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FOREWORD

The National Curriculum Framework (NCF), 2005, recommends that children's life at school must be linked to their life outside the school. This principle marks a departure from the legacy of bookish learning which continues to shape our system and causes a gap between the school, home and community. The syllabi and textbooks developed on the basis of NCF signify an attempt to implement this basic idea. They also attempt to discourage rote learning and the maintenance of sharp boundaries between different subject areas. We hope these measures will take us significantly further in the direction of a child-centred system of education outlined in the National Policy on Education (1986).

The success of this effort depends on the steps that school principals and teachers will take to encourage children to reflect on their own learning and to pursue imaginative activities and questions. We must recognise that, given space, time and freedom, children generate new knowledge by engaging with the information passed on to them by adults. Treating the prescribed textbook as the sole basis of examination is one of the key reasons why other resources and sites of learning are ignored. Inculcating creativity and initiative is possible if we perceive and treat children as participants in learning, not as receivers of a fixed body of knowledge.

These aims imply considerable change in school routines and mode of functioning. Flexibility in the daily time-table is as necessary as rigour in implementing the annual calendar so that the required number of teaching days are actually devoted to teaching. The methods used for teaching and evaluation will also determine how effective this textbook proves for making children's life at school a happy experience, rather than a source of stress or boredom. Syllabus designers have tried to address the problem of curricular burden by restructuring and reorienting knowledge at different stages with greater consideration for child psychology and the time available for teaching. The textbook attempts to enhance this endeavour by giving higher priority and space to opportunities for contemplation and wondering, discussion in small groups, and activities requiring hands-on experience.

National Council of Educational Research and Training (NCERT) appreciates the hard work done by the Textbook Development Committee responsible for this book. We wish to thank the Chairperson of the advisory group in Science and Mathematics, Professor J.V. Narlikar and the Chief Advisor for this book, Dr. N. Rathnasree for guiding the work of this committee. Several teachers contributed to the development of this textbook; we are grateful to their principals for making this possible. We are indebted to the institutions and organisations which have generously permitted us to draw upon their resources, material and personnel. We are especially grateful to the members of the National Monitoring Committee, appointed by the Department of Secondary and Higher Education, Ministry of Human Resource Development under the Chairpersonship of Professor Mrinal Miri and Professor G.P. Deshpande, for their valuable time and contribution. As an organisation committed to systemic reform and continuous improvement in the quality of its products, NCERT welcomes comments and suggestions which will enable us to undertake further revision and refinement.

Director
National Council of Educational
Research and Training

New Delhi
December 2005

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

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A NOTE FOR STUDENTS

The team of Paheli and Boojho will be with you as you journey through this textbook. They love to ask questions. All kinds of questions come to their minds and they collect them in their sacks. Sometimes, they may share some of these questions with you, as you read through the chapters.

Paheli and Boojho are also on the lookout for answers to many questions — sometimes the questions seem answered after they discuss them with each other, sometimes through discussions with other classmates, teachers or their parents. Answers to some questions do not seem available even after all these. They might need to experiment on their own, read books in the library, send questions to scientists. Just dig and dig and dig into all possibilities and see if the questions can be answered. Perhaps, they would carry some of the unanswered questions in their sacks to higher classes.

What will really thrill them, would be your adding questions to their sacks or answer to their questions. Sometimes activities are suggested in the textbook, results or findings of these by different groups of students would be of interest to other students and teachers. You can complete the suggested activities and send your results or findings to Paheli and Boojho. Do keep in mind that activities that involve using blades, scissors or fire need to be done strictly under the care of your teachers. Stick to the precautions given and then enjoy doing all the suggested activities. Mind, the book will not be able to help you much, if the activities are not completed!

You can send your feedback for Paheli and Boojho at.

To

The Head
Department of Education in
Science and Mathematics,
NCERT, Sri Aurobindo Marg,
New Delhi 110016

CONSTITUTION OF INDIA

Part IV A (Article 51 A)

Fundamental Duties

Fundamental Duties – It shall be the duty of every citizen of India —

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;

(k) who is a parent or guardian, to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

CONTENTS

1 Components of Food

In lower classes, we made lists of the food items that we eat. We also identified food items eaten in different parts of India and marked these on its map.

A meal could consist of *chapati*, *dal* and brinjal curry. Another may be rice, *sambar* and a vegetable preparation of lady's finger (*bhindi*). Yet another meal could be *appam*, fish curry and vegetables.

Activity 1

Our meals usually have at least one item made of some kind of grain. Other items could be a *dal* or a dish of meat and vegetables. It may also include items like curd, butter milk and pickles. Some examples of meals from different regions are given in Table 1.1. Select food items and enter these in Table 1.1.

Sometimes, we may not really have all this variety in our meals. If we are travelling, we may eat whatever is available on the way. It may not be possible for some of us, to eat such a variety of items, most of the time.

There must be some reason though, why meals usually consist of such a distribution. Do you think that our body needs different kinds of food for some special purpose?

1.1 What Do Different Food Items Contain?

We know that each dish is usually made up of one or more ingredients, which we get from plants or animals. These ingredients contain some components that are needed by our body. These

Table 1.1 Some common meals of different regions/states

Region/ State	Item of grain	Item of *dal*/meat	Vegetables	Others
Punjab	*Makki* (corn) *roti*	*Rajma* (Kidney beans)	*Sarson saag* (Mustard leaf curry)	Curd, *ghee*
Andhra Pradesh	Rice	*Tuar dal* and *rasam* (*charu*)	*Kunduru* (*dondakai*)	Buttermilk, *ghee*, pickle (*aavakai*)

components are called **nutrients**. The major nutrients in our food are named carbohydrates, proteins, fats, vitamins and minerals. In addition, food contains dietary fibres and water which are also needed by our body.

Do all foods contain all these nutrients? With some simple methods we can test whether cooked food or a raw ingredient contains one or more of these nutrients. The tests for presence of carbohydrates, proteins and fats are simpler to do as compared to the tests for other nutrients. Let us do these tests and record all our observations in Table 1.2.

For carrying out these tests, you will need solutions of iodine, copper sulphate and caustic soda. You will also need a few test tubes and a dropper.

Try these tests on cooked food items as well as raw materials. Table 1.2 shows you a way to record the observations from these tests. Some food items are given in this table. You can conduct the tests either with these or any other available food items. Do these tests carefully and do not try to eat or taste any chemicals.

If the required solutions are not available in readymade form, your teacher can prepare them as given in the box.

Let us begin by testing different food items to see if they contain **carbohydrates**. There are many types of carbohydrates. The main carbohydrates found in our food are in the form of starch and sugars. We can easily test if a food item contains starch.

A dilute solution of iodine can be prepared by adding a few drops of tincture iodine to a test tube half filled with water.
Copper sulphate solution can be prepared by dissolving 2 gram (g) of copper sulphate in 100 millilitre (mL) of water.
10 g of caustic soda dissolved in 100 mL of water makes the required solution of caustic soda.

Activity 2

Test for Starch

Take a small quantity of a food item or a raw ingredient. Put 2-3 drops of dilute iodine solution on it (Fig. 1.1). Observe if there is any change in the colour of the food item. Did it turn blue-black? A blue-black colour indicates that it contains starch.

Fig. 1.1 Testing for starch

Repeat this test with other food items to find out which of these contain starch. Enter all your observations in Table 1.2.

Test for Protein

Take a small quantity of a food item for testing. If the food you want to test is a solid, you first need to make a paste of it or powder it. Grind or mash a small quantity of the food item. Put some of this in a clean test tube, add 10 drops of water to it and shake the test tube.

Now, using a dropper, add two drops of solution of copper sulphate and ten drops of solution of caustic soda to the test tube (Fig. 1.2). Shake well and let the test tube stand for a few minutes. What do you see? Did the contents of the test tube turn violet? A violet colour indicates presence of **proteins** in the food item.

Now, you can repeat this test on other food items.

Fig. 1.2 Testing for protein

Table 1.2 Nutrients present in some food items

Food item	Starch (present)	Protein (present)	Fat (present)
Raw potato	Yes		
Milk		Yes	
Groundnut			Yes
Uncooked powdered rice			
Cooked rice			
Dry coconut			
Uncooked *tuar dal* (powdered)			
Cooked *dal*			
A slice of any vegetable			
A slice of any fruit			
Boiled egg (white portion)			

Test for Fats

Take a small quantity of a food item. Wrap it in a piece of paper and crush it. Take care that the paper does not tear. Now, straighten the paper and observe it carefully. Does it have an oily patch? Hold the paper against light. Are you able to see the light faintly, through this patch?

An oily patch on paper shows that the food item contains **fat**. The food items may sometimes contain a little water. Therefore, after you have rubbed an item on paper, let the paper dry for a while. If there were any water that may have come from food, it would dry up after some time. If no oily patch shows up after this, the food item does not contain any fat.

What do these tests show? Are fats, proteins and starch present in all the food items that you tested? Does a food item contain more than one nutrient? Do you find any food item that does not contain any of these nutrients?

We tested food items for three nutrients — carbohydrates, proteins and fats. There are also other nutrients like **vitamins** and **minerals** that are present in different food items. Why do we need all these nutrients?

1.2 What do Various Nutrients do for our Body?

Carbohydrates mainly provide energy to our body. Fats also give us energy. In fact, fats give much more energy as compared to the same amount of carbohydrates. Foods containing fats and carbohydrates are also called 'energy giving foods' (Fig. 1.3 and Fig. 1.4).

Proteins are needed for the growth and repair of our body. Foods proteins

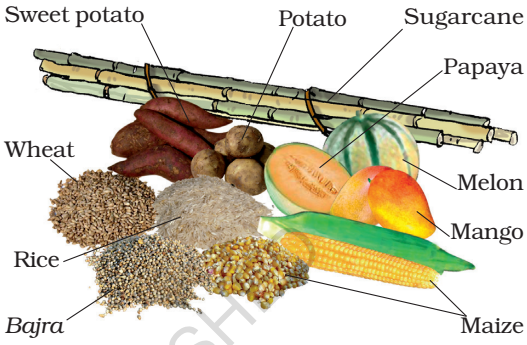
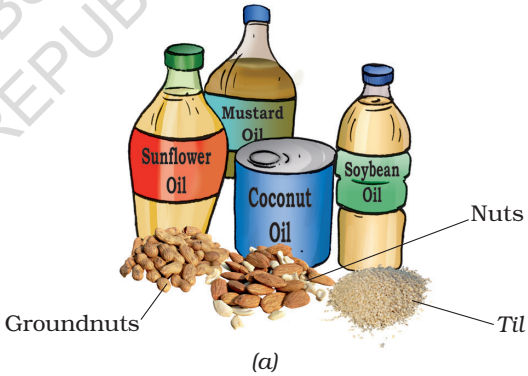


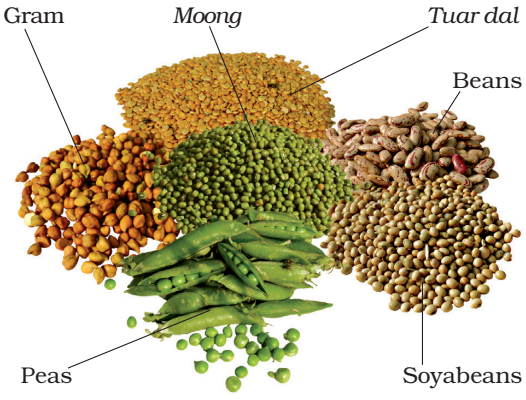
Fig. 1.3 Some sources of carbohydrates



(a)

(b)

Fig. 1.4 Some sources of fats: (a) plant sources and (b) animal sources



(a)

(b)

Fig. 1.5 *Some sources of proteins: (a) plant sources and (b) animal sources*

are often called 'body building foods' (Fig 1.5).

Vitamins help in protecting our body against diseases. Vitamins also help in keeping our eyes, bones, teeth and gums healthy.

Vitamins are of different kinds known by different names. Some of these are Vitamin A, Vitamin C, Vitamin D, Vitamin E and K. There is also a group of vitamins called Vitamin B-complex. Our body needs all types of vitamins in small quantities. Vitamin A keeps our skin and eyes healthy. Vitamin C helps body to fight against many diseases. Vitamin D helps our body to use calcium for bones and teeth. Foods that are rich in different vitamins are shown in Fig. 1.6 to Fig. 1.9.

Minerals are needed by our body in small amounts. Each one is essential

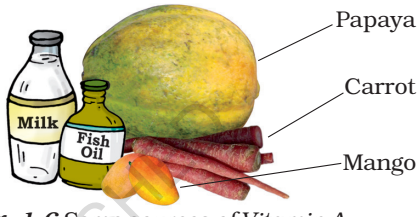


Fig. 1.6 *Some sources of Vitamin A*

Fig. 1.7 *Some sources of Vitamin B*

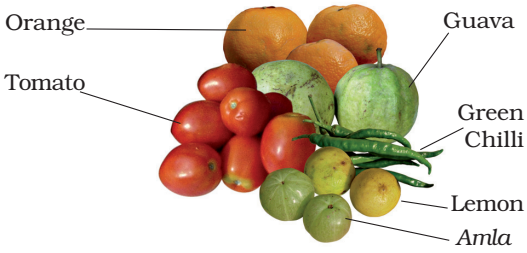


Fig. 1.8 *Some sources of Vitamin C*

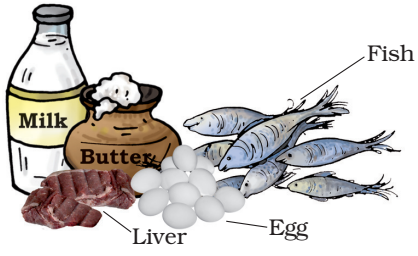
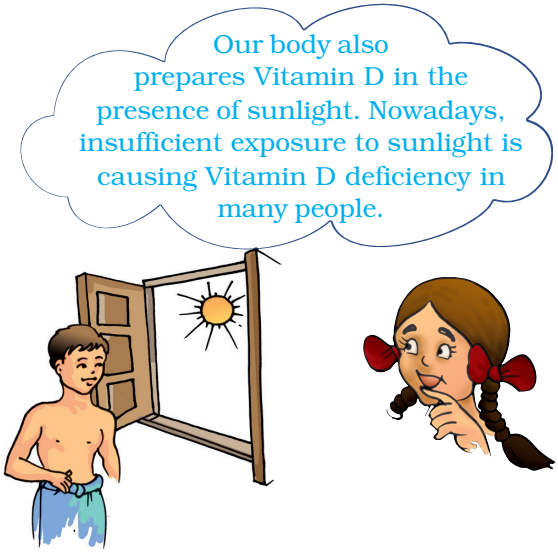


Fig. 1.9 *Some sources of Vitamin D*



for proper growth of body and to maintain good health. Some sources of different minerals are shown in Fig. 1.10.

Most food items, usually, have more than one nutrient. You may have noticed this, while recording your observations in Table 1.2. However, in a given raw material, one particular nutrient may be present in much larger quantity than in others. For example, rice has more carbohydrates than other nutrients. Thus, we say that rice is a "carbohydrate rich" source of food.

Besides these nutrients, our body needs **dietary fibres** and water. Dietary fibres are also known as roughage. Roughage is mainly provided by plant products in our foods. Whole grains and pulses, potatoes, fresh fruits and vegetables are main sources of roughage. Roughage does not provide any nutrient to our body, but is an essential component of our food and adds to its bulk. This helps our body get rid of undigested food.

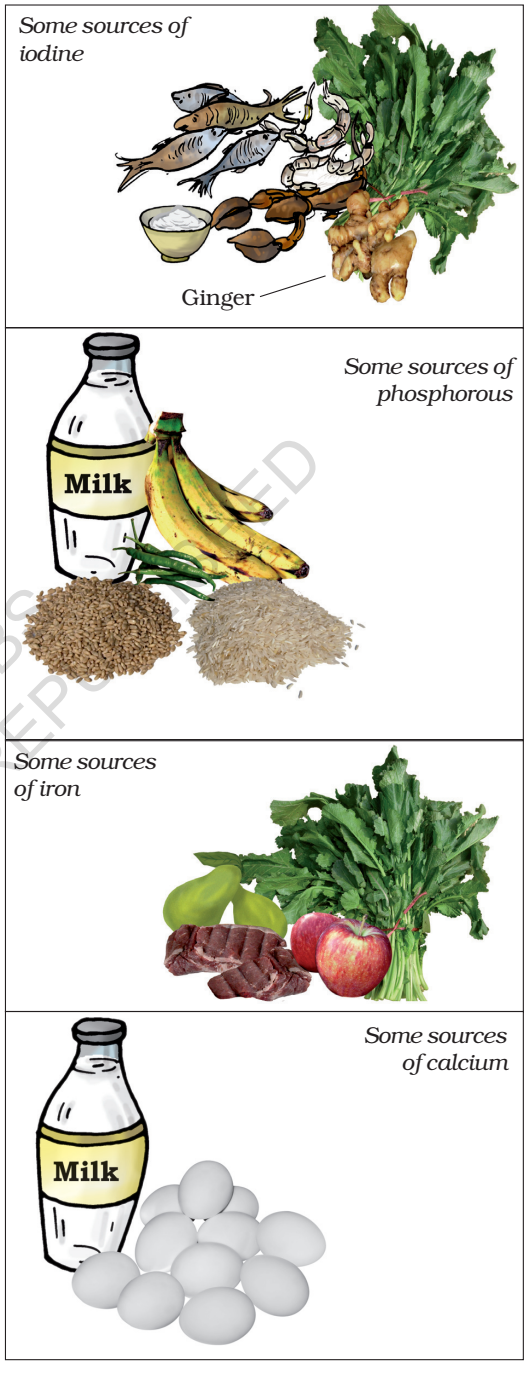


Fig. 1.10 Sources of some minerals

Water helps our body to absorb nutrients from food. It also helps in throwing out some wastes from body as urine and sweat. Normally, we get most of the water that our body needs from the liquids we drink — such as water, milk and tea. In addition, we add water to most cooked foods. Let's see if there is any other source which provides water to our body.

Activity 3

Take a tomato or a fruit like lemon. Cut it into small pieces. Do your hands get wet while doing so?

Carefully observe whenever vegetables and fruits are being cut, peeled, grated or mashed at your home. Do you find any fresh vegetables or fruits that do not contain some amount of water?

We see that many food materials themselves contain water. To some extent, our body needs are met by this water. Apart from this, we also add water while cooking many food items.

1.3 Balanced Diet

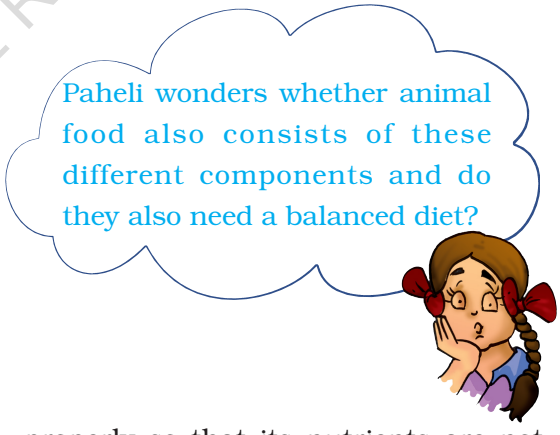
The food we normally eat in a day is our diet. For growth and maintenance of good health, our diet should have all the nutrients that our body needs, in right quantities. Not too much of one and not too little of the other. The diet should also contain a good amount of roughage and water. Such a diet is called a **balanced diet**.

Do you think that people of all ages need the same type of diet? Do you also think that, what we need for a balanced diet would depend on the amount of physical work that we do?

Prepare a chart of whatever you eat over a period of a week. Check whether all the nutrients mentioned are present in one or the other food items being eaten within a day or so.

Pulses, groundnut, soyabean, sprouted seeds (*moong* and Bengal gram), fermented foods (South Indian foods such as *idlis)*, a combination of flours (*missi roti*, *thepla* made from cereals and pulses), banana, spinach, *sattu*, jaggery, available vegetables and other such foods provide many nutrients. Therefore, one can eat a balanced diet without expensive food materials.

Eating the right kind of food is not enough. It should also be cooked properly so that its nutrients are not lost. Are you aware that some nutrients get lost in the process of cooking and preparations?



If the vegetables and fruits are washed after cutting or peeling them, it

may result in the loss of some vitamins. The skins of many vegetables and fruits contain vitamins and minerals. Similarly, repeated washing of rice and pulses may remove some vitamins and minerals present in them.

We all know that cooking improves the taste of food and makes it easier to digest. At the same time, cooking also results in the loss of certain nutrients. Many useful proteins and considerable amounts of minerals are lost if excess water is used during cooking and is then thrown away.

Vitamin C gets easily destroyed by heat during cooking. Would it not be sensible to include some fruits and raw vegetables in our diet?

Boojho thought that fats would be the best foods to eat, all the time. A *katori* (bowl) of fat will give much more energy than a *katori* of carbohydrate rich food, isn't it? So, he ate nothing but food rich in fats — fried food like *samosa* and *poori* (snacks), *malai, rabdi* and *peda* (sweets).

Do you think he was right? No, of course not! It can be very harmful for us to eat too much of fat rich foods and we may end up suffering from a condition called **obesity**.

1.4 Deficiency Diseases

A person may be getting enough food to eat, but sometimes the food may not contain a particular nutrient. If this continues over a long period of time, the person may suffer from its **deficiency**. Deficiency of one or more nutrients can cause diseases or disorders in our body. Diseases that occur due to lack of nutrients over a long period are called **deficiency diseases**.

If a person does not get enough proteins in his/her food for a long time, he/she is likely to have stunted growth, swelling of face, discolouration of hair, skin diseases and diarrhoea**.**

If the diet is deficient in both carbohydrates and proteins for a long period of time, the growth may stop completely. Such a person becomes very lean and thin and so weak that he/she may not even be able to move.

Deficiency of different vitamins and minerals may also result in certain diseases or disorders. Some of these are mentioned in Table 1.3.

All deficiency diseases can be prevented by taking a balanced diet.

In this chapter, we asked ourselves the reason why widely varying food from different regions had a common

Table 1.3 – Some diseases/disorders caused by deficiency of vitamins and minerals

Vitamin/ Mineral	Deficiency disease/disorder	Symptoms
Vitamin A	Loss of vision	Poor vision, loss of vision in darkness (night), sometimes complete loss of vision
Vitamin B1	Beriberi	Weak muscles and very little energy to work
Vitamin C	Scurvy	Bleeding gums, wounds take longer time to heal
Vitamin D	Rickets	Bones become soft and bent
Calcium	Bone and tooth decay	Weak bones, tooth decay
Iodine	Goiter	Glands in the neck appear swollen, mental disability in children
Iron	Anaemia	Weakness

distribution. This distribution, we find, ensures that our meals have a balance of the different nutrients needed by the body.

Summary

- The major nutrients in our food are carbohydrates, proteins, fats, vitamins and minerals. In addition, food also contains dietary fibres and water.
- Carbohydrates and fats mainly provide energy to our body.
- Proteins and minerals are needed for the growth and the maintenance of our body.
- Vitamins help in protecting our body against diseases.
- Balanced diet provides all the nutrients that our body needs, in right quantities, along with adequate amount of roughage and water.
- Deficiency of one or more nutrients in our food for a long time may cause certain diseases or disorders.

FORTIFIED
SAMPOORNA POSHAN
SWASTH JEEVAN

This is a logo for fortified foods as per standards by FSSAI. Fortification of food is the addition of key vitamins and minerals to staple foods such as rice, wheat, oil, milk and salt to improve their nutritional content.

Key words

Balanced diet
Beriberi
Carbohydrates
Energy
Fats
Minerals
Nutrients
Proteins
Roughage
Scurvy
Starch
Vitamins

Exercises

1. Name the major nutrients in our food.
2. Name the following:
   (a) The nutrients which mainly give energy to our body.
   (b) The nutrients that are needed for the growth and maintenance of our body.
   (c) A vitamin required for maintaining good eyesight.
   (d) A mineral that is required for keeping our bones healthy.
3. Name two foods each rich in:
   (a) Fats
   (b) Starch
   (c) Dietary fibre
   (d) Protein
4. Tick (√) the statements that are correct.
   (a) By eating rice alone, we can fulfill nutritional requirement of our body. ( )
   (b) Deficiency diseases can be prevented by eating a balanced diet. ( )
   (c) Balanced diet for the body should contain a variety of food items. ( )
   (d) Meat alone is sufficient to provide all nutrients to the body. ( )
5. Fill in the blanks.
   (a) _____ is caused by deficiency of Vitamin D.
   (b) Deficiency of _____ causes a disease known as beri-beri.
   (c) Deficiency of Vitamin C causes a disease known as _____.
   (d) Night blindness is caused due to deficiency of _____ in our food.

SUGGESTED PROJECTS AND ACTIVITIES

1. Prepare a diet chart to provide balance diet to a twelve year old child. The diet chart should include food items which are not expensive and are commonly available in your area.
2. We have learnt that excess intake of fats is harmful for the body. What about other nutrients? Would it be harmful for the body to take too much of proteins or vitamins in the diet? Read about diet related problems to find answers to these questions and have a class discussion on this topic.
3. Test the food usually eaten by cattle or a pet to find out which nutrients are present in animal food. Compare results obtained from the whole class to conclude about balanced diet requirements for different animals.

0652CH04

2 Sorting Materials into Groups

2.1 Objects Around us

We have seen that our food and clothes have so much variety in them. Not just food and clothes, there is such a vast variety of objects everywhere. We see around us, a chair, a bullock cart, a cycle, cooking utensils, books, clothes, toys, water, stones and many other objects. All these objects have different shapes, colours and uses (Fig. 2.1).

Look around and identify objects that are round in shape. Our list may include a rubber ball, a football and a glass marble. If we include objects that are nearly round, our list could also include objects like apples, oranges, and an earthen pitcher (*gharha)*.

Fig. 2.1 Objects around us

Let us say, we wish to make a group of objects that are made of plastics. Buckets, lunch boxes, toys, water containers, pipes and many such objects, may find a place in this group. There are so many ways to group objects! In the above examples we have grouped objects on the basis of their shape or the materials they are made from.

All objects around us are made of one or more materials. These materials may be glass, metal, plastics, wood, cotton, paper, mud or soil. Can you think of more examples of materials?

Activity 1

Let us collect as many objects as possible, from around us. Each of us could get some everyday objects from home and we could also collect some objects from the classroom or from outside the school. What will we have in our collection? Chalk, pencil, notebook, rubber, duster, a hammer, nail, soap, spoke of a wheel, bat, matchbox, salt, potato. We can also list objects that we can think of, but, cannot bring to the classroom. For example, wall, trees, doors, tractor, road.

Separate all objects from this collection that are made from paper or wood. This way we have divided all objects

into two groups. One group has the objects that are made from paper or wood while the other group has the objects that are not made of these materials. Similarly, we could separate the things that are used for preparing food.

Let us be a little more systematic. List all objects collected, in Table 2.1. Try to identify the materials that each one is made of. It would be fun to make this a large table – collecting information about as many objects as possible. It may seem difficult to find out the materials out of which some of these objects are made. In such cases, discuss with your friends, teacher and parents to identify the materials.

Table 2.1 Objects and the materials they are made of

Objects	Materials they are made of
Plate (*thali*)	Steel, glass, plastics (any other)
Pen	Plastics, metal

Activity 2

Table 2.2 lists some common materials. You can also add more materials in Column 1 that are known to you. Now, try and think of everyday objects you know, that are made mainly of these materials, and list them in Column 2.

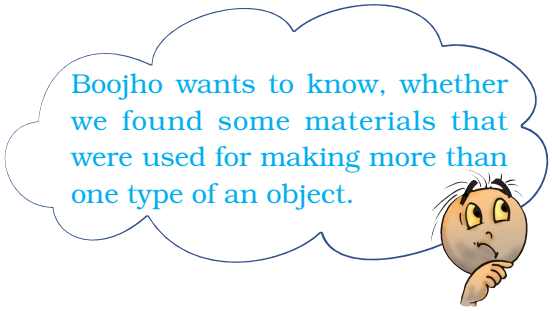


Table 2.2 Different types of objects that are made from the same material

Material	Objects made of these materials
Wood	Chair, table, plough, bullock cart and its wheels, ...
Paper	Books, notebooks, newspaper, toys, calendars,...
Leather	
Plastics	
Cotton	

What do we find from these tables? First, we grouped objects in many different ways. We then found that objects around us are made of different materials. At times, an object is made of a single material. An object could also be made of many materials. And then again, one material could be used for making many different objects. What decides which material should be used for making any given object? It seems

that we need to know more about different materials.

2.2 Properties of Materials

Have you ever wondered why a tumbler is not made with a piece of cloth? Keep in mind that we generally use a tumbler to keep a liquid. Therefore, would it not be silly, if we were to make a tumbler out of cloth (Fig 2.2)! What we need for a tumbler is glass, plastics, metal or other such material that will hold water. Similarly, it would not be wise to use paper-like materials for cooking vessels.

We see then, that we choose a material to make an object depending

Fig. 2.2 Using a cloth tumbler

on its properties, and the purpose for which the object is to be used.

So, what are all the properties of materials that would be important for their usage? Some properties are discussed here.

Appearance

Materials usually look different from each other. Wood looks very different from iron. Iron appears different from copper or aluminium. At the same time, there may be some similarities between iron, copper and aluminium that are not there in wood.

Activity 3

Collect small pieces of different materials – paper, cardboard, wood, copper wire, aluminium sheet, chalk. Do any of these appear shiny? Separate the shiny materials into a group.

Now, observe as the teacher cuts each material into two pieces and look at the freshly cut surface (Fig. 2.3). What do you notice? Does the freshly cut surface of some of these materials appear shiny? Include these objects also in the group of shiny materials.

Do you notice such a shine or lustre in the other materials, cut them anyway as you can? Repeat this in the class with as many materials as possible and make a list of those with and without lustre. Instead of cutting, you can rub the surface of material with sand paper to see if it has lustre.

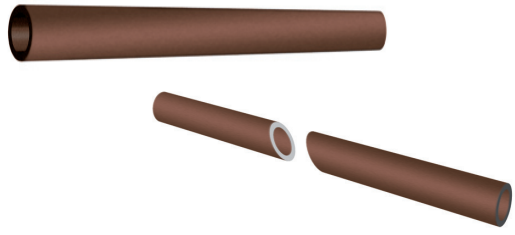


Fig. 2.3 Cutting pieces of materials to see if they have lustre

Materials that have such lustre are usually metals. Iron, copper, aluminium and gold are examples of metals. Some metals often lose their shine and appear dull, because of the action of air and moisture on them. We therefore, notice the lustre, only on their freshly cut surface. When you visit an ironsmith or a workshop, look out for freshly cut surfaces of metal rods to see if they have lustre.

Hardness

When you press different materials with your hands, some of them may be hard to compress while others can be easily compressed. Take a metal key and try to scratch with it, the surface of a piece of wood, aluminium, a piece of stone, a nail, candle, chalk, any other material or object. You can easily scratch some materials, while some cannot be scratched so easily. Materials which can be compressed or scratched easily are called **soft** while some other materials which are difficult to compress are called **hard**. For example, cotton or sponge is soft while iron is hard.

In appearance, materials can have different properties, like lustre, hardness, be rough or smooth. Can you think of other properties that describe the appearance of a material?

Soluble or Insoluble?

Activity 4

Collect samples of some solid substances such as sugar, salt, chalk powder, sand and sawdust. Take five glasses or beakers. Fill each one of them about two-thirds with water. Add a small amount (spoonful) of sugar to the first glass, salt to the second and similarly, add small amounts of the other substances into the other glasses. Stir the contents of each of them with a spoon. Wait for a few minutes. Observe what happens to the substances added to water (Fig. 2.4). Note your observations as shown in Table 2.3.

Fig. 2.4 What disappears, what doesn't?

Table 2.3 Mixing different solid materials in water

Substance	Disappears in water/ does not disappear
Salt	Disappears completely in water
Sugar	
Sand	
Chalk powder	
Sawdust	

You will notice that some substances have completely disappeared or dissolved in water. We say that these substances are **soluble** in water. Other substances do not mix with water and do not disappear even after we stir for a

long time. These substances are **insoluble** in water.

Water plays an important role in the functioning of our body because it can dissolve a large number of substances. Do liquids also dissolve in water?

Activity 5

Collect samples of vinegar, lemon juice, mustard oil or coconut oil, kerosene or any other liquid. Take a glass tumbler. Fill it up to half with water. Add a few spoonfuls of one liquid to this and stir it well. Let it stand for five minutes. Observe whether the liquid mixes with water (Fig. 2.5). Repeat the same with other liquids, as many different liquids as are available to you. Write your observations in Table 2.4.

Table 2.4 Solubility of some common liquids in water

Liquid	Mixes well/ Does not mix
Vinegar	Mixes well
Lemon juice	
Mustard oil	
Coconut oil	
Kerosene	

(a) (b)

Fig. 2.5 *(a) Some liquids mix well with water while (b) some others do not*

We notice that some liquids get completely mixed with water. Some others do not mix with water and form a separate layer when kept aside for some time.

Boojho suggests that we also check if the liquids that we used in Activity 5, mix well with some liquid other than water.

Paheli is curious to know whether gases also dissolve in water.

Some gases are soluble in water whereas others are not. Water, usually, has small quantities of some gases dissolved in it. For example, oxygen gas dissolved in water is very important for the survival of animals and plants that live in water.

Objects may float or sink in water

While doing Activity 4, you might have noticed that the insoluble solids separated out from water. You may have also noticed this with some liquids in Activity 5. Some of these materials that did not mix with water, floated to the surface of water. Others may have sunk to the bottom of the tumbler, right? We notice many examples of objects that float in water or sink (Fig. 2.6). Dried leaves fallen on the surface of a pond, a stone that you throw into this pond, few

Fig. 2.6 Some objects float in water while others sink in it

drops of honey that you let fall into a glass of water. What happens to all of these?

Boojho would like you to give him five examples each, of objects that float and those that sink in water. What about testing these same materials to see if they float or sink in other liquids like oil?

Transparency

You might have played the game of hide and seek. Think of some places where you would like to hide so that you are not seen by others. Why did you choose those places? Would you have tried to hide behind a glass window? Obviously not, as your friends can see through that and spot you. Can you see through all the materials? Those substances or materials, through which things can be seen, are called transparent (Fig. 2.7). Glass, water, air and some plastics are examples of transparent materials. Shopkeepers usually prefer to keep biscuits, sweets and other eatables in transparent containers of glass or plastic, so that buyers can easily see these items (Fig. 2.8).

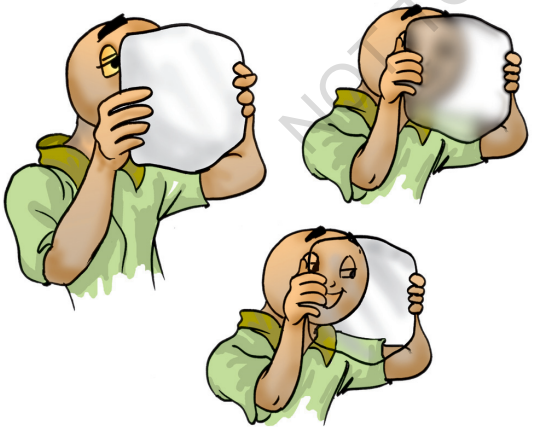


Fig. 2.7 Looking through opaque, transparent or translucent material

Fig. 2.8 Transparent bottles in a shop

On the other hand, there are some materials through which you are not able to see. These materials are called opaque. You cannot tell what is kept in a closed wooden box, a cardboard carton or a metal container. Wood, cardboard and metals, are examples of opaque materials.

Do we find that we can group all materials and objects, without any confusion, as either opaque or transparent?

Activity 6

Take a sheet of paper and look through it towards a lighted bulb. Make a note of your observation. Now, put 2-3 drops

of some oil and spread it on the sheet of paper. Look again towards the lighted bulb through that portion of the paper on which the oil has been spread. Do you find that the bulb is more clearly visible than before? But, can you see clearly through the oiled paper? Is everything on the other side of it visible? Perhaps not. The materials through which objects can be seen, but not clearly, are known as **translucent**. Remember the oily patch on paper when we tested food items for presence of fats? That was translucent too. Can you think of some more examples of translucent materials?

We can therefore group materials as opaque, transparent and translucent.

Fig. 2.9 Does torch light pass through your palm?

Paheli suggests covering the glass of a torch with your palm at a dark place. Switch on the torch and observe the other side of the palm. She wants to know whether palm of your hand is opaque, transparent or translucent?

We learnt that materials differ in their appearance and the way they mix in water or other liquids. They may float or sink in water or may be transparent, opaque or translucent. Materials can be grouped on the basis of similarities or differences in their properties.

Why do we need to group materials? In everyday life, we often group materials for our convenience. At home, we usually store things in such a manner that similar objects are placed together. Such an arrangement helps us to locate them easily. Similarly, a grocer usually keeps all type of biscuits at one corner of his shop, all soaps at another while grains and pulses are stored at some other place.

There is another reason why we find such grouping useful. Dividing materials in groups makes it convenient to study their properties and also observe any patterns in these properties. We will study more about this in higher classes.

Key words

Hard	Opaque	
Insoluble	Rough	
Lustre	Soluble	
Material	Translucent	
Metals	Transparent	

Summary

- Objects around us are made up of a large variety of materials.
- A given material could be used to make a large number of objects. It is also possible that an object could be made of a single material or of many different types of materials.
- Different types of materials have different properties.
- Some materials are shiny in appearance while others are not. Some are rough, some smooth. Similarly, some materials are hard, whereas some others are soft.
- Some materials are soluble in water whereas some others are insoluble.
- Some materials such as glass, are transparent and some others such as wood and metals are opaque. Some materials are translucent.
- Materials are grouped together on the basis of similarities and differences in their properties.
- Things are grouped together for convenience and to study their properties.

Exercises

1. Name five objects which can be made from wood.
2. Select those objects from the following which shine:
   Glass bowl, plastic toy, steel spoon, cotton shirt
3. Match the objects given below with the materials from which they could be made. Remember, an object could be made from more than one material and a given material could be used for making many objects.

Objects	Materials
Book	Glass
Tumbler	Wood
Chair	Paper
Toy	Leather
Shoes	Plastics

4. State whether the statements given below are True or False.
   (i) Stone is transparent, while glass is opaque.
   (ii) A notebook has lustre while eraser does not.
   (iii) Chalk dissolves in water.
   (iv) A piece of wood floats on water.

(v) Sugar does not dissolve in water.

(vi) Oil mixes with water.

(vii) Sand settles down in water.

(viii) Vinegar dissolves in water.

5. Given below are the names of some objects and materials:

   Water, basket ball, orange, sugar, globe, apple and earthen pitcher

   Group them as:

   (a) Round shaped and other shapes

   (b) Eatables and non eatables

6. List all items known to you that float on water. Check and see if they will float on an oil or kerosene.

7. Find the odd one out from the following:

   a) Chair, Bed, Table, Baby, Cupboard

   b) Rose, Jasmine, Boat, Marigold, Lotus

   c) Aluminium, Iron, Copper, Silver, Sand

   d) Sugar, Salt, Sand, Copper sulphate

SUGGESTED ACTIVITY

1. You may have played a memory game with your friends. Several objects are placed on a table, you are asked to observe them for a few minutes, go into another room and write down the names of all objects that you can remember. Play this game, with a difference! Ask all the participants in the game to remember objects with some particular property while playing this memory game — remember and write down the names of objects that were made of wood or objects that are edible and so on. Have fun!

2. From a large collection of materials, make groups of objects having different properties like transparency, solubility in water and other properties. In later chapters you will also learn about properties of materials related to electricity and magnetism. After making different groups from the collected materials, try and find out if there are any patterns in these groups. For instance, do all materials which have lustre conduct electricity?

0652CH05

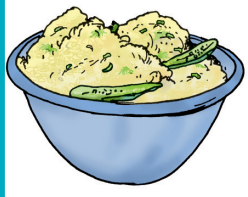
3 Separation of Substances

In our daily life, there are many instances when we notice a substance being separated from a mixture of materials.

Tea leaves are separated from the liquid with a strainer, while preparing tea (Fig. 3.1).

Fig. 3.1 Separating tea leaves with a strainer

Grain is separated from stalks, while harvesting. Milk or curd is churned to separate the butter (Fig. 3.2). We gin cotton to separate its seeds from the fibre.



Perhaps you might have eaten salted *daliya* or *poha*. If you found that it had chillies in it, you may have carefully taken them out before eating.

Suppose you are given a basket containing mangoes and guavas and asked to separate them. What would you do? Pick out one kind and place them in a separate container, right?

Seems easy, but what if the materials we want to separate are much smaller than mango or guava? Imagine you are given a glass of sand with salt mixed in it. Impossible, even to think of separating salt from this mixture by picking out grains of sand by hand!

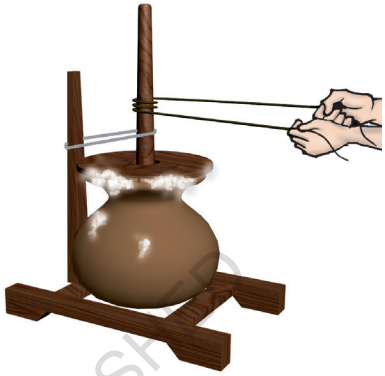


Fig. 3.2 Butter is taken out by churning milk or curd

But, why would we need to separate substances like this at all, is what Paheli wants to know.

Activity 1

In Column 1 of Table 3.1, are given a few processes of separation. The purpose of separation and the way separated components are used is mentioned in Column 2 and 3 respectively. However, the information given in Columns 2 and 3 is jumbled up. Can you match each

Table 3.1 Why do we separate substances?

Separation process	Purpose for which we do the separation	What do we do with the separated components?
1) Separate stones from rice	a) To separate two different, but useful components.	i) We throw away the soild component.
2) Churning milk to obtain butter	b) To remove non-useful components.	ii) We throw away the impurities.
3) Separate tea leaves	c) To remove impurities or harmful components.	iii) We use both the components.

process with its purpose and the way separated components are used?

We see that, before we use a substance, we need to separate harmful or non-useful substances that may be mixed with it. Sometimes, we separate even useful components if we need to use them separately.

The substances to be separated may be particles of different sizes or materials. These may be in any three states of matter i.e., solid, liquid or gas. So, how do we separate substances mixed together if they have so many different properties?

3.1 Methods of Separation

We will discuss some simple methods of separating substances that are mixed together. You may come across some of these methods being used in day to day activities.

Handpicking

Activity 2

Bring a packet of food grain purchased from a shop to the classroom. Now, spread the grains on a sheet of paper. Do you find only one kind of grain on the sheet of paper? Are there pieces of stone, husks, broken grain and particles of any other grain in it? Now, remove with your hand the pieces of stone, husks and other grains from it.

This method of **handpicking** can be used for separating slightly larger sized impurities like the pieces of dirt, stone, and husk from wheat, rice or pulses (Fig. 3.3). The quantity of such impurities is usually not very large. In such situations, we find that handpicking is a convenient method of separating substances.

Fig. 3.3 Handpicking stones from grain

Threshing

You must have seen bundles of wheat or paddy stalks lying in fields after

harvesting the crop. Stalks are dried in the sun before the grain is separated from them. Each stalk has many grain seeds attached to it. Imagine the number of grain seeds in hundreds of bundles of stalk lying in the field! How does the farmer separate grain seeds from those bundles of stalks?

One may pluck mangoes or guavas from the trees. But, grain seeds are much smaller than mangoes or guavas. So, plucking them from their stalks would be impossible. How does one separate grain seeds from their stalks?

The process that is used to separate grain from stalks etc. is **threshing**. In this process, the stalks are beaten to free the grain seeds (Fig. 3.4). Sometimes,

Fig. 3.4 Threshing

threshing is done with the help of bullocks. Machines are also used to thresh large quantities of grain.

Winnowing

Activity 3

Make a mixture of dry sand with sawdust or powdered dry leaves. Keep this mixture on a plate or a newspaper. Look at this mixture carefully. Can the two different components be made out easily? Are the sizes of particles of the two components similar? Would it be possible to separate the components by handpicking?

Now, take your mixture to an open ground and stand on a raised platform. Put the mixture in a plate or sheet of paper. Hold the plate or the sheet of paper containing the mixture, at your shoulder height. Tilt it slightly, so that the mixture slides out slowly.

What happens? Do both the components — sand and sawdust (or powdered leaves) fall at the same place? Is there a component that blows away? Did the wind manage to separate the two components?

This method of separating components of a mixture is called **winnowing**. Winnowing is used to separate heavier and lighter components of a mixture by wind or by blowing air.

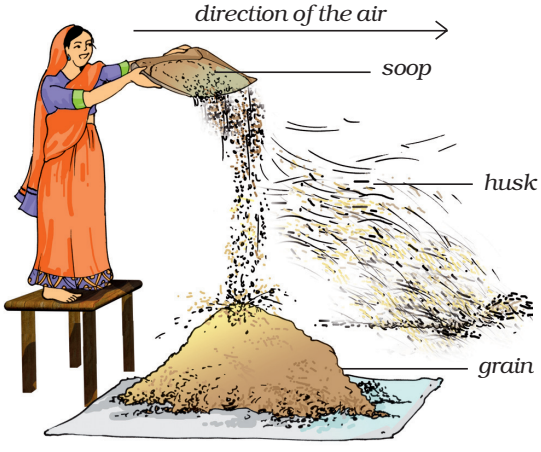


Fig. 3.5 Winnowing

This method is commonly used by farmers to separate lighter husk particles from heavier seeds of grain (Fig. 3.5).

The husk particles are carried away by the wind. The seeds of grain get separated and form a heap near the platform for winnowing. The separated husk is used for many purposes such as fodder for cattles.

Sieving

Sometimes, we may wish to prepare a dish with flour. We need to remove impurities and bran that may be present in it. What do we do? We use a sieve and pour the flour into it (Fig. 3.6).

Sieving allows the fine flour particles to pass through the holes of the sieve while the bigger impurities remain on the sieve.

In a flour mill, impurities like husk and stones are removed from wheat before grinding it. Usually, a bagful of wheat is poured on a slanting sieve. The sieving removes pieces of stones, stalk and husk that may still remain with wheat after threshing and winnowing.

Fig. 3.6 Sieving

You may have also noticed similar sieves being used at construction sites

Fig. 3.7 Pebbles and stones are removed from sand by sieving

to separate pebbles and stones from sand (Fig. 3.7).

Activity 4

Bring a sieve and a small quantity of flour from home, to the class. Sieve the flour to separate any impurities in it. Now, make a fine powder of chalk pieces and mix it with the flour. Can we separate the flour and the powdered chalk by sieving?

Sieving is used when components of a mixture have different sizes.

Sedimentation, Decantation and Filtration

Sometimes, it may not be possible to separate components of a mixture by winnowing and handpicking. For example, there may be lighter impurities like dust or soil particles in rice or pulses. How are such impurities separated from rice or pulses before cooking?

Rice or pulses are usually washed before cooking. When you add water to these, the impurities like dust particles

get separated. These impurities go into water. Now, what will sink to the bottom of the vessel — rice or dust? Why? Have you seen that the vessel is tilted to pour out the dirty water?

When the heavier component in a mixture settles after water is added to it, the process is called **sedimentation**. When the water (along with the dust) is removed, the process is called **decantation** (Fig. 3.8). Let us find a few other mixtures that can be separated through sedimentation and decantation.

The same principle is used for separating a mixture of two liquids that do not mix with each other. For example, oil and water from their mixture can be separated by this process. If a mixture of such liquids is allowed to stand for some time, they form two separate layers. The component that forms the top layer can then be separated by decantation.

Let us again consider a mixure of a solid and liquid. After preparing tea, what do you do to remove the tea leaves? Usually, we use stainer to remove tea leaves. Try decantation. It helps a little. But, do you still get a few leaves in your tea? Now, pour the tea through a strainer. Did all the tea leaves remain in the strainer? This process is called **filtration** (Fig. 3.1). Which method of separating tea leaves from prepared tea is better, decantation or filtration?

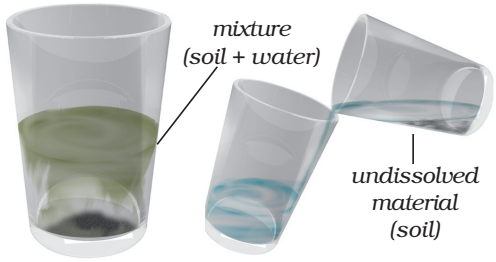


Fig. 3.8 Separating two components of a mixture by sedimentation and decantation

Let us now consider the example of water that we use. Do all of us, at all times, get safe water to drink? Sometimes, water supplied through taps may be muddy. The water collected from ponds or rivers may also be muddy, especially after rains. Let us see if we can use some method of separation to remove insoluble impurities like soil from the water.

Activity 5

Collect some muddy water from a pond or a river. If it is not available, mix some soil to water in a glass. Let it stand for half an hour. Observe the water carefully and note your observations.

Does some soil settle at the bottom of water? Why? What will you call this process?

Now, slightly tilt the glass without disturbing the water. Let the water from the top flow into another glass (Fig. 3.8). What will you call this process?

Is the water in the second glass still muddy or brown in colour? Now filter it. Did the tea strainer work? Let us try filtering the water through a piece of cloth. In a piece of cloth, small holes or pores remain in between the woven threads. These pores in a cloth can be used as a filter.

If the water is still muddy, impurities can be separated by a filter that has even

smaller pores. A filter paper is one such filter that has very fine pores in it. Fig. 3.9 shows the steps involved in using a filter paper. A filter paper folded in the form of a cone is fixed onto a funnel (Fig. 3.10). The mixture is then poured on the filter paper. Solid particles in the mixture do not pass through it and remain on the filter.

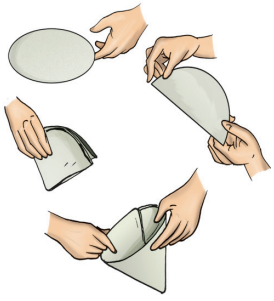


Fig. 3.9 *Folding a filter paper to make a cone*

Fig. 3.10 *Filtration using a filter paper*

Fruit and vegetable juices are usually filtered before drinking to separate the seeds and solid particles of pulp. The method of filtration is also used in the process of preparing cottage cheese (*paneer*) in our homes. You might have seen that for making *paneer*, a few drops of lemon juice are added to milk as it boils. This gives a mixture of particles of solid *paneer* and a liquid. The *paneer* is then separated by filtering the mixture through a fine cloth or a strainer.

Evaporation

Activity 6

Add two spoons of salt to water in another beaker and stir it well. Do you see any change in the colour of water? Can you see any salt in the beaker, after stirring? Heat the beaker containing the salt water (Fig. 3.11). Let the water boil away. What is left in the beaker?

Fig. 3.11 *Heating a beaker containing salt water*

In this activity, we used the process of evaporation, to separate a mixture of water and salt.

The process of conversion of water into its vapour is called **evaporation**. The process of evaporation takes place continuously wherever water is present.

Where do you think, salt comes from? Sea water contains many salts mixed in it. One of these salts is the common salt. When sea water is allowed to stand in shallow pits, water gets heated by sunlight and slowly turns into water vapour, through evaporation. In a few days, the water evaporates completely leaving behind the solid salts (Fig. 3.12). Common salt is then obtained from this mixture of salts by further purification.

Fig. 3.12 Obtaining salt from sea water

Use of more than one method of separation

We have studied some methods for separation of substances from their mixtures. Often, one method is not sufficient to separate the different substances present in a mixture. In such a situation, we need to use more than one of these methods.

Activity 7

Take a mixture of sand and salt. How will we separate these? We already saw that handpicking would not be a practical method for separating these.

Keep this mixture in a beaker and add some water to it. Leave the beaker aside for some time. Do you see the sand settling down at the bottom? The sand can be separated by decantation or filtration. What does the decanted liquid contain? Do you think this water contains the salt which was there in the mixture at the beginning?

Now, we need to separate salt and water from the decanted liquid. Transfer this liquid to a kettle and close its lid. Heat the kettle for some time. Do you notice steam coming out from the spout of the kettle?

Take a metal plate with some ice on it. Hold the plate just above the spout of the kettle as shown in Fig. 3.13. What do you observe? Let all the water in the kettle boil off.

When the steam comes in contact with the metal plate cooled with ice, it condenses and forms liquid water. The water drops that you observed falling from the plate, were due to condensation of steam. The process of conversion of water vapour into its liquid form is called **condensation**.

Did you ever see water drops condensed under a plate that has been used to cover a vessel containing milk that has just been boiled?

After all the water has evaporated, what is left behind in the kettle?

We have thus, separated salt, sand and water using processes of decantation, filtration, evaporation and condensation.

Paheli faced a problem while recovering salt mixed with sand. She has mixed a packet of salt in a small

Fig. 3.13 Evaporation and condensation

amount of sand. She then tried the method suggested in Activity 7, to recover the salt. She found, however, that she could recover only a small part of the salt that she had taken. What could have gone wrong?

Can water dissolve any amount of a substance?

In chapter 2, we found that many substances dissolve in water and form a solution. We say that these substances are soluble in water. What will happen if we go on adding more and more of these substances to a fixed quantity of water?

Activity 8

You will need a beaker or a small pan, a spoon, salt and water. Pour half a cup of water in the beaker. Add one teaspoonful of salt and stir it well, until the salt dissolves completely (Fig 3.14). Again add a teaspoonful of salt and stir well. Go on adding salt, one teaspoonful at a time, and stir.

After adding a few spoons of salt, do you find that some salt remains undissolved and settles at the bottom of the beaker? If yes, this means that no more salt can be dissolved in the amount of water we have taken. The solution is now said to be **saturated**.

Here is a hint as to what might have gone wrong when Paheli tried to recover large quantity of salt mixed with sand. Perhaps the quantity of salt was much more than that required to form a saturated solution. The undissolved salt

Fig 3.14 Dissolving salt in water

would have remained mixed with the sand and could not be recovered. She could solve her problem by using a larger quantity of water.

Suppose, she did not have sufficient quantity of water to dissolve all the salt in the mixture. Is there some way that water could be made to dissolve more salt before the solution gets saturated?

Let us try and help Paheli out.

Activity 9

Take some water in a beaker and mix salt in it until it cannot dissolve any more salt. This will give you a saturated solution of salt in water.

Now, add a small quantity of salt to this saturated solution and heat it. What do you find? What happens to the undissolved salt in the bottom of the beaker? Does it dissolve, now? If yes, can some more salt be dissolved in this solution by heating it?

Let this hot solution cool. Does the salt appear to settle at the bottom of the beaker again?

The activity suggests that larger quantity of salt can be dissolved in water on heating.

Does water dissolve equal amounts of different soluble substances? Let us find out.

Activity 10

Take two glasses and pour half a cup of water in each of them. Add a teaspoon of salt to one glass and stir till the salt dissolves. Go on adding salt, one teaspoon at a time, till the solution saturates. Record the number of spoons of salt that dissolved in the water, in Table 3.2. Now, repeat the same activity with sugar. Repeat this with some other substances that are soluble in water.

What do you notice from Table 3.2? Do you find that water dissolves different substances in different amounts?

Table 3.2

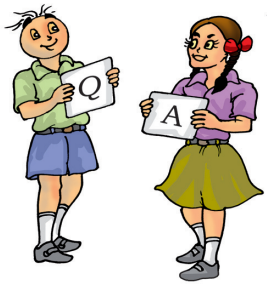
Substance	Number of spoons of substance that dissolved in water
Salt	
Sugar	

We have discussed a few methods of separating substances. Some of the methods of separation presented in this chapter are also used in a science laboratory.

We also learnt that a solution is prepared by dissolving a substance in a liquid. A solution is said to be saturated if it cannot dissolve more of the substance in it.

Key words

Churning
Condensation
Decantation
Evaporation
Filtration
Handpicking
Saturated solution
Sedimentation
Sieving
Solution
Threshing
Winnowing



Summary

- Handpicking, winnowing, sieving, sedimentation, decantation and filtration are some of the methods of separating substances from their mixtures.

- Husk and stones could be separated from grains by handpicking.
- Husk is separated from heavier seeds of grain by winnowing.
- Difference in the size of particles in a mixture is utilised to separate them by the process of sieving and filtration.
- In a mixture of sand and water, the heavier sand particles settle down at the bottom and the water can be separated by decantation.
- Filtration can be used to separate components of a mixture of an insoluble solid and a liquid.
- Evaporation is the process in which a liquid gets converted into its vapour. Evaporation can be used to separate a solid dissolved in a liquid.
- A saturated solution is one in which no more of that substance can be dissolved.
- More of a substance can be dissolved in a solution by heating it.
- Water dissolves different amount of soluble substances in it.

Exercises

1. Why do we need to separate different components of a mixture? Give two examples.
2. What is winnowing? Where is it used?
3. How will you separate husk or dirt particles from a given sample of pulses before cooking.
4. What is sieving? Where is it used?
5. How will you separate sand and water from their mixture?
6. Is it possible to separate sugar mixed with wheat flour? If yes, how will you do it?
7. How would you obtain clear water from a sample of muddy water?
8. Fill up the blanks
   (a) The method of separating seeds of paddy from its stalks is called _____.
   (b) When milk, cooled after boiling, is poured onto a piece of cloth the cream (*malai*) is left behind on it. This process of separating cream from milk is an example of _____.
   (c) Salt is obtained from seawater by the process of _____.
   (d) Impurities settled at the bottom when muddy water was kept overnight in a bucket. The clear water was then poured off from the top. The process of separation used in this example is called _____.
9. True or false?
   (a) A mixture of milk and water can be separated by filtration.
   (b) A mixture of powdered salt and sugar can be separated by the process of winnowing.

(c) Separation of sugar from tea can be done with filtration.

(d) Grain and husk can be separated with the process of decantation.

10. Lemonade is prepared by mixing lemon juice and sugar in water. You wish to add ice to cool it. Should you add ice to the lemonade before or after dissolving sugar? In which case would it be possible to dissolve more sugar?

SUGGESTED PROJECTS AND ACTIVITIES

1. Visit a nearby dairy and report about the processes used to separate cream from milk.
2. You have tried a number of methods to separate impurities like mud from water. Sometimes, the water obtained after employing all these processes could still be a little muddy. Let us see if we can remove even this impurity completely. Take this filtered water in a glass. Tie a thread to a small piece of alum. Suspend the piece of alum in the water and swirl. Did the water become clear? What happened to the mud? This process is called loading. Talk to some elders in your family to find out whether they have seen or used this process.

THINGS TO SEE

"The winnowers", painted by Gustav Courbet in 1853

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4 Getting to Know Plants

Go outside and observe all the plants around you (Fig. 4.1). Do you see that some plants are small, some very big, while some are just patches of green on the soil? Some have green leaves, while some others have reddish ones. Some have huge red flowers, some have tiny blue ones, while some have none. We do see a variety of plants existing all around us — near our homes, in the school ground, on the way to the school, in the parks and gardens, isn't it?

Let us get to know the different parts of any plant. This will help us understand the differences between plants of different kinds. Can you label the stem, branch, root, leaf, flower and fruit of the plant shown in Fig.4.1? Colour the parts of the plant.

Fig. 4.1 A Nature walk!

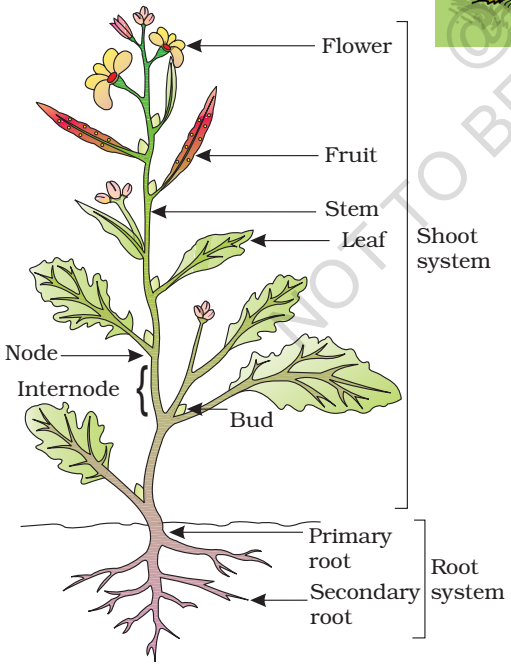


Fig. 4.2 Parts of a plant

4.1 Herbs, Shrubs and Trees

Activity 1

Look closely at the stem and branches of:

1. Plants much smaller than you.
2. Plants that are about your size, and
3. Plants which are much taller than you.

Feel their stem and try to bend them gently to see if they are tender or hard.

Table 4.1 Categories of plants

Plant name	Column 1 Height	Column 2 Stem				Column 3 Where do the branches appead		Column 4
		Green	Tender	Thick	Hard	At the base of the stem	Higher up on the stem	Category of plant
Tomato	Short	Yes	Yes					Herb
Mango	Very tall			Yes	Yes		Yes	Tree
Lemon	About my height				Yes	Yes		Shrub

Take care that the stem does not break. Hug the tall plants to see how thick their stems are!

We also need to notice from where the branches grow in some plants — close to the ground or higher up on the stem.

We will now group all the plants we observed, in Table 4.1. Some examples are shown. You can fill the Columns 1, 2 and 3 for many more plants. Fill Column 4 later after studying the section.

Based on these characters most plants can be classified into three categories: **herbs, shrubs** and **trees**. An example of each is shown in Fig.4.3.

Suggestion: Student can work in groups of 4–5 so that a minimum number of plants are harmed/ damaged.

You may also use **weeds** with soft stems for the activities. Do you know what weeds are? In crop fields, lawns, or in pots, often some unwanted plants or weeds start growing. Have you seen farmers removing these weeds from their fields?

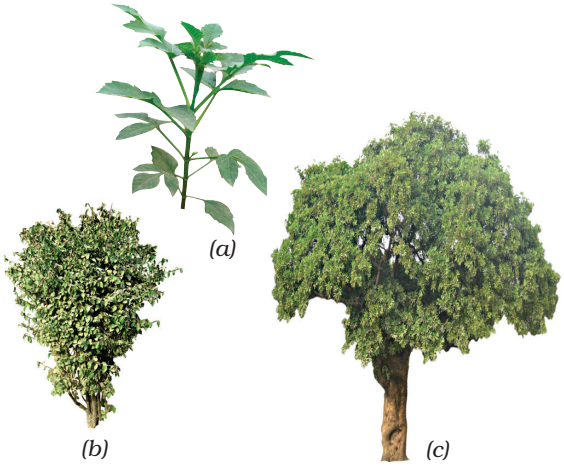


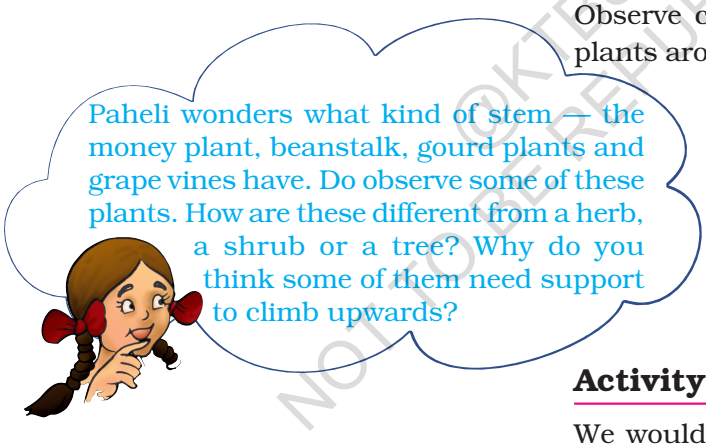
Fig.4.3 (a) Herb, (b) shrub and (c) tree

Plants with green and tender stems are called herbs. They are usually short and may not have many branches [Fig.4.3 (a)].

Some plants develop branches near the base of stem. The stem is hard but not very thick. Such plants are called shrubs [Fig.4.3(b)].

Some plants are very tall and have hard and thick stem. The stems have branches in the upper part, much above the ground. Such plants are called trees [Fig.4.3(c)].

Based on the above characteristics can you now classify the plants listed by you and complete column 4 in Table 4.1?



Plants with weak stems that cannot stand upright but spread on the ground are called **creepers** (Fig.4.4), while those that take support and climb up are called **climbers** (Fig.4.5). These are different from the herbs, shrubs and trees.

Perhaps there are some plants in your school or at home that you take care of. Write down the names of any two trees, shrubs, herbs or creepers growing in your house or school.

Fig. 4.4 Creepers

Fig. 4.5 Climbers

4.2 Stem

Observe closely the stems of different plants around you. Note down different structures/parts borne by the stem. Compare you observations with the that of your friends. What do you find? Stems bear leaves, branches, buds, flowers and fruits.

Activity 2

We would require a glass, water, red/blue ink and a soft stem. Pour water to fill one-third of the glass. Add a few drops of red/blue ink to the water. Cut the base of the stem and put it in the glass as shown in Fig.4.6.

Observe the set-up. Does the colour appear in the stem? You will find that the colour rises in the stem. If this is kept for a longer period, the colour

Fig. 4.6 Stem in a glass with coloured water

appears in the veins of leaves also. How do you think the colour reached there?

From this activity, we see that the stem helps in upward movement of water. The water and minerals go to leaves and other plant parts attached to the stem.

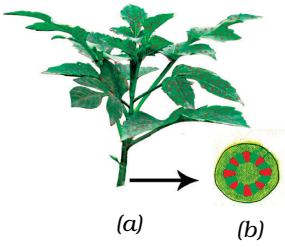


Fig. 4.7 (a) Water moves up the stem and reaches leaves
(b) Enlarged view of open end of stem

4.3 Leaf

Observe the leaves of some plants around you and draw them in your notebook. Are all the leaves of same size, shape and colour?

How are leaves attached to the stem? The part of leaf by which it is attached to the stem is called **petiole**. The broad, green part of the leaf is called **lamina** (Fig. 4.8). Can you identify these parts of the leaves in plants around you? Do all the leaves have petioles?

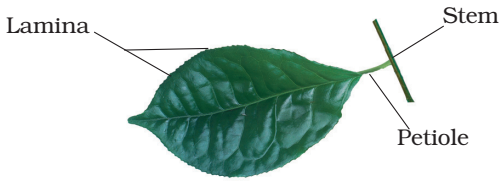


Fig. 4.8 A leaf

Let us get to know the leaf better by taking its impression! If you thought that leaves cannot sign, here is an activity which will make you think again.

Activity 3

Put a leaf under a white sheet of paper or a sheet in your notebook. Hold it in place as shown in Fig. 4.9. Hold your pencil tip sideways and rub it on the portion of the paper having the leaf below it. Did you get an impression with some lines in it? Are they similar to those on the leaf?

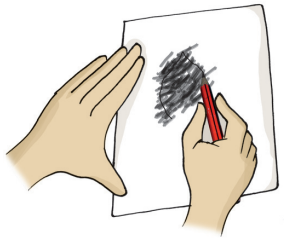


Fig. 4.9 Taking an impression of a leaf

These lines on the leaf are called **veins**. Do you see a prominent line in the middle of the leaf? This is called the **midrib.** The design made by veins in a leaf is called the **leaf venation**. If this design is net-like on both sides of midrib, the venation is **reticulate** [Fig. 4.10 (a)]. In the leaves of grass you might have seen that the veins are parallel to one another. This is **parallel venation** [(Fig. 4.10 (b)]. Observe the venation in as many leaves as you can without removing them from the plant. Draw the pattern and write

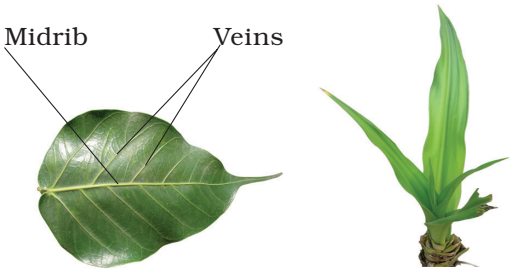


Fig. 4.10 Leaf venation (a) reticulate and (b) parallel

names of some plants having reticulate and parallel venation.

Shall we now find out some of the functions of a leaf?

Activity 4

We will require a herb, two transparent polythene bags and thread.

Do this activity during day time on a sunny day. Use a healthy, well watered plant that has been growing in the sun. Enclose a leafy branch of the plant in a polythene cover and tie up its mouth as shown in Fig. 4.11. Tie up the mouth of another empty polythene cover and keep it also in the sun.

After a few hours, observe the inner surface of the covers. What do you see? Are there any droplets of water? How do you think they got there? [Don't forget to remove the polythene bag after the activity!]

Water comes out of leaves in the form of vapour by a process called **transpiration**. Plants release a lot of water into the air through this process.

Why did we tie a cover around the leaves? Would we have seen the water evaporate if we had not tied a polythene

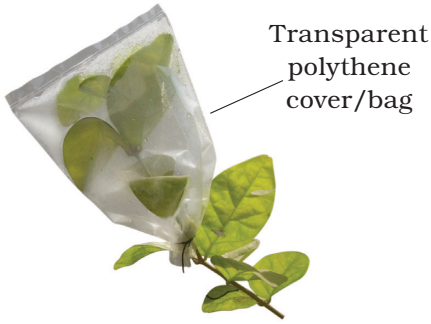


Fig. 4.11 What does the leaf do?

cover? What makes the water appear on the polythene bag? In Chapter 3, we noticed water changing into different forms in some of our activities. Can you think of these and name the process that makes water drops appear on the polythene cover?

Leaves also have another function. Let us study this.

Activity 5

We would require a leaf, spirit, a beaker, test tube, burner, water, a watch glass and iodine solution for this activity.

Take a leaf in a test tube and pour spirit to completely immerse the leaf.

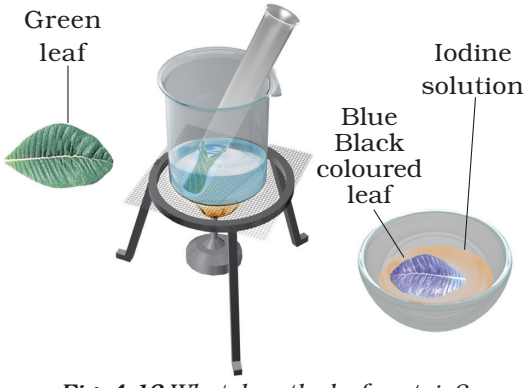


Fig. 4.12 What does the leaf contain?

Note: Since the activity involves the use of spirit and heating, it is advised that it is demonstrated by the teacher in the class.

Now, place the test tube in a beaker half filled with water. Heat the beaker till all the green colour from the leaf comes out into the spirit in the test tube. Take out the leaf carefully and wash it in water. Place it on a watch glass and pour some iodine solution over it (Fig. 4.12).

What do you observe? Compare your observations with those done in Chapter 1, when you tested food for presence of different nutrients. Does this mean that the leaf has starch in it?

In Chapter 1, we saw that a slice of raw potato also shows the presence of starch. Potatoes get this starch from their leaves and store it. Leaves prepare their food in the presence of sunlight and a green coloured substance present in them. For this, they also use water and carbon dioxide. This process is called **photosynthesis**. Oxygen is given out in this process. The food prepared by leaves ultimately gets stored in different parts of plant.

We have seen that the stem supplies leaf with water. The leaf uses the water to make food. The leaves also lose water through transpiration. How do the stem and leaves get water? That is where the roots come in!

4.4 Root

Look at Fig. 4.13. Who do you think is watering their plant correctly, Paheli or Boojho? Why?

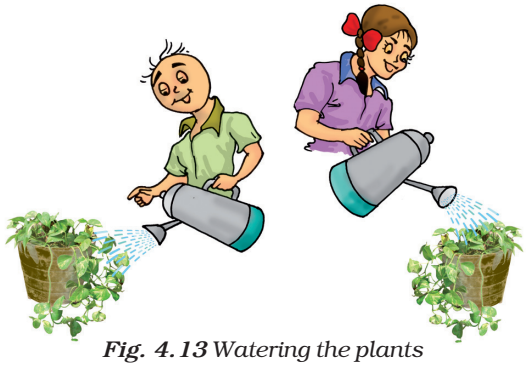


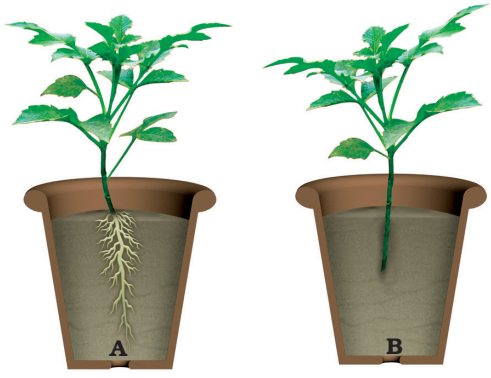
Fig. 4.13 Watering the plants

Which part of the plant is in the soil? Let us learn more about this part from the following activities.

Activity 6

You would require two pots, some soil, *khurpi* (for digging), blade or a pair of scissors and water. This activity is to be done in groups of 4-5 students.

Select two plants of the same kind from an open ground and dig them out with roots. Take care that their roots do not break. Plant one of them in pot A [Fig. 4.14 (a)]. Cut off the roots from the



(a) (b)

Fig. 4.14 (a) Plant with roots, and (b) without roots

other plant and plant it in pot B [Fig. 4.14 (b)]. Water them regularly. Observe the plants after a week. Are both plants healthy?

Both the plants are watered regularly, but, one is without roots, isn't it? Does this activity help you understand an important function of the root?

Let us do an activity to study another function of root.

Activity 7

We would require seeds of gram and maize, cotton wool, *katori* (bowl) and some water.

Take two *katoris* (bowl). Place some wet cotton in them. Put 3 or 4 seeds of gram in one and maize in the other. Keep the cotton wet by sprinkling water every day, until the sprouts have grown into young plants. After a week try to separate the young plants from the cotton (Fig. 4.15).

Fig. 4.15 *Young plants grown on cotton*

Was it easy to separate the cotton from the roots? Why?

In Activity 6, we could not pull out the plants from the soil, right? We dug them out. This is because roots help in holding the plant firmly to the soil. They **anchor** the plant to the soil.

You have seen that there are different kinds of stems and leaves. Do the roots also show a variety? Let us find out.

Activity 8

Study Fig. 4.16 (a) and (b) carefully. Now, look at the roots of the gram plants you have pulled out from the cotton in the previous activity. Do they look like the roots shown in Fig. 4.16 (a) or those in Fig. 4.16 (b)? How about the roots of

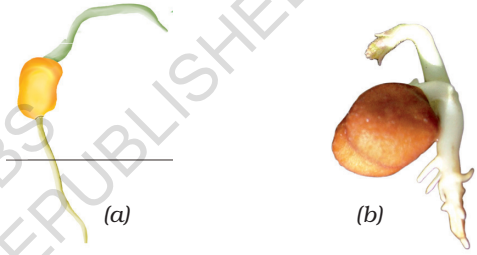


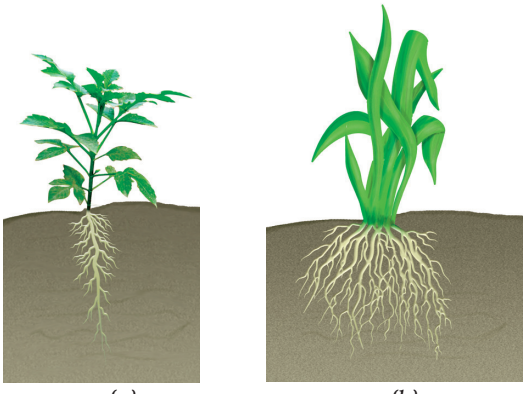
Fig 4.16 *(a) Roots of*_____
*(b) Roots of*_____

maize plant? Write 'gram' or 'maize' in the blank spaces in the figure after matching the roots with the figures.

In what way are the roots of gram and maize similar? In what way are they different? There seem to be two different types of roots, isn't it? Are there also other types of roots? Let us find out.

Activity 9

Go to an open ground where many wild plants are growing. Dig out a few, wash the soil off the roots and observe them. Do you find that all of them have either the kind of roots shown in Fig. 4.17 (a) or as in Fig. 4.17 (b)?



(a) (b)

Fig. 4.17 (a) Taproot and (b) fibrous roots

For roots of the kind shown in Fig.4.17 (a), the main root is called **tap root** and the smaller roots are called **lateral roots**. Plants with roots as shown in Fig. 4.17 (b) do not have a main root. All roots seem similar and these are called **fibrous roots**.

Separate the plants you have collected into two groups. In group (a) put those that have tap roots and in group (b) those that have fibrous roots. Look at the leaves of the plants in Group (a). What kind of venation do they have? What kind of venation do you see for plants of Group (b)?

Do you notice that leaf venation and the type of roots in a plant are related in a very interesting way? In Table 4.2, can you match the type of leaf venation and the type of roots for some plants you have studied in all the activities so far?

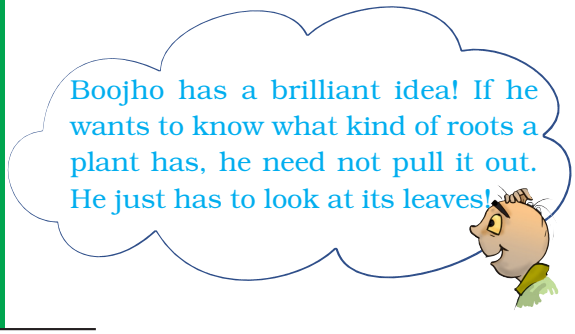


Table 4.2 Types of roots and types of leaf venation

Name of plant	Type of leaf venation	Type of roots

We have learnt that roots absorb water and minerals from the soil and the stem conducts these to leaves and other parts of the plant. The leaves prepare food. This food travels through the stem and is stored in different parts of plant. We eat some of these as roots—like carrot, radish, sweet potato, turnip and tapioca. We also eat many other parts of a plant where food is stored.

Do you agree that stem is like a street with two way traffic (Fig. 4.18)? Write the name of material that goes up in the stem and that which comes down.

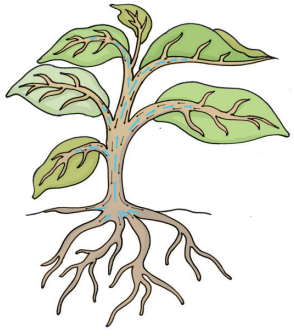


Fig. 4.18. Stem as two-way traffic street

In the next section, we will study about the structure of a flower.

4.5 Flower

You are shown three branches of a rose in Fig 4.19 (a), (b) and (c). Which one will help you best to recognise the plant?

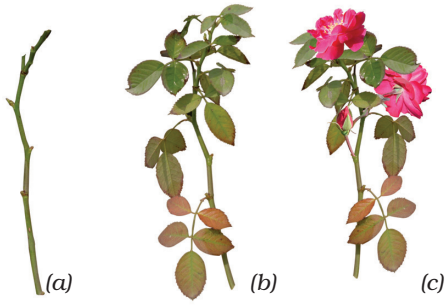


Fig 4.19 Rose: (a) A leafless branch
(b) A branch with leaves
(c) A branch with leaves and flowers

Which colour did you use for the flower in Fig. 4.19 (c)? Are all flowers colourful? Have you ever seen flowers on grass, wheat, maize, mango or guava? Are those brightly coloured?

Let us study a few flowers.

When choosing flowers to study, avoid using marigold, chrysanthemum or sunflower. You will learn in higher classes that they are not single flowers, but groups of flowers.

Activity 10

We would require one bud and two fresh flowers each, of any of the following– *datura*, china rose, mustard, brinjal, lady's finger, gulmohur. Also a blade, a glass slide or a sheet of paper, a magnifying glass and water.

Observe Fig. 4.20 carefully. Look at the prominent parts of the open flower. These are the **petals**. Different flowers have petals of different colours.

Where do you think the petals are in a closed bud? Which is the most prominent part in a bud? Did you see that this part is made of small leaf-like structures? They

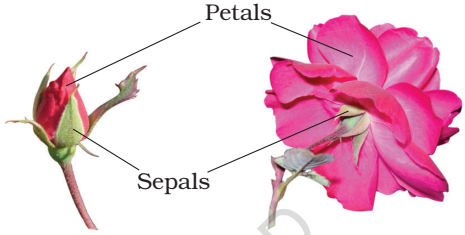


Fig. 4.20 Bud and flower

are called **sepals**. Take a flower and observe its petals and sepals. Now, answer the following questions:

How many sepals does it have?

Are they joined together?

What are the colours of the petals and the sepals?

How many petals does the flower have?

Are they joined to one another or are they separate?

Do the flowers with joint sepals have petals that are separate or are they also joined together?

Fill the table based on the observations of the whole class (Table 4.3). Add observations to this table, from a field trip to a locality where there are plants with flowers. Fill the last two columns later.

To see the inner parts of the flower clearly, you have to cut it open, if its petals are joined. For example, in *datura* and other bell-shaped flowers, the petals have to be cut lengthwise and spread

Table 4.3 Observations on flowers

Name of flower/ plant	Number and colour of sepals	Number and colour of petals	Are the sepals joined or separate?	Are the petals joined or separate?	Stamens – are they free or joined to petals	Pistil – Present/ absent
Rose	Many (Colour?)	5 (Colour?)	Separate		Free	Present

out so that the inner parts can be seen clearly (Fig. 4.21).

Remove the sepals and petals to see the other parts. Study the Fig. 4.22 carefully, compare your flower with the illustration and identify the **stamens** and **pistil** in your flower.

Look at Fig 4.23 carefully. It shows different kinds of stamens present in different flowers. Can you recognise the two parts of the stamens in your flower? How many stamens are there in your flower? Draw one stamen and label its parts.

Fig. 4.21 A bell-shaped flower

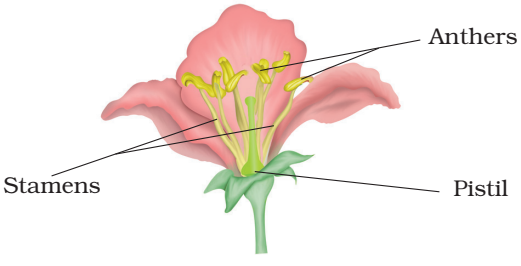


Fig. 4.22 Parts of a flower

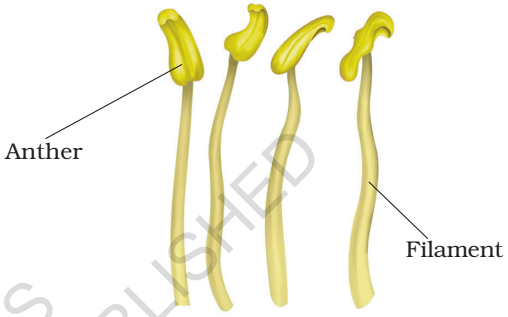


Fig. 4.23 Parts of a stamen

The innermost part of flower is called the **pistil**. If you cannot see it completely, remove the remaining stamens. Identify the parts of the pistil with the help of Fig. 4.24.

Draw a neat, labelled diagram of the pistil of your flower.

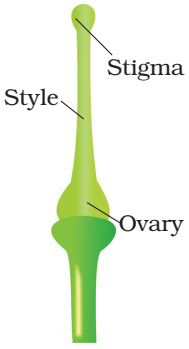


Fig. 4.24 Parts of a pistil

Activity 11

Let us now study the structure of **ovary** (Fig. 4.24). It is the lowermost and swollen part of the pistil. We will cut this part to study what is inside! Look at Fig. 4.25 (a) and (b) carefully to understand how to cut the ovary of a flower.

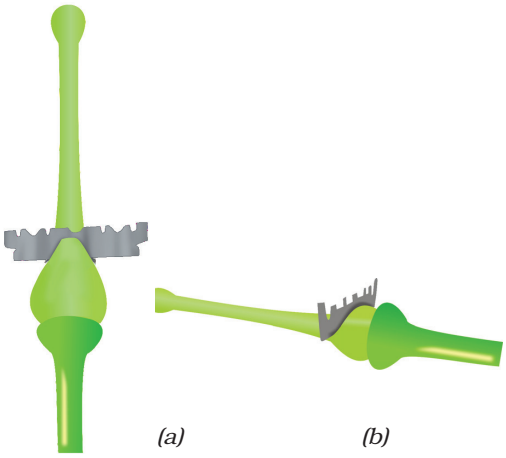


Fig. 4.25 *Cutting an ovary (a) longitudinal cut and (b) transverse cut*

Cut the ovary in two different ways as shown in Fig. 4.25. To prevent them from drying, put a drop of water on each of the two pieces of the ovary, you have cut.

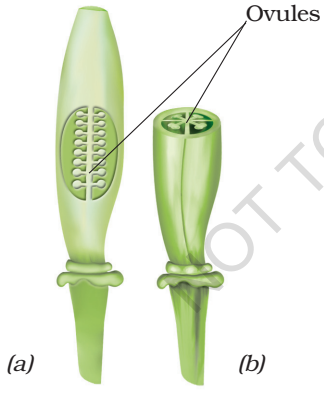


Fig. 4.26 *Inner structure of an ovary (a) longitudinal cut, (b) transverse cut*

Observe the inner parts of the ovary using a lens (Fig. 4.26). Do you see some small bead like structures inside the ovary? They are called **ovules**. Draw and label the inner parts of the ovary in your notebook.

Try to find out the names of as many flowers as you can by asking the gardener or any other person. Remember, not to pluck more flowers than you need. Based on what you have filled in Table 4.3, answer the following questions.

Do all flowers have sepals, petals, stamens and pistils? Are there flowers that do not have one or more of these? Are there flowers which have parts other than these?

Did you find any flower which has no difference between sepals and petals?

Did you find any flower in which the number of stamens is different from the number of petals?

Do you now agree that the structure of the flower is not always the same? The number of sepals, petals, stamens and pistils may also be different in different flowers. Some of these parts may even be absent at times!

We have studied some features and functions of leaves, stems and roots. We studied the structure of different flowers. We will learn about the function of flowers in higher classes. We will also learn about fruits in higher classes.

Key words

Climbers
Conduct
Creepers
Fibrous roots
Herbs
Lamina
Lateral roots
Midrib
Ovule
Parallel Venation
Petal
Petiole
Photosynthesis
Pistil
Reticulate venation
Sepal
Shrubs
Stamen
Taproot
Transpiration
Trees
Veins

Summary

- Plants are usually grouped into herbs, shrubs and trees based on their height, nature of stem and branches.
- The stem bears leaves, flowers and fruits.
- Leaf usually has a petiole and lamina.
- The pattern of veins on the leaf is called venation. It can be reticulate or parallel.
- Leaves give out water vapour through the process of transpiration.
- Green leaves make their food by the process of photosynthesis using carbon dioxide and water in the presence of sunlight.
- Roots absorb water and minerals from the soil. They also anchor the plant firmly in the soil.
- Roots are mainly of two types: tap root and fibrous root.
- Plants having leaves with reticulate venation have tap roots while plants having leaves with parallel venation have fibrous roots.
- The stem conducts water from roots to the leaves (and other parts) and food from leaves to other parts of the plant.
- The parts of a flower are sepals, petals, stamens and pistil.

Exercises

1. Correct the following statements and rewrite them in your notebook.

   (a) Stem absorbs water and minerals from the soil.

   (b) Leaves hold the plant upright.

   (c) Roots conduct water to the leaves.

   (d) The number of petals and stamens in a flower is always equal.

   (e) If the sepals of a flower are joined together, its petals are also joined together.

   (f) If the petals of a flower are joined together, then the pistil is joined to the petal.

2. Draw (a) a leaf, (b) a taproot and (c) a flower, you have studied for Table 4.3.
3. Can you find a plant in your house or in your neighborhood, which has a long but weak stem? Write its name. In which category will you place it?
4. What is the function of a stem?
5. Which of the following leaves have reticulate venation?

   Wheat, tulsi, maize, grass, coriander (*dhania*), China rose
6. If a plant has fibrous root, what type of venation do its leaves have?
7. If a plant has leaves with reticulate venation, what kind of roots will it have?
8. Is it possible for you to find out whether a plant has taproot or fibrous roots by looking at the impression of its leaf on a sheet of paper?
9. What are the parts of a flower.
10. From the following plants, which of them have flowers?

    Grass, maize, wheat, chilli, tomato, *tulsi*, *peepal*, *shisham*, banyan, mango, *jamun*, guava, pomegranate, papaya, banana, lemon, sugarcane, potato, groundnut
11. Name the part of plant which produces food. Name the process.
12. In which part of a flower, you will find the ovary?
13. Name two plants in which one has joined sepals and the other has separate sepals.

SUGGESTED PROJECT AND ACTIVITIES

1. **BECOME A LEAF EXPERT**

   Do this activity with a number of leaves over a period of few weeks. For every leaf that you wish to study, pluck it and wrap it in a wet cloth and take it home. Now, place the leaf between the folds of a newspaper and place a heavy book on it. You can also put it under your mattress or a trunk! Take out the leaf after a week. Paste it on a paper and write a poem or story about it. With your leaf collection pasted in a book, you can become an expert about leaves!

2. Names of plant parts are hidden in this grid. Search them by going up, down, diagonally, forward or backward. Have fun!

O	V	U	L	E	L	Y	T	S	T	E	M
V	E	I	N	W	Q	H	E	R	B	P	I
A	N	I	M	A	L	Z	E	X	R	N	D
R	F	I	L	A	M	E	N	T	M	U	R
Y	A	R	A	B	L	C	O	D	B	E	I
L	E	E	U	O	F	O	L	G	H	I	B
A	L	H	I	I	R	J	A	L	K	U	R
T	M	T	N	O	T	P	P	Q	R	R	A
E	E	N	S	T	U	F	E	H	V	W	N
P	Y	A	M	G	I	T	S	Z	Z	N	C
F	L	O	W	E	R	E	H	T	N	A	H
S	T	A	M	E	N	N	S	E	P	A	L

5 Body Movements

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Sit absolutely still. Observe the movements taking place in your body. You must be blinking your eyes, time to time. Observe the movements in your body as you breathe. There are so many movements that happen in our bodies.

When you are writing in your notebook which part of the body are you moving? Or, when you turn and look at your friend? Different parts of your body move while you remain at the same place, in these examples. You also move from one place to another — you get up and go to your teacher or to the school compound, or go home after school. You walk, run, skip, jump and move from place to place.

Let us see how animals move from place to place by filling up Table 5.1, after discussing with our friends, teachers and parents.

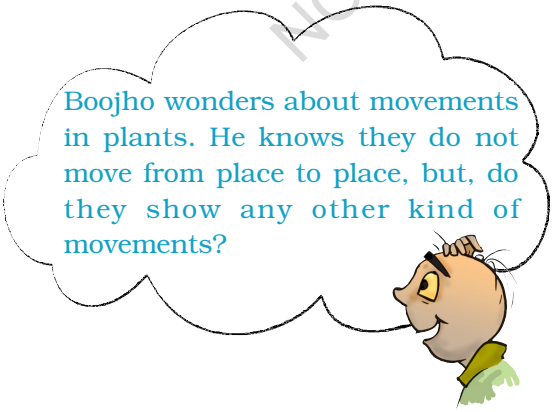


Table 5.1 How do animals move from place to place?

Animal	Body part used for moving from place to place	How does the animal move?
Cow	Legs	Walk
Humans		
Snake	Whole body	Slither
Bird		
Insect		
Fish		

Walk, run, fly, jump, creep, crawl, slither and swim – these are only a few of the ways in which animals move from one place to another. Why are there so many differences in the way that animals move from place to place? Why is it that many animals walk while a snake slithers or crawls and a fish swims?

5.1 Human Body and its Movements

Let us look closely at some of our own movements to begin with, before looking at all these varieties of movements in animals.

Do you enjoy doing physical exercise at school? How do you move your hands and legs while doing different exercises?

Let us try some of the many movements, our body is capable of.

Bowl an imaginary ball at an imaginary wicket. How did you move your arm? Did you rotate it at the shoulder in a circular movement? Did your shoulder also move? Lie down and rotate your leg at the hip. Bend your arm at the elbow and the leg at the knee. Stretch your arm sideways. Bend your arm to touch your shoulder with your fingers. Which part of your arm did you bend? Straighten your arm and try to bend it downwards. Are you able to do it?

Try to move the various parts of your body and record their movements in Table 5.2.

Why is it that we are able to move a few parts of our body easily in various directions and some only in one direction? Why are we unable to move some parts at all?

Activity 1

Place a scale length-wise on your arm so that your elbow is in the centre (Fig. 5.1).

Ask your friend to tie the scale and your arm together. Now, try to bend your elbow. Are you able to do it?

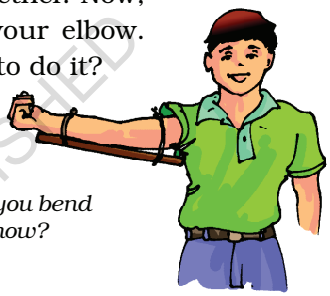


Fig. 5.1 *Can you bend your arm now?*

Table 5.2 Movements in our body

Body Part	Movement				
	Rotates completely	Rotates partly/turns	Bends	Lifts	Does not move at all
Neck		Yes			
Wrist					
Finger					
Knee					
Ankle					
Toe					
Back					
Head					
Elbow					
Arm	Yes				

Did you notice that we are able to bend or rotate our body in places where two parts of our body seem to be joined together — like elbow, shoulder or neck? These places are called **joints**. Can you name more such joints? If our body has no joints, do you think it would be possible for us to move in any way at all?

What exactly is joined together at these joints?

Press your fingers against the top of your head, face, neck, nose, ear, back of the shoulder, hands and legs including the fingers and toes.

Do you get a feel of something hard pressing against your fingers? The hard structures are the bones. Repeat this activity on other parts of your body. So many bones!

Bones cannot be bent. So, how do we bend our elbow? It is not one long bone from the upper arm to our wrist. It is different bones joined together at the elbow. Similarly, there are many bones present in each part of the body. We can bend or move our body only at those points where bones meet.

There are different types of joints in our body to help us carry out different movements and activities. Let us learn about some of them.

Ball and socket joints

Activity 2

Roll a strip of paper into a cylinder. Make a small hole in an old rubber or plastic ball (under supervision) and push the paper cylinder into it as shown in Fig. 5.2. You can also stick the cylinder on the ball. Put the ball in a small bowl.

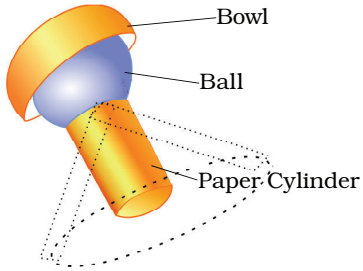


Fig. 5.2 *Making a ball and socket joint*

Does the ball rotate freely inside the bowl? Does the paper cylinder also rotate?

Now, imagine that the paper cylinder is your arm and the ball is its end. The bowl is like the part of the shoulder to which your arm is joined. The rounded end of one bone fits into the **cavity** (hollow space) of the other bone (Fig.5.3). Such a joint allows movements in all directions. Can you name another such joint you can think of, recollecting the body movements we tried at the beginning of this section?

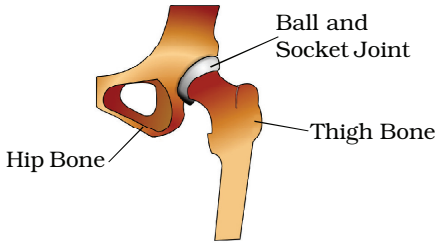


Fig. 5.3 *A ball and socket joint*

Pivotal Joint

The joint where our neck joins the head is a pivotal joint (Fig. 5.4). It allows us to bend our head forward and backward and turn the head to our right or left. Try these movements. How are these movements different from those of our arm that can rotate a complete circle in

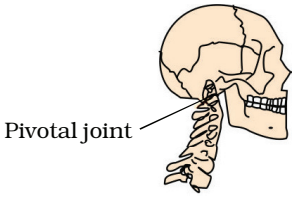


Fig. 5.4 *A pivotal joint*

its ball and socket joint? In a pivotal joint a cylindrical bone rotates in a ring.

Hinge joints

Open and close a door a few times. Observe the **hinges** of the door carefully. They allow the door to move back and forth.

Activity 3

Let us look at the kind of movement allowed by a hinge. Make a cylinder with cardboard or thick chart paper, as shown in Fig. 5.5. Attach a small pencil to the cylinder by piercing the cylinder at the centre, as shown. Make a hollow half cylinder from cardboard such that the rolled up cylinder can fit inside it easily. The hollow half cylinder with the rolled up cylinder sitting inside it, allows movement like a hinge. Try to move the rolled up cylinder. How does it move? How is this movement different from what we saw with our constructed ball and socket joint? We saw this kind of

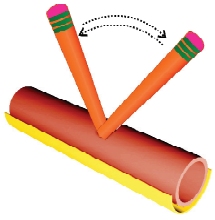


Fig. 5.5 *Directions of movement allowed by a hinge like joint*

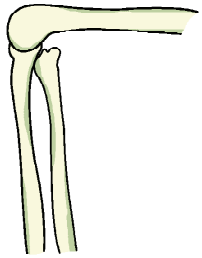


Fig. 5.6 *Hinge joints of the knee*

movement at the elbow in Activity 1. What we have constructed in Fig. 5.5 is different from a hinge, of course. But, it illustrates the direction in which a hinge allows movement. The elbow has a hinge joint that allows only a back and forth movement (Fig. 5.6). Can you think of more examples of such joints?

Fixed joints

Some joints between bones in our head are different from those we have discussed so far. The bones cannot move at these joints. Such joints are called **fixed** joints. When you open your mouth wide, you can move your lower jaw away from your head, isn't it? Try to move your upper jaw, now. Are you able to move it? There is a joint between the upper jaw and the rest of the head which is a fixed joint.

We discussed only some of the joints that connect parts of our body.

What gives the different parts of the body their different shapes?

If you wanted to make a doll, what will you make first? Perhaps a framework to give the doll shape before making its outer structure, isn't it? All the bones in our body also form a framework to give a shape to our body.

The human skeleton is composed of around 305 bones at birth. The number of bones in the skeleton changes with age. It decreases to 206 bones by adulthood after some bones have fused together.

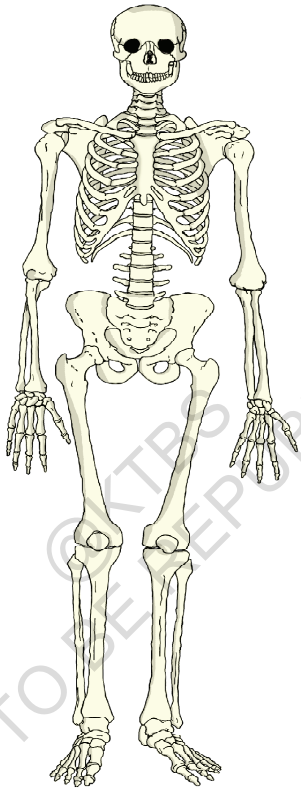


Fig. 5.7 *The Human skeleton*

This framework is called the **skeleton** (Fig. 5.7.)

How do we know that this is the shape of a human skeleton? How do we know the shapes of the different bones in our body? We can have some idea about the shape and number of bones in some parts of our body by feeling them. One way we could know this shape better would be to look at X-ray images of the human body.

Did you or anyone in your family ever have an X-ray of any part of your body taken? Sometimes when we are hurt, or have an accident, doctors use these X-ray images to find out about any possible injuries that might

have happened to the bones. The X-rays show the shapes of the bones in our bodies.

Feel the bones in your forearm, upper arm, lower leg and upper leg. Try to find the number of bones in each part. and knee joints and compare these with the X-ray images (Fig. 5.8).

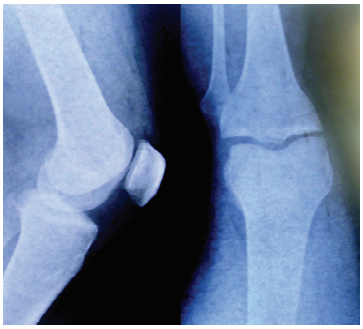


Fig. 5.8 *X-ray images of ankle and knee joints*

Bend your fingers. Are you able tobend them at every joint? How many bones does your middle finger have? Feel the back of your palm. It seems to have many bones, isn't it (Fig. 5.9)? Is your wrist flexible? It is made up of several small bones called **carples**. What will happen if it has only one bone?

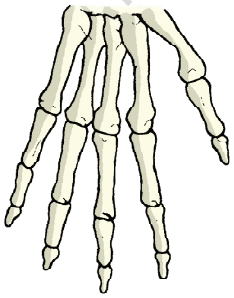


Fig. 5.9 *Bones of the hand*

Activity 4

Take a deep breath and hold it for a little while. Feel your chest bones and the back bone by gently pressing the middle of the chest and back at the same time. Count as many ribs (bones of the chest)

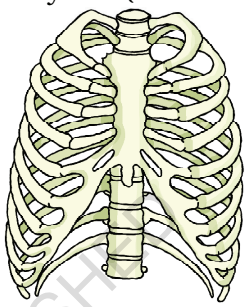


Fig. 5.10 *The rib cage*

as possible. Observe Fig. 5.10 carefully and compare with what you feel of the chest bones. We see that the ribs are curiously bent. They join the chest bone and the backbone together to form a box. This is called the **rib cage**. There are 12 ribs on each side of chest. Some important internal parts of our body lie protected inside this cage.

Ask some friends to touch their toes without bending their knees. Starting from the neck, move your fingers downwards on the back of your friend. What you feel is the **backbone**. It is made up of many small bones called vertebrae.

Fig. 5.11 *The backbone*

The backbone consists of 33 vertebrae (Fig. 5.11). The rib cage is joined to these bones.

If backbone was made up of only one long bone, will your friend be able to bend?

Fig. 5.12 *Shoulder bones*

Make your friend stand with both hands pressed to the wall and ask her to push the wall. Do you notice two bones on the back are prominent where the shoulders are? They are called **shoulder bones** (Fig. 5.12).

Observe Fig. 5.13 carefully. This structure is made of **pelvic bones**. They enclose the portion of your body below the stomach. This is the part you sit on.

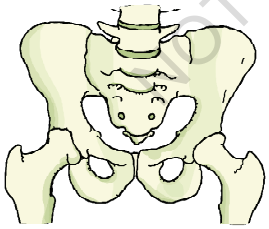


Fig. 5.13 *Pelvic bones*

The skull is made up of many bones joined together (Fig. 5.14). It encloses and protects a very important part of the body, the brain.

We discussed many bones and the joints of our skeleton. There are

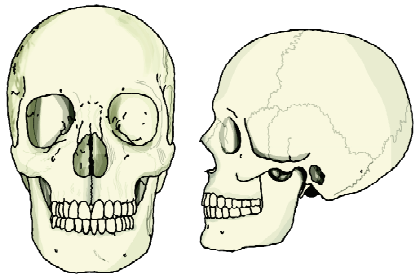


Fig. 5.14 *The skull*

some additional parts of the skeleton that are not as hard as the bones and which can be bent. These are called **cartilage**.

Feel your ear. Do you find any hard bony parts that can be bent (Fig. 5.15)? There do not seem to be any bones here, isn't it? Do you notice anything different between the ear lobe and the portions above it (Fig. 5.16), as you press them between your fingers?

Fig. 5.15 *Upper part of ear has cartilage*

Fig. 5.16 *The ear lobe*

You do feel something in the upper parts of the ear that is not as soft as the ear lobe but, not as hard as a bone, isn't it? This is cartilage**.** Cartilage is also found in the joints of the body.

We have seen that our skeleton is made up of many bones, joints and cartilage. You could feel, bend and move many of them. Draw a neat figure of the skeleton in your notebook.

We have learnt about the bones in our body and about joints that help us move in different ways. What makes the bones move the way they do? Let us find out.

Make a fist with one hand, bend your arm at the elbow and touch your shoulder with the thumb (Fig. 5.17). Do you see any change in your upper arm? Touch it with the other hand. Do you observe a swollen region in the upper arm? This is a **muscle**. The muscle bulged due to **contraction** (it became smaller in length). Now bring your arm back to its normal position. What happened to the muscle? Is it still contracted? You can observe similar contraction of muscles in your leg when you walk or run.

When contracted, the muscle becomes shorter, stiffer and thicker. It pulls the bone.

Muscles work in pairs. When one of them contracts, the bone is pulled in that direction. The other muscle of the pair relaxes. To move the bone in the opposite direction, the relaxed musle contracts to pull the bone towards its original position, while the first relaxes. A muscle can only pull. It cannot push. Thus, two muscles have to work together to move a bone (Fig. 5.17).

Are muscles and bones always required for movement? How do other animals move? Do all animals have bones? What about an earthworm or a snail? Let us study the manner of movement, that is, the gait of some animals.

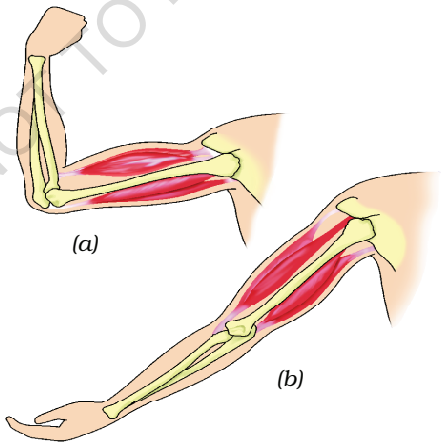


Fig. 5.17 *Two muscles work together to move a bone*

5.2 "Gait of Animals"

Earthworm

Activity 5

Observe an earthworm moving on soil in a garden. Gently lift it and place it on a piece of blotting or filter paper. Observe its movement (Fig. 5.18). Then place it on a smooth glass plate or any slippery surface. Observe its movement now. Is it different from that on paper? In which of the above two surfaces do you find that the earthworm is able to move easily?

The body of an earthworm is made up of many rings joined end to end. An earthworm does not have bones. It has muscles which help to extend and shorten the body. During movement, the earthworm first extends the front part of the body, keeping the rear portion fixed to the ground. Then it fixes the front end and releases the rear end. It then shortens the body and pulls the rear end forward. This makes it move forward by a small distance. Repeating such muscle expansions and contractions, the earthworm can move through soil. Its body secretes a slimy substance to help the movement.

How does it fix parts of its body to the ground? Under its body, it has a large number of tiny bristles (hair like structures) projecting out. The bristles are connected with muscles. The bristles help to get a good grip on the ground.

The earthworm, actually, eats its way through the soil! Its body then throws away the undigested part of the material that it eats. This activity of an earthworm makes the soil more useful for plants.

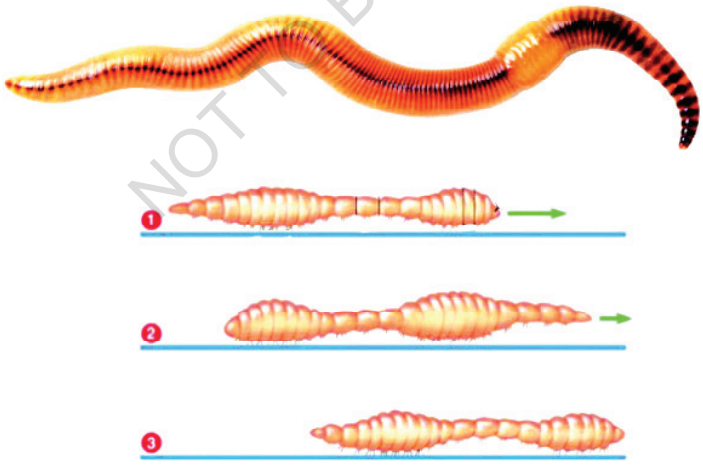


Fig. 5.18 *Movement of earthworm*

Snail

Activity 6

Observe a snail in your garden or in field. Have you seen the rounded structure it carries on its back (Fig. 5.19)?

Fig. 5.19 *A snail*

This is called the shell and it is the outer skeleton of the snail, but is not made of bones. The shell is a single unit and does not help in moving from place to place. It has to be dragged along.

Place the snail on a glass plate and watch it. When it starts moving, carefully lift the glass plate along with the snail over your head. Observe its movements from beneath.

A thick structure and the head of the snail may come out of an opening in the shell. The thick structure is its foot, made of strong muscles. Now, carefully tilt the glass plate. The wavy motion of the foot can be seen. Is the movement of a snail slow or fast as compared to an earthworm?

Cockroach

Activity 7

Observe a cockroach (Fig. 5.20).

Cockroaches walk and climb as well as fly in the air. They have three pairs of legs. These help in walking. The body is covered with a hard outer skeleton. This outer skeleton is made of number of plates joined together and that permits movement.

Fig. 5.20 *A cockroach*

There are two pairs of wings attached to the body behind head. The cockroaches have distinct muscles — those near the legs move the legs for walking. The body muscles move the wings when the cockroach flies.

Birds

Birds fly in the air and walk on the ground. Some birds like ducks and swans also swim in water. The birds can fly because their bodies are well suited for flying. Their bones are hollow and light. The bones of the hind limbs are typical for walking and perching. The bony parts of the forelimbs are modified as wings. The shoulder bones are strong.

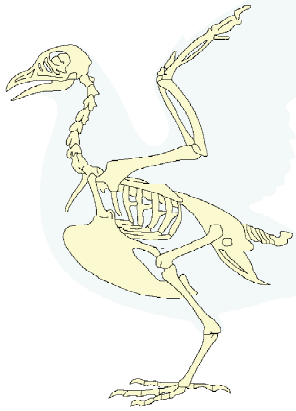


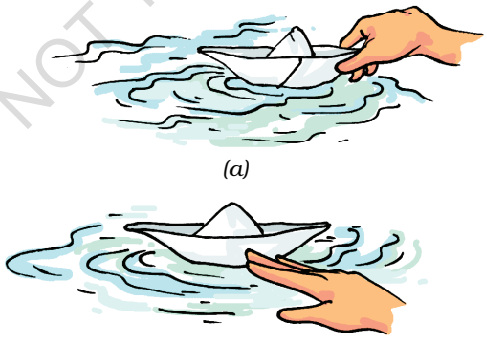
Fig. 5.21 *Skeleton of a bird*

The breastbones are modified to hold muscles of flight which are used to move the wings up and down (Fig. 5.21).

Fish

Activity 8

Make a paper boat. Put it in water andpush it with one narrow end pointingforward [Fig. 5.22 (a)]. Did it go into thewater easily? Now hold the boatsideways and push it into the waterfrom the broad side [Fig. 5.22 (b)]. Areyou able to make the boat move in waterwhen you push it from this side?



(a)

(b)

Fig. 5.22 *Playing with boats*

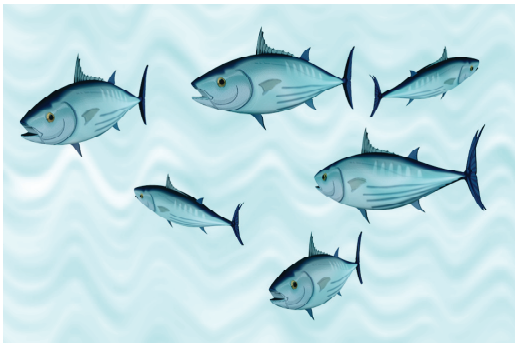


Fig. 5.23 *Fish*

Have you noticed that the shape of aboat is somewhat like a fish (Fig 5.23)?The head and tail of the fish are smallerthan the middle portion of the body –the body tapers at both ends. This bodyshape is called streamlined.The shape is such that water can flowaround it easily and allow the fish tomove in water.The skeleton of the fishis covered with strong muscles. Duringswimming, muscles make the front partof the body curve to one side and thetail part swings towards the oppositeside. The fish forms a curve as shownin Fig. 5.24. Then, quickly, the body andtail curve to the other side. This makesa jerk and pushes the body forward. Aseries of such jerks make the fish swimahead. This is helped by the fins ofthe tail.

Fish also have other fins on their body which mainly help to keep the balance of the body and to keep direction, while swimming. Did you ever notice that under water divers wear fin like flippers on their feet, to help them move easily in water?

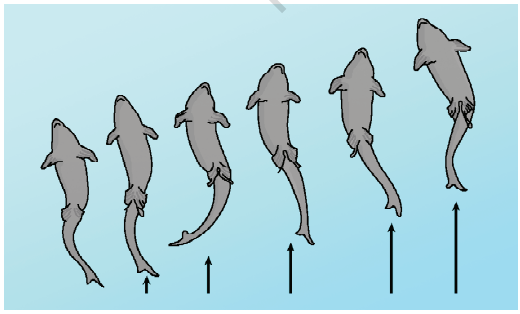


Fig. 5.24 *Movement in Fish*

How do snakes move?

Have you seen a snake slither? Does it move straight (Fig. 5.25)?

Snakes have a long backbone. They have many thin muscles. They are connected to each other even though they are far from one another. Muscles also interconnect the backbone, ribs and skin.

The snake's body curves into many loops. Each loop of the snake gives it a forward push by pressing against the ground. Since its long body makes many loops and each loop gives it this push, the snake moves forward very fast and not in a straightline.

We have learned about the use of bones and muscles for the movements

Fig. 5.25 *Movement in a snake*

of different animals. Paheli and Boojho have many questions in their sacks about the different movements in animals. So must you be having many unanswered questions buzzing in your minds? The ancient Greek philosopher Aristotle, in his book *Gait of Animals*, asked himself these questions. Why do different animals have the body parts that they do have and how do these body parts help animals to move the way they do? What are the similarities and differences in these body parts between different animals? How many body parts are needed by different animals for moving from place to place? Why two legs for humans and four for cows and buffaloes? Many animals seem to be having an even number of legs, why? Why is the bending of our legs different from that of our arms?

So many questions and perhaps we have looked for some answers through our activities in this chapter and we need to look for many more answers.

Yoga — For Better Health

Yoga is an invaluable gift of the ancient Indian tradition. The United Nations declared 21 June as International Day of Yoga. Yoga keeps a person healthy. It helps in keeping the backbone erect, enabling you to sit straight and not slouch. Many postures in yoga require you to lift your own weight, which help in making the bones strong and help ward off osteoporosis. It also helps in relieving joint pain, which is mostly observed in elderly people. It tunes all muscles in the body and keeps them active. It keeps the heart healthy and makes it work more efficiently. Certain yoga postures should be performed under the supervision of a trained person.

Key words

Backbone	Muscle
Ball and socket joint	Outer skeleton
Bristles	Pelvic bones
Cartilage	Pivotal joint
Cavity	Rib cage
Fixed joint	Shoulder bones
Gait of animals	Skeleton
Hinge joint	Streamlined

Summary

- Bones and cartilage form the skeleton of the human body. It gives the frame and shape to the body and helps in movement. It protects the inner organs.
- The human skeleton comprises the skull, the back bone, ribs and the breast bone, shoulder and hipbones, and the bones of hands and legs.
- The bones are moved by alternate contractions and relaxations of two sets of muscles.
- The bone joints are of various kinds depending on the nature of joints and direction of movement they allow.
- Strong muscles and light bones work together to help the birds fly. They fly by flapping their wings.
- Fish swim by forming loops alternately on two sides of the body.
- Snakes slither on the ground by looping sideways. A large number of bones and associated muscles push the body forward.
- The body and legs of cockroaches have hard coverings forming an outer skeleton. The muscles of the breast connected with three pairs of legs and two pairs of wings help the cockroach to walk and fly.
- Earthworms move by alternate extension and contraction of the body using muscles. Tiny bristles on the underside of the body help in gripping the ground.
- Snails move with the help of a muscular foot.

Exercises

1. Fill in the blanks:

   (a) Joints of the bones help in the ———————— of the body.

   (b) A combination of bones and cartilages forms the _____ of the body.

   (c) The bones at the elbow are joined by a _____ joint.

   (d) The contraction of the _____ pulls the bones during movement.

2. Indicate true (T) and false (F) among the following sentences.

   (a) The movement and locomotion of all animals is exactly the same. ( )

   (b) The cartilages are harder than bones. ( )

   (c) The finger bones do not have joints. ( )

   (d) The fore arm has two bones. ( )

   (e) Cockroaches have an outer skeleton. ( )

3. Match the items in Column I with one or more items of Column II.

Column I	Column II
Upper jaw	have fins on the body
Fish	has an outer skeleton
Ribs	can fly in the air
Snail	is an immovable joint
Cockroach	protect the heart
	shows very slow movement
	have a streamlined body

4. Answer the following:

   (a) What is a ball and socket joint?

   (b) Which of the skull bones are movable?

   (c) Why can our elbow not move backwards?

THINGS TO THINK ABOUT

We discussed the many movements our bodies are capable of. Healthy bones, muscles, joints and cartilages are needed by the body for all these movements. Some of us suffer from conditions that could make these movements not so easy. In a whole class activity, try to find ways that one would manage everyday activities, if any one of our body movements was not possible. In Activity 1, for instance, you tied a scale on your arm and disabled the elbow movement. Think of other ways of restricting normal body movements and find ways that everyday activities could then be managed.