likewise. Find out if they have identified bones which you haven't. Try and locate these bones in your body and colour them in the 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 others hard?

The hard parts of the ear 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 cord. Try and identify the cartilage in these places in the frontal view diagram 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 are able to move the various parts of our body because of these joints.

You may have seen different kinds of joints in many other things around you. Does the human skeleton also have different kinds of joints? Let's do a few experiments to 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 manner 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 joint between the shoulder blade and the bone of the arm

The joint between the hip bone and the bone of the leg

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 from the elbow joint.

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 fold your forearm up and down at the elbow joint in the manner shown in Figure 20 (a).

Could you bend your forearm in the direction below the elbow joint?

To understand how the elbow joint works open and close the lid of a box or attache 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 like a door hinge in your body. Make a list of these hinge joints. (11)

Figure 20

a: The elbow joint   b: The finger joint   c: The knee joint

ANOTHER PROPERTY OF THE ELBOW JOINT

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 among the bones in your body that you cannot easily feel from 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 flip her forearm by rotating it. You can feel the difference in movement of the two inner bones while she rotates her forearm.

Figure 21

YOUR SPINAL CORD IS A SPRING

You may have often done the exercise in which you have stood straight up and touched the floor with your palms by bending your body but without bending your knees. You may have also done the exercise in which you have bent your body to the left and right at the waist.

Could you explain what property of the spinal cord enabled you to perform both these exercises? (12)

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

How does the cartilage between the vertebrae help in rotating the spinal cord in different directions? (13)

Figure 22 **Figure 23**

FIRST AID FOR BROKEN BONES

If you are injured and that part of your body swells and the pain is unbearable, it may be because the bone inside that part of the body is broken.

In such a situation:

1. The injured person should not move at all.

2. If the bone of the arm or leg is broken, then make a splint with bamboo or wood, or any other long, stiff material and tie it to the injured limb in the manner shown in Figure 24.

3. Cover the injured person with a blanket and reach her to the hospital as soon as possible.

Figure 24

SOME QUESTIONS FOR REVISION

1. Imagine what would happen if there were no bones in your body. Give reasons while writing your answer.

2. Try and find the joints in the bones of a goat or cow. Make a list of these joints.

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

NEW WORDS

skeleton x-ray clavicle ribs spinal cord hip bone vertebraehinge joint cartilage ball-and-socket joint fleshy

Chapter - 10

VOLUME

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 one kg of rice equal to one kg of wheat? If their weight is not equal then what do the two have in common? (3)

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

How do shop keepers measure kerosene? (5)

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

You may have seen that people usually use a vessel of a specific measure to measure the volume of the liquid in all these cases. 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.

In this case, 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)

You may have used a vessel of a fixed measure to compare the volumes of water. You have probably measured liquids in this way so this may not be a new task for you. We often have to measure milk, kerosene and medical solutions at home.

THE LITRE

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

MEASURING 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 the millilitre. A millilitre is also written as ml. One litre equals 1,000 millilitres.

1 litre = 1,000 millilitre

Your kit has two measuring cylinders - one large and one small. The bigger 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 graduations on both the cylinders.

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

Fill water up to any mark on this measuring cylinder.

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

In Question 11 you calculated the amount of water contained between two consecutive markings on the measuring cylinder. This amount of water is the least count of the measuring cylinder (Figure 1).

This 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 the 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)

Figure 1

EXPERIMENT 2

SYRINGE AS A MEASURING CYLINDER

You may have seen an injection syringe. If you can get a syringe without a needle at home or from somewhere else bring it to the class. The injection syringe can also be used to measure volume. Seal the mouth of the needle-less syringe by melting it (Figure 2).

Itis now ready to be used as a measuring cylinder.

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

Figure 2

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 white paper on its side. Before pasting the paper smear it with kerosene oil so that it becomes translucent. You can then see the level of the liquid through it.

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 with the syringe 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 on the paper strip 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)

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 your 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. This shape is called **concave** (Figure 3).

As shown in the picture, the lowest part of the curvature is taken as the measure of the level of the liquid in the test tube.

Figure 3

HOUSEHOLD MEASURES OF VOLUME

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

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 of water.

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)

In Question 17 did you calculate the actual volume of a drop of water or its average volume? (18)

Figure 4

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 have made to find out how much water can be filled into different vessels in your home or in the classroom.

THE VOLUME OF SOLIDS

You have learned how to measure the volumes of liquids. Let us now do a few experiments with solid objects to find out how their volume can be measured.

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.

What do you think happened when the pebbles were dropped into the pitcher?

When pebbles are dropped in water, they displace water to occupy space. Where does the water displaced from the space occupied by the pebbles go? This displaced water occupies a new space without changing its volume. In fact, the amount of water remains the same. So when the pebbles are dropped in, the water level rises.

Figure 5

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 fully into the water.

Did the level of the water rise? (19)

Take out the block.

Did the level of water fall back to its earlier mark on the beaker? (20)

Repeat the experiment with the blocks B and C.

After reading the story of the crow and the pitcher of water, you must have figured out why the level of water rose in this 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 graph strip with an A (Figure 6). Repeat the same experiment with Blocks B and C. Mark the changed water levels on the graph strip B and C respectively.

While doing the experiment remember that the water level should be at the initial marking 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? Why is this so? (23)

Figure 6

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 for 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 also. 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 a side measuring 1 cm. Every such cube has a volume of 1 cc or $1cm^3$. Therefore, each cube can be taken as a unit for measuring volume.

We are now ready to measure the volume of Blocks A, B and C.

First of all, fill the beaker with water to the point marked X. Slowly drop the plastic cubes into water one by one. Continue dropping cubes until the water level touches point A on the beaker.

Count the number of cubes dropped in the beaker to make the water level reach point A and note the 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 from point X to 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 volumes of other blocks in the kit in cubic centimetres. (28)

EXPERIMENT 6

WATER, MILK OR OIL - THEY ARE ALL THE SAME

Are you 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 dipped 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?

What is your guess? Explain with reasons. (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.

EXPERIMENT 7

ANOTHER METHOD OF MEASURING VOLUME

Take an overflow vessel (Figure 7). Place it on a level surface. Fill it to a level where water begins to flow from its spout. When the water stops dripping from the spout and the level is stable, place an empty beaker under the spout. Now carefully drop 50 plastic cubes one by one into the overflow vessel. As you do this, water will flow out from the spout and collect in the beaker below.

Figure 7

How much water was collected in the beaker? Measure the amount with your measuring cylinder.

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)

Table 1

S No	Object	Amount of water flowing out from the overflow vessel (ml)
1.	50 cubes	
2.	80 cubes	
3.	100 cubes	

Repeat the experiment using a different number of cubes.

Look at your table.

Can you see a relationship between the volume of a cube and the amount of water displaced by it? (33)

You have observed another method of measuring volume. Write the method in detail in your own words. (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 millilitre.

Do you think it is wrong to do so? If yes, in what way is it wrong? (37)

A PROBLEM

When a cork is placed in water, it floats on the surface.

What problem would you face in finding the volume of a cork? (38)

Suggest a way of overcoming this problem. (39)

Find the volume of a cork using the method you have thought of. (40)

EXPERIMENT 8

FIRST THINK AND THEN DO THIS

You found the average volume of a drop of water. Now find the volume of a gram seed.

Write your answer and 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 8 a).

Figure 8 a b c

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 the same as that of Block A (Figure 8 b). Make several such layers of cubes and stack them one above the other till their height matches the height of Block A (Figure 8 c).

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)

Do 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. Note the volume of these blocks in cm^3 as measured either in Experiment 5 or 7. (47)

Table 2

S. No of Blocks	Length (cm)	Breadth (cm)	Height (cm)	Product (cm3)	Volume (cm3)

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 THE LITRE BECAME A UNIT OF VOLUME

Measure and note down the length, breadth and height of the inside of the one-litre plastic container provided in the kit. (50)

Calculate how many cubes fit into a litre and note your answer. (51)

EXPERIMENT 11

SIZE AND VOLUME

In the chapter on ‘Area’ you saw that doubling the sides of a square makes its area four times larger. In the same way 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 with a side of 1cm side together. We shall call each such cube R. You already know the the volume of these cubes.

Write down the volume of Cube R in Table 3. (52)

Let’s now put some of these cubes together to get a cube whose side is 2 cm (Figure 9). We shall call this cube S.

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 a side measuring 3 cm and Cube U has a side that is 4 cm long.

Note the lengths of the side and volume of cubes T and U in the table. (55)

Figure 9 R S T U

Table 3

Cube	Length of side (cm)	Volume (cm3)	How many times larger than volume of Cube R

R
S
T
U

On the basis of the above table, what happens to the volume of a cube when the length of its side is doubled? (56)

If the volume is to be multiplied 27 times how many times longer should the side of the cube be? (57)

If each side of a cube is halved, how many times smaller would its volume be?(58)

The relationship between the length of the side and volume is not limited to cubes alone. This relationship is found in 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 on '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

EXPERIMENT 12

DIFFERENT THINGS, SAME VOLUME

Take twenty 1cc 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 will you judge whether two objects with different shapes have the same volume or not? (61)

Figure 10

QUESTIONS FOR REVISION

1. **Sohail measured two litres of milk and gave Sunita three fourths of it. How much milk does Sohail have now. Write your answer in ml.**
2. **Look at the measuring cylinder in the figure and read its least count and 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 by your method. Did you face any problem in measuring its volume? If yes, describe your problems.**
4. **A measuring cylinder contains 75 ml of water. Seema put in seven 1 cc blocks into it. How high will the water level in the measuring cylinder rise?**
5. **Estimate the volume of each of following things and then find out the actual volume by measuring them**

    - A cup of tea
    - A ball
    - A lime, a peanut, a tamarind seed
    - 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 the problem in class.**
8. **Can you think of a method to measure the volume of your own body.**

NEW WORDS

Concave translucent displaced

11.

PLAYING GAMES WITH AIR

The hot air of the arid summer months parches your throat and dries your skin. Then comes the monsoon and its moisture-laden winds soothe your skin? In winter, the breeze chills you to the bone. Bicycling in the direction the wind blows is so 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.

Can you make a list of 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 if they contain air or not? (2)

In this chapter we shall do some experiments with air. These experiments will help us learn many things about air. We cannot see air, but we can do experiments that 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 by immersing it in the way shown below.

Stuff some paper in the glass and pack the paper at the bottom (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, keeping it in its inverted position, and check whether your guess was correct.

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). The balloon or coloured paper will indicate the level of water inside the glass. Check whether the glass is filled with water or not.

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 if 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 Experiment 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 there is air 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.

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 spilling the water it contains. Insert the free end of the other valve tube into the mouth of the measuring cylinder.

What you have to do now is fill water in the injection bottle with the syringe. As water enters the injection bottle, the air in it is forced out through the other refill into the measuring cylinder. If you fill the injection bottle with water, all its air will go into the measuring cylinder. You can then check the reading of the measuring cylinder to find out how much air it contains.

So go ahead and do the experiment. Fill water into the injection bottle with the syringe. But ensure that the second valve tube is inside the measuring cylinder.

Figure 3

When the injection bottle is filled with water, check the reading on the scale 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.

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 attaching the balloon. Place the bottle in the sun. Inspect it after 4 to 5 minutes.

Figure 4

What happened to the balloon? (15)

Why did this happen? (16)

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 pull its piston out 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)

Figure 5

Were you able to press the piston? (22)

Did you feel a pressure on your finger while pressing the piston? (23)

What is the volume of air after you pressed the piston? (24)

When you pressed the piston, did the amount of air in the syringe decrease or did only its volume decrease? (25)

Fill the syringe with water and repeat the same experiment.

Could you press the piston down when the syringe is 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)

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, like the one in which milk is packed and sold. Insert a glass tube or the casing of an old ball-point pen through this packet, as shown in Figure 5, and tie the tube tightly with thread. Place the packet on a table and put a couple of books on top of it. Fill air into the packet by blowing through the tube.

What happened? Why did this happen? (29)

EXPERIMENT 8

Take a large plastic bottle. Select a two-holed rubber cork that fits firmly in 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.

Close the mouth of the bottle with the cork. The balloon should be inside the bottle as shown in Figure 6.

Seal the mouth of the bottle and the holes in the cork with sealing wax so that the bottle is airtight. Now suck in air from the bottle through the tube which does not have a balloon attached to it.

Figure 6

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 stay in the tube 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 sealing wax or candle wax to make the hole airtight. Close the mouth of the bottle firmly with the cork. The lower end of the tube in the bottle should be submerged in the water (Figure 8). Blow hard into the bottle through the tube and remove your mouth quickly.

Figure 8

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 squash it a little. But take care that the bottle does not break. Invert the slightly crushed bottle and dip the tube into a beaker full of water. Now 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 piece 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 piston to the halfway mark. Close the nozzle of the syringe with your thumb and try to pull the piston to the maximum extent. Were you able to pull the piston easily? What did you feel on your thumb? What happens when you leave the piston 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.	
6.	
7.	
8.	
9.	
10.	
11.	

NEW WORDS

pressure piston

12.

THIS IS THE WAY TO MAKE GRAPHS

There are many ways of giving information - in words, through a picture, with the help of a table etc. The growth of a plant (the increase in its length) has been shown here in different ways as an example. One way to describe the plant's growth is through a graph. A graph is a good way of presenting information in a simple and easy-to-understand manner.

We shall learn to make and read graphs in this chapter.

By means of a table

Day	Length of plant (cm)
0	0.0
4	1.4
8	5.4
12	9.6
16	10.2
20	10.9

In words

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.

By means of a picture

Through a graph

EXERCISE 1

Huma made a 1 cm x 1 cm square. She then made squares with 2 cm, 3 cm, 4 cm and 5 cm long sides.

She decided to measure the perimeter of these squares. Do you remember how you measured the perimeter of a square in the chapter on 'Area'?

Huma measured the perimeter of these squares and entered her measurements in a table.

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

When she studied the figures in the table, Huma concluded that the perimeter of a square increases when the length of its side increases. But she wondered whether the perimeter increased according to some rule or whether it increased randomly. Huma decided to find out. She used the figures in Table 1 to plot a graph to try and understand the relationship between the length of the side of a square and its perimeter.

Let us make the same graph. Take a graph paper from the kit copy in your workbook. It has squares made of thick lines which are 1 cm long. Each line in these big 1 cm x 1 cm squares have been divided into ten equal parts.

What is the length of each small 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. The horizontal line is called the X axis and the vertical line is the Y axis. The lines of the X and Y axis should be made on the thick lines of the graph paper (Figure 2). You had made similar lines in the chapter on 'Learning How to Make Maps'.

Figure 2

The point where both these lines meet on your graph paper 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 see which two measurements you are making a graph with. In this case, you have to see 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. Divide the X axis into equal distances of 1 cm, 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 equal distances of 1 cm, beginning from the origin, up to 20 cm and number them 1 to 21.

You are now ready to mark the figures in the table on your graph paper. There are two figures for each square. One is the length of its side and the other is its perimeter. We shall mark both these figures in the form of a point on the graph. Since there are five squares, there will be five points. We can get our graph line by drawing a line joining these five points.

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 you show these two figures as a single point?

1. The length of the side of the first square is 1 cm. So 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.

It is the graph point of the first square. Now, make the graph point for the second square. What are the two figures for this square? Check them in Table 1. The table shows that the length of the side of the second square is 2 cm and its perimeter is 8 cm. Now, repeat the three steps above.

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 graph points on your graph paper. What will the line joining them look like? Will it be a straight line? If you think it will be a straight line, you can use a scale to join the points. But take care about a few things while doing so.

Place the scale in such a way that as many points are near it as possible. Shift or rotate the scale to find the best position. Draw a straight line in this position. This is your graph line.

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 other squares as well. This is possible because every point on the straight line of your graph 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 be the perimeter of a square 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. Name 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 4.5-cm-long side. Can you guess how?

Draw a vertical line parallel to the X axis from point A towards 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.

Figure 3

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)

EXERCISE 2

RELATIONSHIP BETWEEN THE SIDE OF A SQUARE AND ITS DIAGONAL

Make a square with a 1 cm-long 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 of the square 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 forwards and backwards and answer the following questions:

If the diagonal of a square is 7.5 cm long, what is the length of its side? (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 done the lesson on '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 by pouring a little at a time, noting down 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 till 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 to equal 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 of water 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 that covers the entire graph paper. That will make it easier for you to understand it.

3. Choose a scale that makes it easier for you to make further 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 scale 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 ninetyeight 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:

$$\text{Percentage of enrolement} = \frac{\text{Total number of children studying in middle schools}}{\text{Total population of children between 11 and 14 years}} \times 100$$

$$= \frac{20700000}{49800000} \times 100 = 42 \text{ percent}$$

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)

Find out from the graph the percentage of enrolment of children in the years 1970 and 1993 (23)

In which year was the enrolment percentage the highest? (24)

What changes have occurred in the enrolment percentage from the year 1950 to 1993? (25)

What influence will an increase in the percentage of children enrolled in middle schools have on our country and its children? (26)

Graph B (Figure 5) shows the sex ratio of our country. This ratio tells us the total number of women in the country per thousand men. That means, if we assume that there are 1,000 men and 1,020 women in a country, 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)

Find out the sex ratios in India from 1901 to 1991 from the graph. (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 in our country 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 bits of copper. She took a piece of copper with a volume of 4 cc. She weighed it and noted the weight in the table below. Similarly, she weighed copper bits with volumes of 8, 12, 16, 20 and 24 cc. She noted these weights too in Table 4.

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

Use the figures in this table to plot a graph of the volume and weight of copper pieces.

While choosing your scale ensure that the largest figure can be shown on the graph paper and that you use the entire graph paper. Also, you should not face any difficulty in making 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 bit 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 put 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.

The graph will not be in the form of a straight line. It will be in the form of two straight lines meeting at a point.

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 will be the volume of the 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 given 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) Write down 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.

13.

GASES

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.

METHOD OF PREPARING LIME WATER

Fill a beaker one half 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 about one half 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. But 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

Take two glass tubes and join them with a rubber tube as shown in Figure 2.

Fix one glass tube in a one-holed rubber cork that fits tightly in the mouth of a boiling tube. Put about 5 gm of marble chips and some dilute hydrochloric acid in the boiling tube. The amount of hydrochloric acid should be enough to cover the marble chips completely. Fit the one-holed cork with the glass tube in the boiling tube. The free end of the glass tube should dip into the boiling tube.

Dip the free end of the second glass tube into a solution of lime water in a test tube.

Figure 2

Do the marble chips react with the hydrochloric acid? (1)

Look at the solution in the test tube. Has a gas form 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 a test tube about one fourth 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. 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 3

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)

Figure 4

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 another boiling tube in the same way you pour water. While pouring the gas, take care that the bottle is not fully inverted over the boiling tube, covering its mouth completely. It should be kept at a slight tilt so that the air inside the boiling tube can escape as the gas from the bottle fills the boiling tube (Figure 5).

Figure 5

After some time, remove the bottle 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 say that the gas from the bottle was transferred to 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 through 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. Transfer the test tube, keeping it inverted, into a container of water and remove your thumb. The water in the test tube should not flow out when you remove your thumb (Figure 6)

Figure 6

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 6 and heat the boiling tube. Use a test tube holder to hold the boiling tube over a 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 shall not do any experiments with this gas because it contains some air.

Fill a boiling tube with this gas. Close the mouth of the boiling tube with a cork and place it on a stand.

How does the gas smell? (20)

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 this observation? (21)

Figure 7

Take another boiling tube filled with the gas. Drop a burning matchstick into it. Let it burn completely. Keep dropping burning matchsticks in the boiling tube till the effect of the gas on the flame is no longer seen. Now drop another burning 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)

On the basis of Experiment 4 can you say which gas was formed when the matchsticks burned that now prevents them from burning further? (23)

EXPERIMENT 8

Fill another boiling tube with this gas as you did in Experiment 7. Test the gas, in turn, 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, as 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 question No 26 and 28 say whether the gas is acidic, basic or neutral. (29)

This gas is 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**
	Colour		
	Smell		
	Effect on blue litmus		
	Effect on red litmus		
	Effect on burning matchstick		
	Effect on smoldering incense stick		
	Effect on lime water		
	Effect on pink indicator solution		

EXPERIMENT 10

THE SCIENCE OF BURNING: CARBON DIOXIDE AND OXYGEN

Take two small candles. Place them on a table or on the floor and light them. Cover one candle with a beaker or glass tumbler (Figure 8)

Figure 8

Can you say 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 two litre plastic bottle and --------------

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**	**Time taken for candle to extinguish**

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 boiling tube (Figure 9). After some time, add some lime water to the boiling tube and shake it well.

Figure 9

What happened to 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 things in air, oxygen and carbon dioxide. Fill in the blanks on the basis of whatever you have learned.

1) **------------------ gas helps a burning 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. This means air contains ------------------ gas.**

7) **When objects burn 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 it have on the bulb and the candle? Give reasons for your answer.**
3. **The equipment used for putting out a fire, the 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 learned in this chapter, can you say what this gas is?**
4. **What would happen if there is no oxygen in air?**
5. **You learned about two gases in this chapter. Have you heard about any other gases? List them and list whatever properties you know about these gases.**

NEW WORDS

oxygencarbon dioxide indicator solution

14.

RESPIRATION

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 even if there is a shortage of 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 do some experiments to find out.

EXPERIMENT 1

RESPIRATION IN HUMAN BEINGS

Let’s first find out how long a person can hold her/his breath. Use a watch with a seconds' needle to time your breathing. If you don’t have a watch, then practice counting at a uniform rate. You can measure the time by counting. Close your mouth and close your nose with your fingers so that air cannot pass through it.

How long could you keep your mouth and nose closed? (1)

What did you feel after keeping your mouth and nose closed 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)

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 (s)he 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 air in a minute is called the **expiration rate**.

EXERCISE AND BREATHING

You may have seen that we begin to pant after running or exercising. So do exercise and running affect the rate at which we breathe in and out?

In your opinion does the expiration rate increase of decrease after exercising? (6)

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 the tape around the chest of one of your friends and measure the width of her/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 inspired or exhaled? (7)

EXPERIMENT 4

HOW MUCH AIR IN YOUR BREATH?

Make a measuring cylinder with a two-litre plastic bottle. To do this, pour 100 ml of water at a time in the bottle and mark the water level after each addition.

Now fill the bottle to the brim and invert it in a bucket or a large container of water. But remember, no air bubbles should remain in the bottle 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. Don’t breathe in while blowing the air out. 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.

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)

EXPERIMENT 5

IS THERE A DIFFERENCE BETWEEN INHALED AND EXHALED AIR?

Exhale air from 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 on the surface of the mirror.

Look at the surface of the mirror carefully. What did you see? (12)

Clean the mirror again and blow air on 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 differences between the air we breathe out and the air from a syringe.

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 could break. So take the help of your teacher to do this.

Fill both boiling tubes one fourth with pink phenolphthalein solution. Mark them A and B. Now repeatedly blow in and suck out air in this apparatus as shown in Figure 7.

Figure 6 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 air flow into the apparatus? How can you find out?

2. When you blow air out, through which boiling tube does the air flow out of the apparatus? Can you say 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. Are the inspired air and expired air similar? If they are not, what are the differences between them? (16)

Wash and clean the two boiling tubes and fill both one fourth with lime water.

Repeat the experiment of repeatedly 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 between inspired and expired air did you find out about in this experiment? (17)

You studied the properties of oxygen and carbon dioxide in the chapter on '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 into 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 inspired and expired air on the basis of Experiments 5, 6, 7 and the table given above? (20)

EXPERIMENT 8

RESPIRATION IN PLANTS

Do plants respire in the way humans do? Let's do an experiment to find out.

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 a test tube about one fourth 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.

Did the lime water change colour? (21)

Figure 8 Figure 9

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. Look carefully at the test tube while doing so.

Did the ime 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.

What effect did the experiment with sprouted seeds have on the lime water? (23)

On the basis of your observations in these experiments 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 this 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 to the nose and mouth of the person and a rubber tube connects the mask to the oxygen cylinder. 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 going there.

Would it have been possible for the first person to land on the moon to find living creatures 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.

EXERCISES FOR REVISION

1. In this chapter you did experiments related to respiration in flowers, seeds etc. Can you suggest an experiment in which you can study respiration in an entire plant?

2. In Experiment 8 why was the experiment first done with an empty flask?

3. Can you suggest any similarities between respiration and burning on the basis of what you learnt in this chapter?

NEW WORDS

inspiration living beings expiration

expiration rate artificial respiration

15.

LIGHT

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 of the objects in the room. So we do not 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 these objects. Second, the object is itself a source of light or, in other words, 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. Turn 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. The question then is, why can't we see an object situated on the other side of a wall? 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

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 fall in a straight line at the same height. 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. But do not place the three match boxes at the same height. Their levels should be slightly higher or lower compared 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 boxes to exactly the same height. To ensure that the three holes are in a straight line, pass a long needle through them. Place the burning candle at one end and try to see the flame from the other end. Is it visible?

What does this experiment tell you about the path of light? (1)

Figure 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 postcards while making the tubes. Paste a piece of black paper to cover one of the open ends of the wider tube, as shown in the figure. You could use either glazed or carbon paper. Make a hole with a pin in the centre of the black glazed paper. This is your pinhole tube. Similarly, paste a piece of white paper to cover one end of the narrower tube. Apply some oil on this paper so that it becomes semi-transparent. 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.

Figure 3 **Figure 4**

What did you see on the screen? (2)

Slide the screen tube forwards and backwards and carefully observe the **image** of the flame on the screen while you do this.

What happens to the image when the screen 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 end of the tube 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 a ray of light coming out of the slit. Let this ray 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.

We shall use this mirror strip covered with a slit black paper in the following experiments.

EXPERIMENT 3

REFLECTION - HOW LIGHT RETURNS AFTER STRIKING AN OBJECT

Place a blank sheet of paper on level ground, partly in 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 spread on the floor. 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 first 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 this mirror is called the **incident ray** and the ray returning from it is called the **reflected ray**.

Figure 6

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 a right angle (90 degrees) to line AC. The second line should bisect line AC at point B. We shall call this line the **normal** (Figure 7).

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 polished surface facing the normal. Take the mirror strip with a slit and let its light ray fall on 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)

Adjust the mirror strip with the slit so that its light ray falls on line 3.

On which line does the reflected ray fall now? (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 on the normal? Perform the experiment to find out and write your answer in your exercise book. (11)

You don't have to draw the angle of incidence on the paper before performing the experiment, as 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 build two models.

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.

When you look through Window 2, you will be able to see things kept 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 in front of the tree trunk (Figure 9). You can also sit in a ditch and see what is happening outside, or look on the other side of a wall with your periscope.

You may have read about submarines. The move under water. They are fitted with periscopes.

How is the periscope used in a submarine? (12)

Figure 8 (a) (b) (c)

Figure 9

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 on the 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 from below and look at the bangle pieces from the open end. What do you see?

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.

Figure 10

A GAME OF MAGIC

Place a coin in a bowl or a big 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.

Place the bundle standing up horizontally 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 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.

What happens to the ray of light when it enters the glass bundle and when it comes out? (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 in the bowl. Write your answer in your exercise book. (15)

Figure 11

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 in all the positions? Draw diagrams to show how the pencil looks from all four sides.

EXPERIMENT 8

REFRACTION THROUGH A HAND LENS

Use a hand lens to focus the sun's rays on a spot. Adjust the hand lens 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**.

What is the focal length of your lens? (16)

Now use your hand lens to make 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.

EXPERIMENT 9

Cut two one mm wide slits on a piece of black paper. The distance between the two slits should be approximately one cm. Wrap this paper on a mirror strip as you did in Experiment 3.

Choose a spot where light and shade meet. Hold a hand lens vertically over a sheet of white paper in the shade. Use the two slit mirror strip to throw two rays of light on the hand lens. Tilt the hand lens a little and move it back and forth until the rays passing through it are clearly visible on the paper (Figure 12).

What happens to the light rays when they 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)

Figure 12

You have two more hand lenses 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 hand lens.

EXPERIMENT 10

IMAGE WITH A HAND LENS

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 hand lens 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 more clear 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 as a hand lens forms images. Let us try to understand how our eyes work.

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 EXERCISES 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. Keep the mirror strips facing each other and place 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

16.

ELECTRIC CIRCUITS AND CELLS

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 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 the previous year before we go ahead with out 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 the bulb through the ……………..

(b) The path of electricity is called a ………………..

(c) When current flows through 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 following in a circuit?

CAUTION: DON'T EVER DO THESE THINGS

Always bear the following precautions in mind. We told you about 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 directly connect the positive (+) and negative (-) terminals of a cell. The cell gets discharged quickly if you do so.

MAKE YOUR OWN SWITCH

Our country faces a shortage of electricity. So wasting electricity means you are depriving some one 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 cells 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)

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.

Figure 1 Figure 2

Let us make a switch for our circuits. Take a 10 cm-long iron strip. Bend it at two places 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 a circuit as shown in Figure 2.

Figure 1 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 onto 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 could 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.

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)

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 this:

Figure 3 Circuit 1

AN EXERCISE

DRAW CIRCUIT DIAGRAMS

You saw how a circuit diagram is drawn using symbols. Let us practice drawing such diagrams.

A few circuits are shown in Figure 4. Draw their circuit diagrams using the symbols you have learned.

Figure 4

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 others used longer wires. One group kept the cell on the left side of the bulb while another kept it on the right. But were all the circuits actually different? How would you differentiate between two similar looking 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.

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 circuit diagram?

Does the circuit change when you merely shift objects 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 faulty 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 Circuit 2: Series Circuit

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 they give the same amount of light? (16)

If one of them gives less light, will it give more light 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 the amount of light they give out? (18)

Sometimes, bulbs that appear similar externally can differ from each other. So even similar looking bulbs do not always give the same amount of light 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 now made and seen a series connection. Let us explore the other type of connection.

EXPERIMENT 3

PARALLEL CIRCUIT

Circuit Diagram 3 (Figure 6) shows a circuit in which two bulbs are connected in a different manner. It shows the second type of circuit.

Figure 6 Circuit 3: Parallel 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 make a parallel circuit with them.

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)

Circuit 4 Circuit 5

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 in this experiment? List them in your exercise book. (28)

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)

A PUZZLE

Some circuit diagrams are shown below. Observe them carefully and say which ones are series and which are parallel.

Circuit 6
Circuit 7
Circuit 8
Circuit 9
Circuit 10

EXPERIMENT 4

A CIRCUIT WITH TWO CELLS

Figure 7 shows two circuits, each made with two cells.

In Circuit Diagrams 11 and 12, are the cells connected in series or parallel? (31)

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 for 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 other 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-positive or negative-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.

Figure 7

Circuit 11
Circuit 12
Circuit 13

Last year you studied the circuit of a torch by opening it.

Can 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 discharging? (34)

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)

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)

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 to determine whether a liquid is a conductor or an insulator that we used for solids. However, we shall use a new kind of bulb called an LED.

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 for help.

Figure 8

Take the rubber cap of an injection bottle. Invert it and pierce two pins into its raised bottom rim so that their sharp points go through the walls into the central hollow (Figure 8). Make sure that the pin-points do not touch each other, but are fairly close.

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 the table below. 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?

Make the following table in your exercise book and write down your observations.

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.	……………………	

HOW THE FIRST CELL WAS MADE

You have used many cells in your experiments till now. Some of them may have been fully discharged and gone dead. Would you like to know how the first cell was made? It is a very interesting story.

Scientists in Europe began experimenting with electricity around 400 years ago. They generated electricity in different ways and conducted various experiments. However, they faced one major problem which prevented them from understanding electricity in depth. They did not have a stable and permanent source of electricity.

This may sound like a minor problem today, but it took scientists nearly 200 years to find a solution.

That solution came in the year 1780. And it came almost by chance. A biologist named Luigi Galvani from Bologna, Italy, once saw 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 frog's 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 frog's legs. However, he discovered that if a frog's leg hung from an iron hook is touched with another iron rod, it does not twitch. Volta was a bit puzzled.

If the reaction in a frog's leg is due to the electricity in its body, why are two different metals required to make it twitch, he wondered? After a lot of thinking he arrived at the conclusion that electricity does flow through the frog's leg when two different metals touch it. However, this electricity is not contained in the leg of the frog but is 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 is possible to generate electricity if two different metals are placed in some 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.**

Let us make a cell with the same metals and chemicals used by Volta.

EXPERIMENT 6

MAKE YOUR OWN CELL

Figure 9

You will need a few things to make a cell. Collect two injection bottles. 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 spent 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 into the rubber caps of the injection bottles as shown in Figure 9. Ensure that the copper wire and zinc strips do not touch each other.

Now take a wire and connect the copper wire of one bottle with the zinc plate 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.

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 zinc plate and the wire from the other terminal to the copper wire. 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.

EXERCISES FOR REVISION

1. In which of the following circuits will the bulbs light up and in which will they not? Give reasons and test your answers by making the circuits.

a b c

2. Find the mistakes in the following circuits and draw the correct circuit diagrams.

a b c

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

Chapter-17.

SENSITIVITY OF LIVING ORGANISMS

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 answers 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 1

SENSITIVITY OF ANIMALS

TOUCH AND OBSERVE

You may have touched various small creatures. If you have not, touch the following animals and observe how they react:

cow, silverfish, earthworm, cricket, snail (1)

Can you say for sure that they reacted because you touched them? 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. Also 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? Could it be 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 differences 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 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. These days several different kind 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 bars were taken. One was kept 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 the 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 repeatedly asked you 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 by the light? But a candle also produces heat. Is it not possible that the insect came near the candle because it was attracted by 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 given time.

Take the example of the scientist who experimented with snakes to find out more about their sensitivity.

He made the following observations:

1. He blindfolded the snake and played the *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 a *been*, the scientist 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 listen to the sound of the *been* and dance? (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 matter further in your class and write your 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. **In 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 in a particular season. This shows that they are sensitive to the weather/seasons. This sensitivity directly affects their cultivation. We shall talk about this link 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, chose 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 it's 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? Is the situation the same 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 EXERCISES 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.**

18.

LET'S MAKE CRYSTALS

In the chapter on '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 the process.

So let's try making crystals with urea and some other substances.

EXPERIMENT

UREA CRYSTALS

Pour about 5ml 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 hand lens.

What is the shape of the crystals? Make a diagram of a urea crystal. (2)

Is the shape of the urea crystals the same in every group? (3)

EXPERIMENT 2

BENZOIC ACID CRYSTALS

Pour about 30ml 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)

Is the shape and colour of benzoic acid crystals the same for all the groups? (5)

EXPERIMENT 3

ALUM CRYSTALS

Pour about 5ml 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 till 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 on '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 after 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)

Table

Substance	**Colour of crystals**	**Shape of crystals**
Copper sulphate		
Oxalic acid		
Urea		
Salt		

Compare the crystals of copper sulphate made by your group with those of the other groups.

Is the shape of copper sulphate 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.

EXERCISES 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

19.

OUR CROPS
PART 1

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 cultivated 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 rabi and kharif. The rabi season is the cold season and the kharif season is the monsoon season.

Make the following four groups of crops on the basis of what you already know about our crops:

1. **Kharif crops**
2. **Rabi crops**
3. **Summer crops**
4. **Crops that grow in all three seasons (1)**

Study these groups and then say whether different crops generally grow in a particular season. (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 these two seasons. 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)

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)

Table 1

Name of season	Duration (months)	Cloud cover	Rain		Light		Heat/ Cold	Length of night	
			Light	Heavy	Less	More		Long	Short
Rabi									
Kharif									

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 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 many hours long are the nights in July? (8)

How many hours long 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 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.

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 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 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. 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 blossom 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 blossom, the nights should be shorter than 12.5 hours.

Check in the graph to see in which months this condition is met. (18)

Suppose a farmer sows wheat in July. It requires 8 to 10 weeks of growth to be ready to blossom. 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 crop 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 blossom in October.

Which season follows after October - the hot season or the cold season? (22)

So can the wheat crop ripen after it blossoms in October? (23)

Can you now explain in your own words why the wheat crop should be sowed 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 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 wheat is one such plant. This particular limit is different for different plants. For wheat it is 12.5 hours. 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 **independent of night 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 what difference there is in the time the wheat is ready for harvesting in these two states?

NEW WORDS

rabi kharif short night plants long night plants

independent of the night plants

20.

CHEMICAL REACTIONS

Milk curdles if something sour is put into it. The water separates from the solids in the milk. If a little curd is put in milk, the milk slowly converts into curd. In all these examples, something new is formed. When a candle is lit, it burns and goes up in smoke. 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 any one substance or by mixing more than one substance. Each group in the class should give at least one example. The groups should also explain how they 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 in which chemical reactions occur. We shall try and identify the changes during the reaction that tell us that a new substance is being formed. So observe carefully all that happens in each experiment.

EXPERIMENT 1

COPPER ELECTROPLATING

Take 50ml of water in a beaker and dissolve about half a spoonful of copper sulphate in it. Add 1ml of sulphuric acid to the solution. Take five test tubes and label them 1 to 5. Pour equal amounts of copper sulphate solution in each test tube. Add iron nails or pins to test tube No 1. Similarly, add aluminium foil, a plastic substance and a piece of wood to test tubes No 2, 3 and 4 respectively. Do not add anything to test tube No 5.

After half an hour, observe the colour of the copper sulphate solution and the substances in each test tube. Also observe whether the objects 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 colour of the copper sulphate solution became lighter? (3)

In which test tubes did you observe any change in the substance they contain? (4)

Table 1

Test tube No	Object added to solution	Change in colour of solution	Changes in object
Iron nails or pins			
Aluminium foil			
Plastic			
Wood			
Nothing			

On the basis of your observations, explain, with reasons, in which test tubes a chemical reaction took place? (5)

Can you guess what new substance was formed in these chemical reactions? (6)

A PROBLEM TO PONDER OVER

Is there a test tube in which the colour of the solution changed, but nothing happened to the substance it contained? (7)

Is there a 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 present in it? (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 a test tube one-third with water. Dissolve about half a spoonful of urea in it and shake well.

Take another test tube with the same amount of water and dissolve half a spoonful 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 previous two experiments we learned how to recognise whether a new substance is formed in a chemical reaction. Let us now examine 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 time so you should be patient and make arrangements to ensure that the equipment is left undisturbed during the course of the experiment.

Take three test tubes, two beakers and an iron wire brush used for cleaning utensils. Label the test tubes 1 to 3. Cut 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 No 1. Put the second dry ball in test tube No 2. The balls should be large enough to get stuck to the bottom of the test tubes so that the do not fall out even if the test tubes are inverted. Nothing should be done with test tube No 3.

Fill a beaker one-fourth with water. Invert test tubes No 1 and No 3 in the beaker. Test tube No 2 should be kept in a second dry beaker.

Note the water level in test tubes No 1 and No 3. You will see that the water level is same as that in the beaker. Place the two beakers with the test tubes in a safe place where they can’t be disturbed. You should observe the test tubes every day for the next three days. Don’t take them out of water to make your observations. Note the changes you see in the iron wire and the water level in the test tubes.

Record your observations in the table given below.

Table 2

S. 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 tubes did you notice any change in the iron wire? (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)

In which test tube did you find evidence of a chemical reaction and what was the evidence? (19)

In the above three experiments we learned that there are different indicators of a chemical reaction taking place or a new substance being formed.

In the chapter ‘Our food’, you tested various substances to find out whether 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 some air into the test tube with the help of 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 on ‘Gases’ you will carry out chemical reactions to form gases and test their properties. Next year you will learn how to measure the rate of a reaction. You will also see what factors affect chemical reactions.

EXERCISES FOR REVISION

1. Which of the following processes are chemical reactions? How did you conclude that they are chemical reactions?

Making a salt solution
Melting of ice
Adding hydrochloric acid to marble
Separating colours by chromatography
Melting of wax
Evaporation of water
Colourless phenolphthalein indicator solution turning pink

2. In the chapter ‘Respiration’, you learned the difference between inspired and expired 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 took three test tubes. Would we have faced any problem in drawing conclusions if we had taken only one test tube? Give reasons for your answer.

21.

NUTRITION IN PLANTS

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 came 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 big 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 for food. 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. He performed his experiment 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 this 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. He covered the pot with a metal lid 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.

PRIESTLEY'S FIRST EXPERIMENT

For at least a hundred years after van Helmont conducted his experiment, no one paid any attention to the issue of nutrition in plants. In 1771, Joseph Priestley conducted some experiments that yielded a lot of new information on the subject. Priestley did not conduct these experiments to study nutrition in plants. He wanted to find out what gases are present in air.

You have already performed one of Priestley's experiments in the chapter 'Gases'. When a lighed 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 respiration by the mouse 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. What could be the explanation?

What do you think is the reason? (5)

PRIESTLEY'S THIRD EXPERIMENT

Priestley managed to answer this question, to some extent, in August 1771. He performed an extraordinary experiment. He kept a beaker over a lighted candle. As expected, the candle went out after some time. Priestley then placed a sprig of mint inside the beaker. While placing the sprig, 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 did the candle go out the first time it 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 had 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 lights up again.

Priestley showed through his experiment that all green plants have this property. They purify the air.

Let us do an experiment similar to Priestley's, in a slightly modified manner.

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 of the aquatic plant 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 of the aquatic plant in the funnel. Keep this apparatus, too, in the sun.

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 these bubbles are made of.

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 end into the test tube. Take care not to dip the lighted end 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 this 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 could purify air only if they were kept in a lighted place. When they were kept in the dark, they too made 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, taking in oxygen and giving out carbon dioxide.

Ingenhausz thus showed that Priestley's experiments could be repeated and similar results 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 keeping the apparatus in the shade instead of in sunlight.

Is there any change in the rate of formation of bubbles? (16)

Cover the beaker with black paper or cloth.

Check after some time whether bubbles are still being formed. (17)

FOOD FROM AIR?

We read 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 leaves use water and carbon dioxide in the presence of sunlight to make starch.

This process, which takes place in green leaves in the presence of sunlight, can also be written in the form of an equation:

$$\text{carbon dioxide + water} \xrightarrow[\text{and chlorophyll}]{\text{in the presence of sunlight}} \text{starch + oxygen}$$

During this process, not only is starch formed but oxygen is 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 this process. This green substance is called chlorophyll.

WHAT IS NEEDED FOR PHOTOSYNTHESIS

Photosynthesis is an important process. Plants make their food by photosynthesis. 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 necessary for 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 small, white flowered plant like *sada bahar,* parthenium (*gajar ghas*) or balsam. If you can, try and get a plant which is in bloom and has some white or light coloured flowers.

Carefully uproot two such plants. 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 them one-third with water. Add about four teaspoons of red ink to the water in one bottle. Tie two identical plants to two separate dry twigs. Take care not to damage their stems while tying them. Place one plant in the glass with the red ink solution. It should stand erect in the glass with the support of the twig. Put the other plant in a similar way in the glass containing plain water. Keep both glasses in the shade for about an hour.

Study both plants carefully and record your observations in Table 1. (18)

Figure on page 225

Table 1

S. No	Question	Observation	
		Plant in plain water	Plant in red ink solution
1.	Look carefully at the leaves of both plants.		

What difference do you see?

2. Look carefully at the flowers of both plants.
Do you see any change in their colour?

Cut the stems of both plants horizontally with a blade. Observe the cut section with a hand lens.

Can you see red colour anywhere in the stem?

Are the spots of red colour arranged in the same way they are arranged in the figure here?

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 it is necessary to irrigate the fields after sprinkling urea? Think it over and answer with reasons.

The farmer sprinkles urea in the soil of his field. How does the urea affect the leaves of the crop?

This experiment and the information about urea tell us how and from where plants get water and other nutrients dissolved in it.

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. It is through the stomata that the exchange of air in leaves takes place continuously.

We know that plants take water through their roots and air though the stomata of their leaves. We also know that the leaves contain the green substance. 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 *chandani*, but it can be performed with any plant.

You need to find out if starch is present in leaves. You already know how to test for starch, but a problem arises if you try this test with 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 *chandani* 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 of the same plant were covered with black paper without removing them from the plant. The way the black paper was cut and fixed to the leaves is shown in the figure.

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.

Black paper attached to a leaf   The colour of the leaf after iodine is applied

Can you tell by looking at the figure where starch is present and where it is not? (24)

Did the entire leaf get light after it was covered with black paper? If this was not the case, which parts of the leaf did not get light? (25)

Did starch form only in those parts that got light? (26)

On the basis of this experiment, what connection do you see between light and starch formation? (27)

DO PLANTS PRODUCE ONLY STARCH?

In the chapter 'Our food', you read that starch, fats and proteins are present in food. They are also present in plants. Where do these substances come from? Once starch is formed, the plant forms 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 nutrient elements as well, but these are needed only in minute quantities. Hence, they are called micronutrients. Plants absorb these nutrient elements from the soil through their roots. Unfortunately, at this stage we cannot perform any experiment to study these nutrient elements.

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. Therefore, animals and plants are directly linked through food. This relationship can be explained with the help of a diagram.

Figure on page 228

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 breathe in oxygen and produce 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 kept?**
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 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	micronutrients	food chain
chlorophyll	stomata	scavenger

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?

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 fruits?

Season: In which season do you usually sight the bird?

A description of the khanjan in provided below 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 a 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.

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 in focus.

Did you see the colours of the rainbow? The arrangement of colours in sunlight is called the 'spectrum'.

Optical Illusion

Can you tell whether one cube is place 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

Look at the gray circle in Figure 2. Does it have the same colour through out? 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 2

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

Look at Figures 4 and 5 carefully. Are the long lines drawn in them simple lines? Are they parallel lines? First take a guess. Then use a ruler to check whether your guess is correct or not.

Figure 4

Figure 5