Curiosity

Textbook of Science for Grade 6

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एन सी ई आर टी
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राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
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Foreword

The National Education Policy 2020, envisages a system of education in the country that is rooted in Indian ethos and its civilisational accomplishments in all domains of human endeavour and knowledge while at the same time preparing the students to constructively engage with the prospects and challenges of the twenty-first century. The basis for this aspirational vision has been well laid out by the National Curriculum Framework for School Education (NCF-SE) 2023 across curricular areas at all stages. Having nurtured the students' inherent abilities touching upon all the five planes of human existence, the *pañchakośhas*, in the Foundational and the Preparatory Stages have paved the way for the progression of their learning further at the Middle Stage. Thus, the Middle Stage acts as a bridge between the Preparatory and the Secondary Stages, spanning three years from Grades 6 to 8.

This framework, at the Middle Stage, aims to equip students with the skills that are needed to grow, as they advance in their lives. It endeavours to enhance their analytical, descriptive, and narrative capabilities, and to prepare them for the challenges and opportunities that await them. A diverse curriculum, covering nine subjects ranging from three languages—including at least two languages native to India—to Science, Mathematics, Social Sciences, Art Education, Physical Education and Well-being, and Vocational Education promotes their holistic development.

Such a transformative learning culture requires certain essential conditions. One of them is to have appropriate textbooks in different curricular areas as these textbooks will play a central role in mediating between content and pedagogy—a role that will strike a judicious balance between direct instruction and opportunities for exploration and inquiry. Among the other conditions, classroom arrangement and teacher preparation are crucial to establish conceptual connections both within and across curricular areas.

The National Council of Educational Research and Training, on its part, is committed to providing students with such high-quality textbooks. Various Curricular Area Groups, which have been constituted for this purpose, comprising notable subject-experts, pedagogues, and practising teachers as their members, have made

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all possible efforts to develop such textbooks. *Curiosity*, Textbook of Science for Grade 6, is one of these. It has been developed in consonance with the recommendations of NEP 2020 and the NCF-SE 2023 to take students on a journey of experiential learning by citing examples from the world of the learners. The content stimulates curiosity, a sense of exploration, questioning, and critical thinking. The content seamlessly weaves together concepts from physics, chemistry, biology, and earth science, along with cross-cutting themes like environmental education, value education, inclusive education, and Indian Knowledge Systems (IKS). The textbook aims to engage learners through an integrated approach by including multiple activities and thoughtful use of technology. The textbook offers ample opportunities for reflection and group discussions.

To encourage creativity and innovation, it is feasible to regard students as active participants in the learning process, rather than mere recipients of a predetermined set of knowledge. This can only be achieved if the necessary number of hours are dedicated to science teaching–learning annually as outlined in NCF-SE 2023. The pedagogical approach of the textbook also considers how important it is for students to think critically, reason well and make decisions. It also provides students with numerous opportunities to learn from each other, making the learning experience more engaging for both teachers and students.

However, in addition to this textbook, students at this stage should also be encouraged to explore various other learning resources. School libraries play a crucial role in making such resources available. Besides, the role of parents and teachers will also be invaluable in guiding and encouraging students to do so.

With this, I express my gratitude to all those who have been involved in the development of this textbook and hope that it will meet the expectations of all stakeholders. At the same time, I also invite suggestions and feedback from all its users for further improvement in the coming years.

DINESH PRASAD SAKLANI
Director
National Council of Educational
Research and Training

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30 June 2024

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About the Book

Curiosity, Textbook of Science for Grade 6 learners has been crafted in alignment with the recommendations of the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF-SE) 2023. The policy advocates a radical shift from a content-based education to a competency-based education, particularly in the realm of science. Therefore, the formulation of curricular goals for Science, subsequent competencies and learning outcomes are tailored towards competency-based learning. These curricular goals encompass various scientific concepts, including matter, the physical and living world, health, hygiene, and the exploration of the interface between science, society and technology. Additionally, the goals focus on the nature of science, its processes, historical and contemporary aspects of the development of science and science communication. While these goals are explicitly articulated, they are interdependent and collectively contribute to a better understanding of the world around us. Accordingly, the chapters of this textbook are structured around creative activities, reflective questions, processes and illustrations. The integration of the concepts from biology, chemistry, physics and earth science, and cross-cutting themes, such as value education, inclusive education, Indian Knowledge Systems (IKS) and environmental education have been interwoven in the content. Thus, the textbook aims to provide experience-based learning, rather than simply reading and memorising the concepts.

In the Middle Stage, science teaching–learning adopts an integrated approach. This integrated approach develops fundamental capacities across biology, chemistry, physics and earth science. The use of an integrated approach helps the learners to appreciate the interrelations between subjects and make sense of their observations and experiences.

Curiosity, Textbook of Science for Grade 6, comprises twelve chapters. As the name of the textbook suggests, there are numerous opportunities for the learners to explore the world of science and its nature. Through the chapters, learners will embark on a journey that will connect them to the world around and spark curiosity for further exploration. The hands-on activities embedded within each chapter engages the learners and provide them an opportunity to

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reflect on learning. These activities are inclusive in nature. Some activities require both the teacher and learners to prepare in advance.

Chapter 1, titled 'The Wonderful World of Science', provides a holistic view of the new topic of Science introduced in the Middle Stage. It showcases, through examples, the essence of Science—a way of thinking, observing, and finding out by doing, and by asking questions. This chapter weaves together the concepts covered in the rest of the book, and aims to excite the readers as they start their adventures into the world of science. There are no assessment exercises in this chapter and is designed to be **non-evaluative**. Also, every chapter in the book begins with an introduction that makes the learners curious and tries to show different ways with which the goals of the curriculum can be achieved effectively. The chapters begin with the stories related to real-life situations, these are meant to capture learners' interest and connect them with what is already known. The various activities given are based on scientific processes, designed to provide hands and minds-on experiences. Following each activity, there are questions to help learners understand and assess how well they have grasped the information. Questions are significant in the learning process. They help learners to explore and reinforce their understanding. One will also find many thought-provoking questions designed to encourage deep thinking, self-awareness and critical analysis. These questions prompt learners to ponder and delve deeper into their thoughts.

In order to sustain the interest of the readers, some of the challenging ideas, additional information, poems, stories, strange facts and other interesting materials are also presented as add on **non-evaluative** content in the boxes labelled 'Do you know?', 'More to know!', 'Think it over!' and 'More to do!'. The thrill of scientific inquiry comes from pursuing the unknown, giving learners the opportunity to think and explore beyond the syllabus. Some chapters also include a section called 'Know a scientist', which presents the contributions of Indian scientists related to that concept. All these box items, including brief biographies of scientists, are **non-evaluative**. The important ideas and steps in understanding a given concept of science are included as 'Keywords' at the end of each chapter. These 'Keywords' will help learners to acknowledge various

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ideas and encourage them to think more deeply about the content. The keywords related to scientific processes depict the steps or procedure involved in the scientific activities. These words guide learners on how scientific knowledge is generated, tested and applied. 'Summary' offers an overview of the chapter's main points, reinforcing the key ideas discussed. It serves to outline the content presented in the chapter. A **non-evaluative** interesting element that has been incorporated in some of the chapters is the introduction of certain verses from various Indian texts to promote rootedness in the learners as envisaged in NEP 2020.

The primary aim of *Curiosity* is to prepare the children for becoming the responsible members of the society, and therefore efforts have been made to raise awareness about various issues, such as gender, region, environment, health and hygiene, water scarcity and energy conservation. Activities given in the book endeavour to promote peer-learning and group activities.

The assessment exercises, 'Let us enhance our learning', play a vital role in the learning process. They help to reinforce the understanding and identify areas for improvement, making them essential components of effective teaching and learning. Assessment consists of various exercises, from pictorial questions to creating puzzles and multiple-choice questions, to create a challenging and interesting experience for the learners. These questions also facilitate the evaluation of various competencies expected to be developed through a particular chapter. Peer and group activities to explore answers to the questions are also encouraged.

A significant feature of the book is what we termed as 'Learning further'. In this section, some projects and activities are designed to increase learners' interaction with experts, teachers, parents and the wider community. Learners are encouraged to gather diverse information and draw their own conclusions.

The textbook is just one way to learn. Learners should enhance their knowledge by exploring and observing their surroundings. Information and Communication Technology (ICT) can also be a valuable tool for learners' learning and development, when used appropriately. Learners can explore ICT with the help of Quick Response (QR) codes provided in the textbook. QR codes make the reading experiences more interactive and enjoyable. These QR

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codes that have additional resources can be accessed by the learners at their own convenience and pace. These additional resources include videos, puzzles, games, quizzes, audio, documentaries and additional content on some topics.

At the end of this book, learners will find a page titled 'It is not the end, my friend!'. This includes words of encouragement, motivating learners to continue their educational journey and ignite their curiosity for further learning. It is meant to be **non-evaluative**.

May the journey of every learner be filled with joy and continue the curiosity in the higher grades as well!

We express our gratitude to all the members of the textbook development committee for their contributions in shaping this textbook. We look forward to the feedback of the readers.

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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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Chapter 8

A Journey through States of Water

“நெடுங்கடலும் தன்நீர்மை குன்றும் தடிந்தெழிலி
தான்நல்கா தாகி விடின்

(திருக்குறள்)

If it does not rain well, even the mighty ocean will be drained.

(Thirukkural)”

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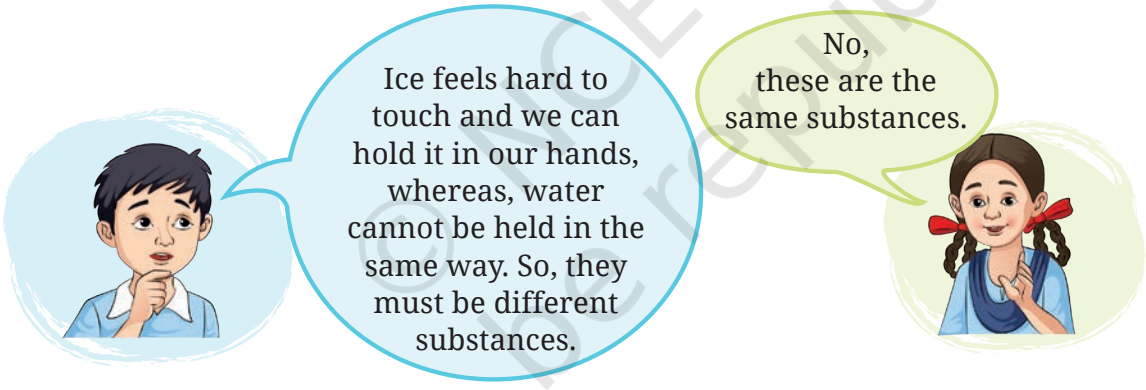
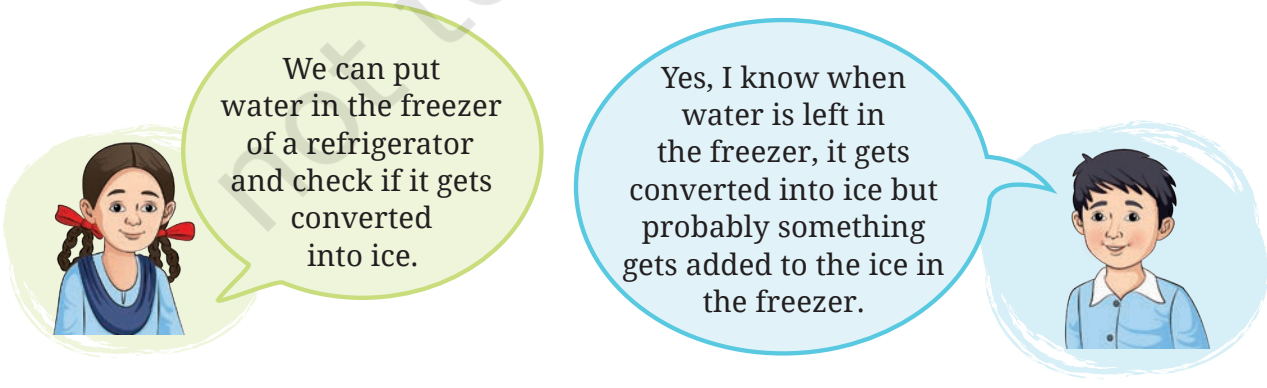
On a bright summer afternoon, Aavi and Thirav enjoy their *shikanji* (lemonade). After looking at the ice in the lemonade, Thirav wonders about the nature of ice and water.



Aavi has a counterview to Thirav. What do you think? Why?



Do you think Thirav is right? How can you find out?

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Activity 8.1: Let us observe

- Put an ice cube in a cup, leave it on the table and observe.

Ice gets converted into water.

What can you conclude from the observations?

Does this mean that ice and water are the same substance? Yes, ice and water are the two forms of the same substance. These forms are also called states. These different states of water show many differences in their behaviour. Water flows but ice does not. Water splashes but ice does not.

8.1 Investigating Water's Disappearing Act

It is a rainy morning. While going to school, Aavi and Thirav observe that there are a lot of water puddles in the playground. That evening, when they go to play, they are surprised to observe that some of the water in the puddles had disappeared.

Have you ever noticed water in the puddles disappearing? Where does it go? Discuss with your friends.

Where else have you seen water disappearing? Can you think of a possible **reason** why this happens?

You might have observed that after washing the utensils, water left on the surface of the utensils, dries up after some time. Does the reason you thought earlier to explain water disappearance apply in this case also?

Aavi wonders if water has seeped through the surface of the utensils.

Thirav thinks that water does not seep through the surface of the utensils. Design an activity to **investigate** whose idea is correct.

Activity 8.2: Let us investigate

- Take a tablespoon of water on a steel plate as shown in Fig. 8.1.

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- Observe whether water seeps through to the other side of the plate or not.
- Keep observing this at regular intervals until the water completely disappears.

What do you infer? Is this activity enough to come to the conclusion that water does not seep through a steel plate?

If water does not seep through the steel plate. Then, where has the water gone?

This water gets converted into gaseous state called **water vapour**. The water vapour is another state of water. Let us think of another observation where you notice the water disappearing.

Fig. 8.1: Steel plate with a tablespoon of water

While making dosa, we sprinkle some water on the hot pan and it disappears. Where does it go?

Let us draw

Draw a detailed sketch (with labels and caption) about what happens to the water.

The water which is sprinkled on the hot pan gets converted into steam. Steam is actually water vapour, some part of which converts into water droplets.

The process of conversion of water into its vapour state is called **evaporation**.

Do you know?

Water vapour is actually invisible but the presence of tiny droplets of water in the steam makes it visible.

The process of evaporation takes place continuously, even at room temperature. Can you think of other examples of evaporation?

Drying of wet clothes, mopped floor, and sweat on our body are some examples of it.

Now what do you think is the reason for the disappearance of water from the puddles? Is it due to: (i) seeping of water into the ground or (ii) evaporation of water or (iii) both of these?

Hand sanitiser disappears as you rub it on your hands. What happens to it?

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8.2 Another Mystery

Next day, Aavi, Thirav and their friends decide to make lemonade. During the preparation, they take cold water in a glass tumbler and add ice cubes into it. After a few minutes, they notice something exciting about the outer surface of the glass tumbler.

Let us find out by conducting a similar activity ourselves.

Activity 8.3: Let us experiment

- Take cold water in a glass tumbler.
- Add a few ice cubes into it as shown in Fig. 8.2.

Fig. 8.2: A glass tumbler containing cold water and ice cubes

- Leave it undisturbed for five minutes and observe it.
- **Record** your observations and the questions that arise in your mind in Table 8.1. You can also touch the outer surface of the glass tumbler to feel if there is any change.

You may have many observations and questions here.

Table 8.1: Record the observations and questions

I observe	I wonder

One observation that arises in Aavi's mind is, "There are some water droplets (tiny drops) appearing on the outer surface of the glass tumbler." Initially, water droplets are deposited and these droplets combine together to form bigger drops. You can also try the above process with a metal container. You may be curious about where the water droplets come from.

Suggest possible reasons explaining the appearance of water droplets on the outer surface of the glass tumbler.

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Discuss with your friends. Write down the possible reasons in Fig. 8.3.

Fig. 8.3: Provide your possible reasons explaining the appearance of water droplets on the outer surface of the glass tumbler

You may have various possible reasons. You may agree or disagree with the reasons of others. Aavi and Thirav argued with a chain of reasons. What do you think about the possible reasons mentioned in Fig. 8.4?

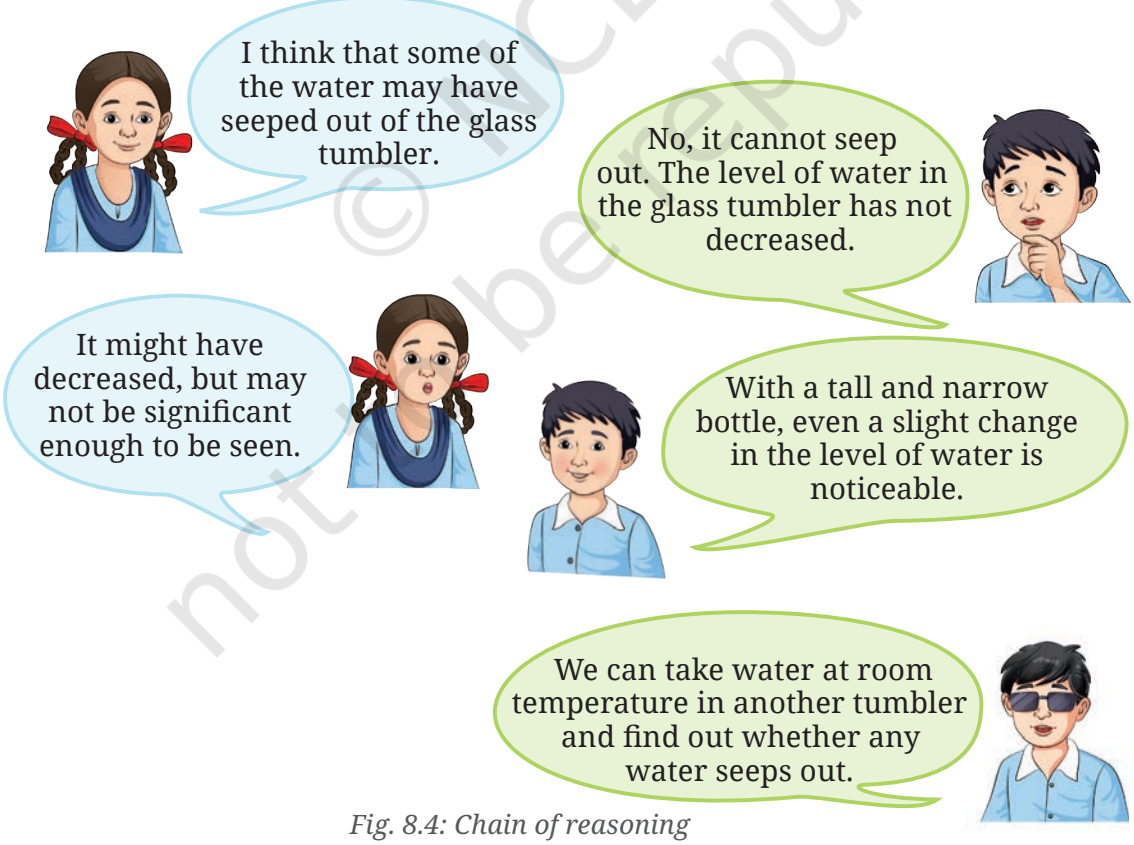

Fig. 8.4: Chain of reasoning

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Continue the discussion on the given reasons or conduct activities to find evidence for the reasons given to help in this discussion. Where else have you seen water droplets like this?

Dew drops on plants

You might have seen dew drops on plants. Why do we see dew drops more in the morning? When we boil the water in a half-filled utensil and cover it with a steel plate, some water drops accumulate on the inner side of the steel plate. Where do these water drops come from? What do you think?

When the water vapour present in the air comes in contact with a cold surface, it forms water droplets. The process of conversion of water vapour into its liquid state is called **condensation**.

After understanding the concept of condensation of water, let us go back to Activity 8.3. Could the water appearing on the outer surface of the glass tumbler in Activity 8.3 also be due to condensation of water vapour present in the air? Let us investigate it.

Activity 8.4: Let us measure

Aavi and Thirav conduct an activity to find evidence for their reasons. You can also conduct the activity by following the steps given below. Record your data in Table 8.2.

- Take a glass tumbler half-filled with water containing a few ice cubes. Cover it with a small steel plate. Weigh it on a digital weighing balance.
- Observe the reading on the balance and record the weight after every five minutes.
- Continue observing for 30 minutes. Record your observations in Table 8.2.

Predict what will happen to the mass of cold water kept on the digital weighing balance. Will it increase or decrease or remain the same?

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Table 8.2: Measurement of mass in condensation experiment using a digital weighing balance

Time	Mass of water
0 min	
5 min	
10 min	
15 min	
20 min	
25 min	
30 min	

Do your findings match with your predictions? Explain your observations.

You may observe some water droplets on the glass tumbler. Water vapour from the air comes in contact with the cold surface of the glass tumbler and gets converted into water droplets on the glass tumbler through condensation. There is an increase in the reading on the digital weighing balance. Can we conclude that water is not seeping through the wall of the tumbler? Can we also conclude that the water collected outside the tumbler is only due to condensation? No, we cannot say that conclusively from Activity 8.4. What more can you do to show that water is not seeping from the glass tumbler? How would you modify Activity 8.4 to find the answer?

Repeat Activity 8.4 with the following modifications—

- Mark the water level on the glass tumbler with a permanent marker or a visible tape.

What do you observe? Water level in the glass tumbler does not go down but the extra water gets collected on the outer surface of the glass tumbler. What can you conclude

More to do!

The amount of water vapour in the air is also known as humidity. The daily humidity data for your area is reported in the newspapers and other sources. Compile the data for the year and study any patterns, if present.

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from this? This activity shows that water is not seeping from the glass tumbler and the extra water is getting collected because of condensation.

8.3 What are the Different States of Water?

Water is a substance that can be observed in three different states in our daily life. In the solid state, it exists as ice. On heating, the ice melts and gets converted into its liquid state. On further heating, water gets converted into its gaseous state. Let us perform Activity 8.5 to identify the properties of different states of water.

Activity 8.5: Let us identify

- Put an ice cube in one container and transfer it to another container of different shape. What changes do you notice in the shape of the ice cube? Record your observations in Table 8.3.
- Pour water from one container to another container of a different shape. Observe how water behaves compared to the ice cube and make a record. Did you notice how water flows from one container to the other? What happens to its shape?
- Pour water on a clean surface and observe how it spreads.
- When water gets converted into water vapour, how does this water vapour spread? Compare this with the spreading behaviour of water.

Table 8.3: Compare different states of water

Property	Ice (Solid state)	Water (Liquid state)	Water vapour (Gaseous state)
Shape			
Ability to flow			
Ability to spread			

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What are the differences in the properties of water in solid, liquid and gaseous states?

Ice (solid state) retains its shape irrespective of the container in which it is placed while water takes the shape of the container. Ice does not flow or spread.

Water (liquid state) flows and changes its shape. Water does not have a fixed shape. It takes up the shape of the container in which it is kept, but the volume of water remains constant. Does water also possess the property to spread? Yes, water also has the property to spread while keeping the volume constant.

Water vapour (gaseous state) exhibits a property of spreading out in the entire available space. Gases do not possess a fixed shape. Water vapour exists even at room temperature; though it is invisible to us. It is present in the air around us. The water that evaporates during processes like drying of clothes or mopping of floors contribute to the water vapour in the air around us.

You are now familiar with the three states of water. Some other substances also exhibit these states. For example, wax, oil and ghee. Let us look at some more examples of solids, liquids and gases.

Look around and find some examples of solid substances. Some examples could be stones, wood and glass.

What are the other examples of liquids you can think of? Here are two examples—milk and oil. Think of five more examples.

Have you ever noticed that you can smell the food being cooked even without entering the kitchen? How does this smell reach us?

It is because the smell of yummy food from cooking spreads through the air and reaches our nostrils, even if we are not in the kitchen.

What are the other examples of gases you can think of? What about oxygen and carbon dioxide?

8.4 How can We Change the States of Water?

So far we have learnt that water can exist in solid, liquid and gaseous states. How can you change the state of water?

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More to know!

Atmospheric Water Generator (AWG) machines collect water from humid air to produce drinkable water. This is done through condensation of water vapour by cooling the air. This process is similar to the formation of drops of water outside the glass tumbler filled with ice cold water.

How can you quickly change ice to its liquid state, water?

If we have to change ice into water, and water into water vapour, we have to supply heat to it. If we want to change water into ice, what should be done?

It can be done by placing water in a cold environment, such as a freezer. Water freezes and is converted into ice. If we take the ice out of the freezer, it melts and is converted into water.

Can you think of any other example, besides water, that can change from solid to liquid?

A candle, which is made of wax, is one such example.

How can we turn candle wax into liquid state? How can we change the liquid wax back into solid state? We should cool the liquid wax to change it into a solid. What are the other liquids you have seen which get converted into a solid? Have you ever seen coconut oil getting converted into its solid state during the winter season?

Hence, we can see that water and other substances change their states on heating or cooling. The process of conversion of a solid into liquid state is called **melting**. The process of conversion of liquid into solid state is called **freezing**.

Let us check the connection between different states of water through Activity 8.6.

Activity 8.6: Let us complete the diagram

Fill up the blank boxes in Fig. 8.5 marked as A, B, C and 1, 2, 3, 4 for conversion of different states of water using the words given in the box. Two words have been filled for you.

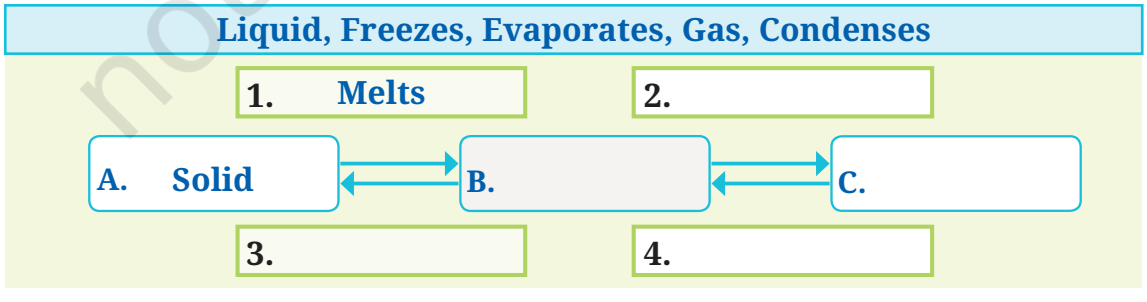

Fig. 8.5: Conversion of different states of water

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8.5 How can Water be Evaporated Faster or Slower?

In section 8.1, we have learnt about evaporation. Let us explore it more!

Observe your surroundings. What are the conditions that affect how fast water evaporates? What differences do you see in evaporation on a cold day versus a hot day? Discuss with your friends. The following words may help in your discussion—fan, drying cloth, sweating, windy day, hot day, rainy day.

Let us perform Activity 8.7 to investigate conditions that will affect how fast water will evaporate.

Activity 8.7: Let us investigate

- Take water in a small cap of a bottle (you may use sanitiser in place of water).
- Take the same amount of water in a plate. The exposed area of water in the bottle cap and the plate are different.
- Keep both of them near each other.
- Record the time taken for the water to completely evaporate in each case in Table 8.4.

Let us investigate

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Reflect on what you did really well in this activity. ?

Table 8.4: Findings of the investigation

Exposed area of water	Time taken for complete evaporation
Less (bottle cap)	
More (plate)	

What can you conclude from this investigation?

If you spread out water on a plate, its area exposed to air is larger. Therefore, evaporation is faster.

What would happen if milk is taken instead of water in the above activity?

Other conditions which affect how fast water evaporates

Design an activity similar to Activity 8.7 to find out what are the other conditions which can affect how fast water will evaporate. What would you change? What would you keep the same? Perform this activity, use Table 8.5 to record the data and discuss your observations.

Table 8.5: Record the data of an investigation where one condition is changed and other condition remains the same

Condition that is kept the same: _____

Condition that is changed	Time taken for complete evaporation

Other than the conditions you have explored to find how water can be made to evaporate faster or slower, you can also conduct Activity 8.8 to explore it further.

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Activity 8.8: Let us explore

- Take identical caps of two bottles.
- Pour equal amount of water in each of the cap.
- Place one of the cap in sunlight and keep the other in shade as shown in Fig. 8.6.
- Observe the two caps of bottles after every 15 minutes.
- Record the time taken for the water to completely evaporate in each case.
- You can also repeat this activity on a windy or a rainy day, and record your observations.

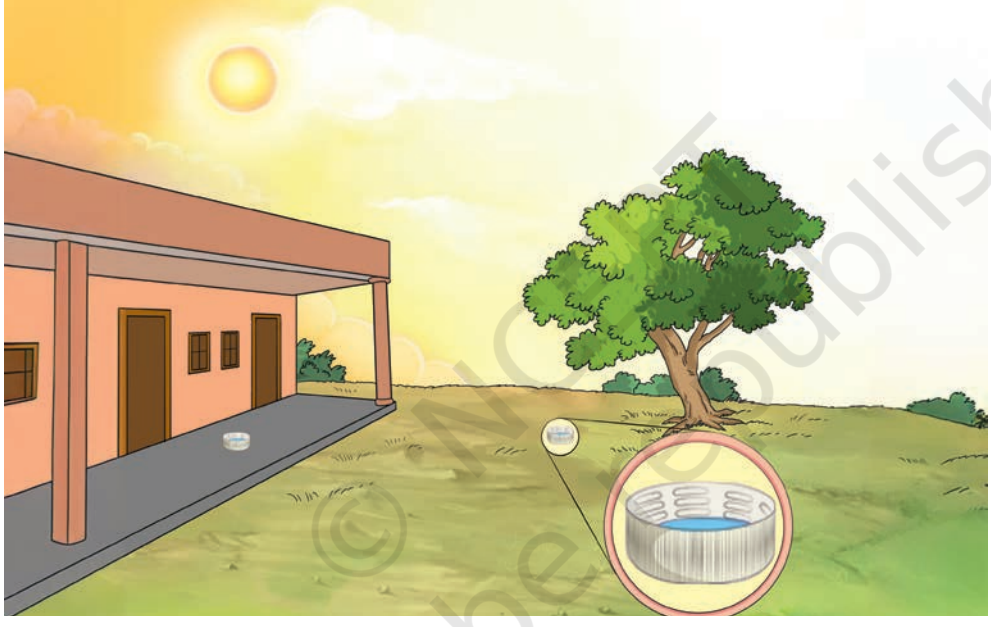

Fig. 8.6: Evaporation of water in sunlight and in shade

What conclusions can you draw from Activity 8.8 and other similar experiences?

- Water evaporates faster from the cap kept in sunlight compared to the cap kept in shade.
- It is a common observation that clothes dry faster on a hot sunny day. Do clothes dry faster or slower on a windy day? It is once again a common observation that clothes dry faster on a windy day. With the increase in the movement of air, water evaporates faster.

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Do you know?

The amount of water vapour in the air is more on rainy days and hence rainy days are more humid.

- It is also a common observation that clothes dry slowly on a rainy day. On a rainy day, water evaporates slowly. If the amount of water in the air is already high (more **humidity**), water evaporates slowly.

If you want to dry your clothes on a rainy day, how can you make it faster?

8.6 Cooling Effect

Aavi's mother purchased a new *matka* (earthen pot) to replace the stainless steel pot for storing drinking water. Upon returning from school, Aavi notices the earthen pot and drinks water from it. Aavi expresses surprise and asks, "Why is the water in the earthen pot so cold? I never observed water getting cold in a stainless steel pot." What do you think is the reason?

Water seeps through the surface of the earthen pot and evaporates, which imparts a cooling effect on the water. What are the other examples of cooling effect? Sprinkling water on the floor or the roof during summer to cool it, is another example.

How do you feel when you rub sanitiser on your hands?

Let us perform Activity 8.9 to observe the cooling effect by making a simple and electricity-free model of pot-in-pot cooler.

Activity 8.9: Let us make a model

- Take two earthen pots of different sizes.
- Fill the bottom of the larger pot with a layer of sand.
- Place the smaller pot into the centre of the larger one as shown in Fig. 8.7.
- Fill the gap between the pots with more sand.
- Pour water in the sand area.

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- Place a lid or wet jute sack to cover the top of the smaller pot.
- You can also make a drawing of the pot-in-pot cooler once it is ready.

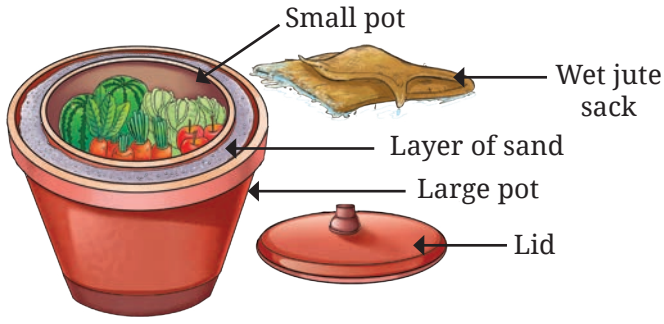

Fig. 8.7: A pot-in-pot cooler

Allow 4–5 hours for the mini pot-in-pot cooler to cool down. The time range can be influenced by many conditions. Observe and discuss how it creates a cooling effect inside the pots. Keep some vegetables and fruits in it and observe for a week on a daily basis to check for the freshness of the vegetables and fruits kept inside the cooler. You will have to add water regularly to keep the sand moist. For how many days can the vegetables and fruits be kept fresh in it? What are the conditions which can affect the number of these days? What else can be used in place of sand for better cooling?

You all may be familiar with this unique clay pot which is called *Surahi* (Fig. 8.8). In summers, *surahi* is used to keep the water cold.

Fig. 8.8: A surahi

8.7 How Do Clouds Give Us Rain?

Condensation plays a significant role in the process of bringing evaporated water back to the Earth's surface. How does this happen? When air moves higher above the Earth's surface, it becomes cooler and cooler. At certain heights, the air gets so cool that the water vapour in it turns into droplets which are generally formed around dust particles. These small droplets float in the air and form clouds. Many droplets join together to form bigger drops of water. Some drops get so heavy that they start falling. These falling water drops are what we call rain.

Do you know?

Why does air containing water vapour go up in the atmosphere (thin layer of air that surrounds the Earth)?

As we know, gas balloons containing lighter gases go up in the air. Similarly, water vapour is lighter than air, causing it to rise.

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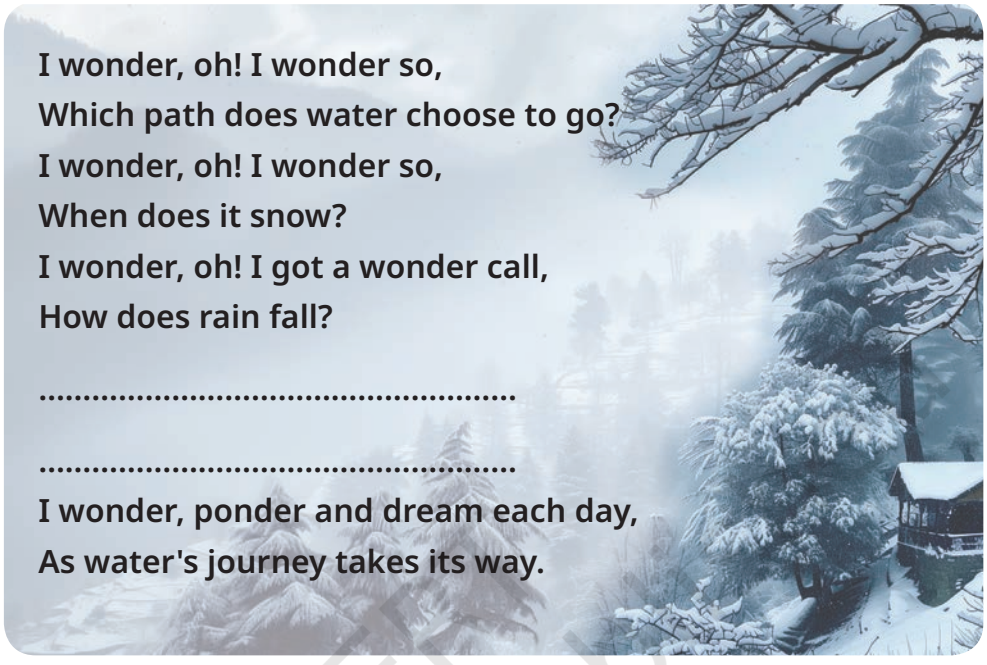
Under special conditions, it might also fall as hail or snow. Aavi enjoys the rain and creates a poem. You can complete the poem and present it in your class.



I wonder, oh! I wonder so,
Which path does water choose to go?
I wonder, oh! I wonder so,
When does it snow?
I wonder, oh! I got a wonder call,
How does rain fall?

.....

.....

I wonder, ponder and dream each day,
As water's journey takes its way.

Activity 8.10 demonstrates the role of dust particles in the formation of clouds.

Caution
Handle burning paper carefully.

Activity 8.10: Let us engage in a group activity

- Take an empty discarded one litre plastic bottle. Pour about one cup of water into it.
- Close the lid tightly. Now quickly squeeze and release the bottle continuously for about 2–3 minutes. Observe the space above the water in the bottle.
- Repeat the same activity after adding a small burnt piece of newspaper into the water.
- What will you observe?
- In this case, you will observe some haziness (clouds) above the water in the bottle.
- The burnt newspaper provides very small invisible dust particles, around which water vapour condenses and forms clouds.

Let us perform Activity 8.11 to represent our understanding of how water changes its state and its movement.

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Activity 8.11: Let us understand the process

Label Fig. 8.9 using arrows shown and the words given in the box to show where water is stored, how water changes its state and where it moves.

Cloud, Lake, Ocean, River, Groundwater, Evaporation, Condensation, Rain, Snow

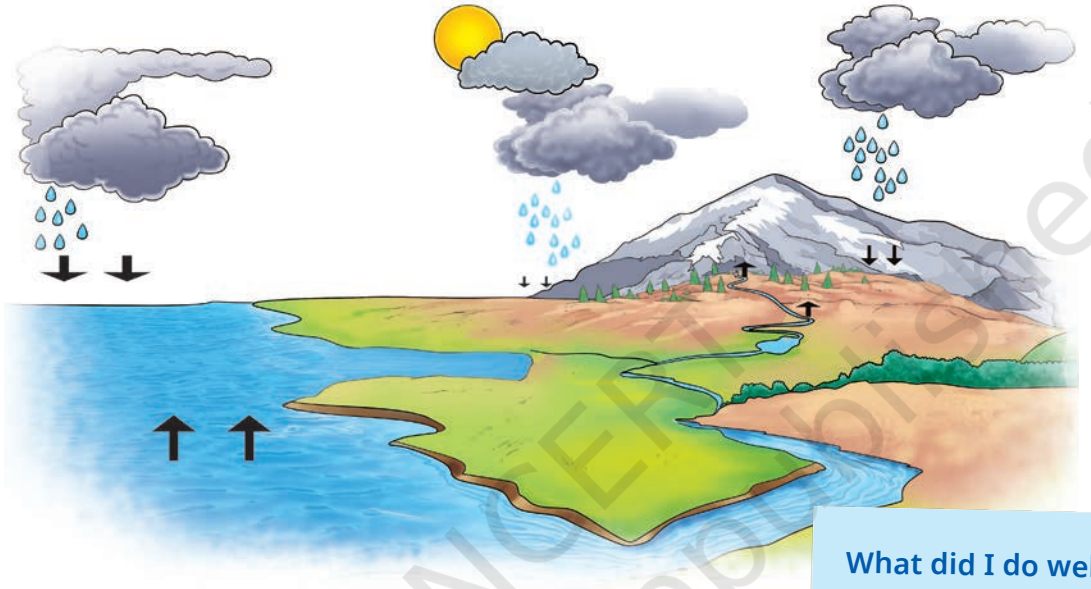

Fig. 8.9: Change of states and movement of water

The water from the ocean and the Earth's surface evaporates into the atmosphere as vapour and returns as rain, hail or snow, ultimately flowing back to the oceans. This circulation of water is known as the **water cycle**.

Only a small portion of water available on the Earth is fit for use by plants, animals and humans. Most of the water is in the oceans and it cannot be used directly. We use water for drinking and also for many other activities. The number of people using water is increasing with a rise in population. The increasing demand for water causes its shortage in many parts of the world. Hence, it is very important to use water wisely and avoid wasting it. Let us keep our water bodies free from pollution. You will learn more about water and its conservation in the chapter 'Nature's Treasures'.

What did I do well? Was I able to label all the parts of the water cycle? Which parts of the water cycle were unclear to me?

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Keywords

Condensation	Experiment
Evaporation	Investigate
Freezing	Observe
Gas	Predict
Humidity	Question
Liquid	Reason
Melting	Record
Solid	
Water cycle	
Water vapour	

Summary

Key Points

- The process of conversion of water into its vapour state is called evaporation.
- The process of conversion of water vapour into its liquid state is called condensation.
- Water is found in different states—solid, liquid and gas.
- Water changes its state on heating or cooling.
- Conditions which make the evaporation faster or slower are exposed area, humidity, air movement, etc.
- Evaporation causes cooling effect.

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- The water vapour in the air condenses to form tiny droplets of water, which appear as clouds. Many tiny water droplets come together and fall down as rain, hail or snow.
- The circulation of water between the Earth surface and atmosphere is known as the water cycle.
- We have used the process of observation, questioning, possible reason and experimenting to find out the concepts of evaporation and condensation.

Let us enhance our learning

1. Which of the following best describes condensation?
   (i) The conversion of water into its vapour state.
   (ii) The process of water changing from a liquid into gaseous state.
   (iii) The formation of clouds from tiny water droplets.
   (iv) The conversion of water vapour into its liquid state.
2. Identify in which of the given processes, evaporation is very important—
   (i) Colouring with
   (a) crayons (b) water colours
   (c) acrylic colours (d) pencil colours
   (ii) Writing on paper with
   (a) pencil (b) ink pen (c) ball point pen
3. We see green coloured plastic grass at many places these days. Space around natural grass feels cooler than space around the plastic grass. Can you find out why?
4. Give examples of liquids other than water that evaporate.
5. Fans move air around, creating a cooling sensation. It might seem strange to use a fan to dry wet clothes since fans usually make things cooler, not warmer. Normally, when water evaporates, it requires heat, not cold air. What do you think about this?
6. Usually, when sludge is removed from drains, it is left in heaps next to the drain for 3–4 days. Afterward, it is transported to a garden or a field where it can be used as

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manure. This approach reduces transportation cost of the sludge and enhances the safety of individuals handling it. Reflect upon it and explain how.

7. Observe the activities in your house for a day. Identify the activities that involve evaporation. How does understanding the process of evaporation help us in our daily activities?

8. How is water present in the solid state in nature?

9. Reflect on the statement "Water is our responsibility before it is our right." Share your thoughts.

10. The seat of a two-wheeler parked on a sunny day has become very hot. How can you cool it down?

Learning further

- Wet one hand with water and leave the other dry. Blow air across both hands and feel the cooling effect. Find out the reasons for it.
- Make a game to navigate through different states of water and water related concepts to reach the finish line. Challenge cards with questions related to water cycle, evaporation, condensation, etc., can be some game elements.
- Discuss with your teacher and act out the stages of the water cycle through a role-playing activity in your school assembly.

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Chapter 9

Methods of Separation in Everyday Life

"साधु ऐसा चाहिए जैसा सूप सुभाय।
सार सार को गहि रहै थोथा दई उड़ाय॥

—कबीर

Just like winnowing makes the husk blow away while retaining the grains, similarly, sages let the virtues stay while discarding the vices.

—Kabir"

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Malli and his sister Valli are excited for their summer vacations. Their parents have planned a trip to visit their relatives and friends living across India. They always stay in touch with their relatives and friends. Do you also keep in touch with your loved ones?

Their first halt is at their *Nani's* (maternal grandmother's) house in Haryana. It is surrounded by large fields. Malli and Valli are fascinated by the variety of grains piled up in the courtyard. Their *Mami* (maternal aunt) and *Mama* (maternal uncle), along with other community members, are busy separating small stones and husk from the grains with their hands.

Malli and Valli are curious to know why this is being done. Their *Nani* notices their curiosity and explains, "We are removing these stones so that the grains are fit for cooking."

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They go around the house to see the fields and the cattle. To keep them busy, *Nani* gives them a challenge of handpicking small stones from grains while keeping their eyes closed.

The method of picking by hand from a **mixture** (when two or more substances are mixed) such as small stones and husk from wheat and rice is called **handpicking.** It is done on the basis of differences in size, colour and shape of the particles. If the particles to be removed are present in small quantities and can easily be picked by hand, handpicking proves to be a convenient method.

Fig. 9.1: Handpicking

At lunch, Malli and Valli are served steaming hot vegetable pulao. While eating the pulao, *Nani* observes that Malli is separating whole black peppers from the pulao and is placing them aside on his plate (Fig. 9.1). Valli playfully teases, "Wow! This is a handpicking method, nice one!" *Nani* tells them about the benefits of black pepper and encourages Malli to eat it.

Later in the day, their *Mama* takes them to the fields where they **observe** bundles of harvested wheat stalks lying in the fields. Some stalks are spread in the sun for drying. Both of them pick up a stalk each and notice numerous grains attached to it. A group of farmers are beating the stalks on a large wooden log. Curiously, Valli asks *Mama*, "Why are they doing this?"

Fig. 9.2: Threshing

Mama explains, "They are beating the stalks to separate the grains" (Fig. 9.2). This process of separating grains from the stalks is known as **threshing**. Farmers work hard, yet they enjoy their work. From time to time, they sing folk songs while working.

Explore folk songs of your region and try to sing along with your friends.

Have fun while you learn

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The separated grains get mixed with piles of husk.

Valli whispers to Malli, "Will the farmers handpick the grains to remove them from so much husk?" She wonders, "How much time will the farmers take to separate these?"

Let us perform an activity to find out the answer to the questions raised by Valli.

A small amount of puffed rice is mixed with chana dal. Can you think of separating the mixture by any method other than handpicking? ?

Activity 9.1: Let us explore

- Take a handful of roasted peanuts and rub them between your palms. What happens?
- Is it possible to separate the removed skin and the peanuts?
- Now, try blowing it. What do you observe?

Which of these components—removed peanut skins or peanuts are blown away?

You observe that blowing air separates the heavier and the lighter components.

How do you think farmers separate so many grains from husk?

Traditionally, a *soop* (bamboo tray) is used for separating heavier and lighter components of a mixture (Fig. 9.3).

Next day, their *Nana* takes them to the fields to show this process at work.

Fig. 9.3: Bamboo tray

Malli and Valli observe a farmer standing on a raised platform. The farmer is moving the bamboo tray which contains threshed wheat grains in the direction of air or wind (Fig. 9.4).

What do you **infer** from Fig. 9.4? Do both the components, wheat grains and husk, fall at the same place? Which of the two components get blown away? Can the wind separate the two components?

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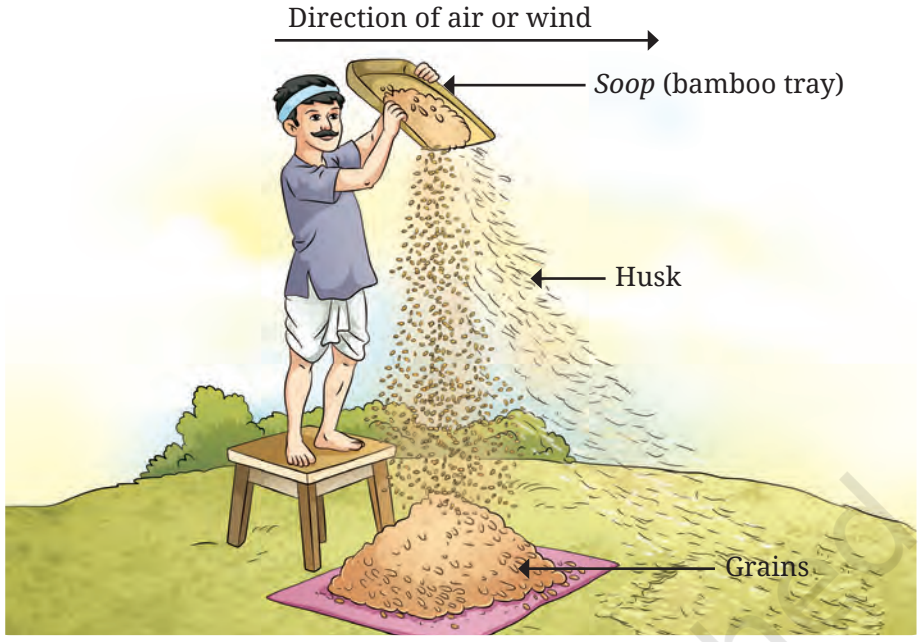

Fig. 9.4: Winnowing

Valli is unable to separate husk from rice in a closed room. How can you help her?

This method of separating heavier and lighter components of a mixture by wind or by blowing air is called **winnowing.** Have you seen any similar kind of activity being done at your home?

More to know!

Technological developments have resulted in developing of threshing machines called threshers. These machines are used for separating grains from the stalks and husk. They perform both the tasks of threshing and winnowing simultaneously.

Next day, Malli and Valli board a train to Ahmedabad to visit their father's friend Ghanshyam bhai. Before leaving, Valli requests her *Mami* to prepare *meethi puri* (sweet Indian bread made from wheat flour) for their journey.

Valli: Shall I help you knead the wheat flour?

Mami: To prepare a dish with flour, first we need to remove bran that may be present in the flour.

Valli: How do we do it?

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Mami: We use a sieve for this purpose.

Sieving allows the fine flour particles to pass through the holes of the sieve as shown in Fig. 9.5. The bigger particles such as bran and small stones remain on the sieve.

Fig. 9.5: Sieving

Carefully observe a sieve. Are all the holes of the sieve the same size? Will sieving work if the holes of the sieve are larger than the substances? Is there any difference in the size between the particles that pass through the sieve and the particles that remain on the sieve? Sieving is used when components of a solid–solid mixture have different sizes.

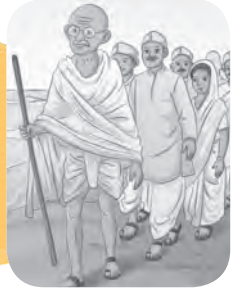
Upon reaching Ahmedabad, they visit Sabarmati Ashram along with Ghanshyam bhai where they learn about the *Namak Satyagrah* (Dandi March).

Have you ever observed sieves being used at construction sites to separate pebbles and stones from the sand?

More to do!

What is Sabarmati Ashram famous for?

Draw a poster showing Dandi March and discuss why it was organised.



Malli asks, "Where is *namak* (common salt) obtained from?"

"From seawater", replies Ghanshyam bhai.

Seawater is a mixture of salts and some other substances dissolved in water. To obtain salt, the seawater is kept in shallow pits and exposed to sunlight and air. In a few days, the water

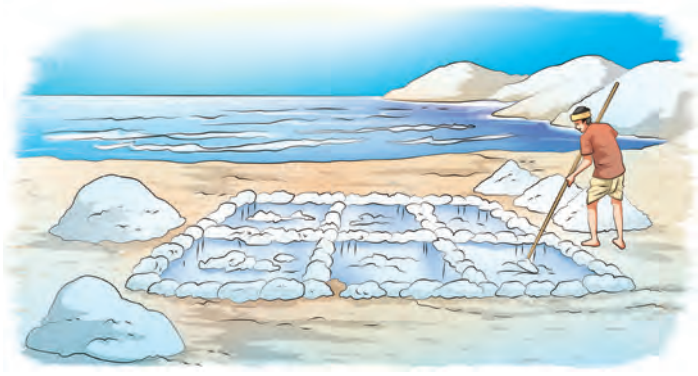


Fig. 9.6: Obtaining salt from seawater

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evaporates completely, leaving behind the solid mixture (Fig. 9.6). Common salt is then obtained from this mixture by further purification.

Find out about some water bodies in India that contain common salt. One such source is Sambhar Lake in Rajasthan.

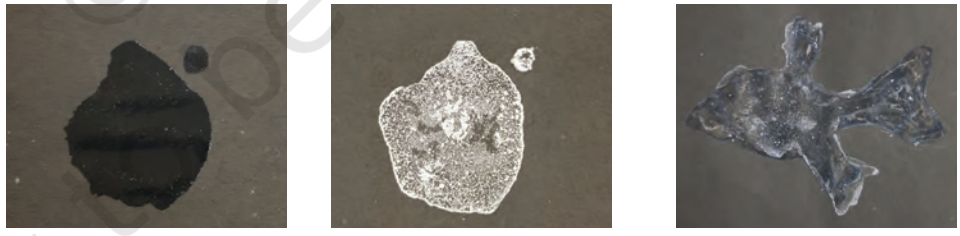
More to do!

Let us explore how salt can be separated from a salt solution.

Activity 9.2: Let us observe and create

Have you ever observed white patches on the dark coloured clothes you wear during hot summers? How are these patches formed?

- Take a bowl or any container and fill it half with water.
- Add 2–3 teaspoons of salt into it and stir till the salt dissolves to form a solution.
- Take a small piece of black or dark coloured thick paper and spread a few drops of the salt solution on it (Fig. 9.7a).
- You can also create any art of your choice with this salt solution.
- Allow it to dry and then observe it (Fig. 9.7b and Fig. 9.7c).



(a) Before drying *(b) After drying* *(c) Art created*

Fig. 9.7: A few drops of salt solution spread on thick black paper

Do you observe some patches on the paper? What do you think is left on the paper? You can feel the presence of salt by touching the paper. Where has the water disappeared? Recall the chapter 'A Journey through States of Water'.

Let us probe further to get the answer.

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In the traditional Indian system of holistic health and medicine called Ayurveda, the herbs or parts of plants are prescribed as remedies. These ingredients like roots, leaves, flowers or seeds of various medicinal plants are often dried in the shade. This practice facilitates the evaporation of excess water, leaving behind the important part of the medicine.

Do you know?

Activity 9.3: Let us investigate

This activity may be demonstrated by the teacher.

- Take some salt solution (prepared in Activity 9.2) in a china dish. If a china dish is not available, another suitable vessel may be used.
- Heat and let the water boil away as shown in Fig. 9.8.
- Allow the china dish to cool down.
- What do you observe? What is left in the china dish?

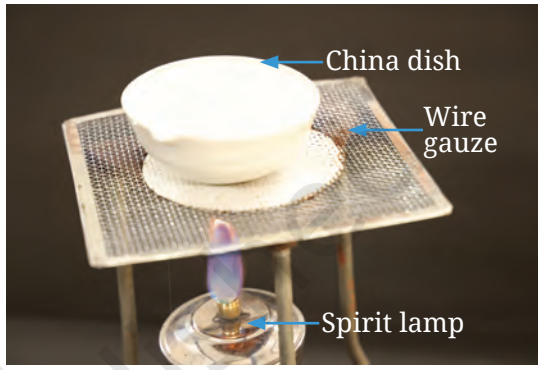
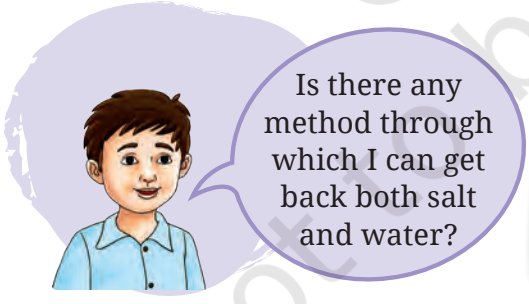
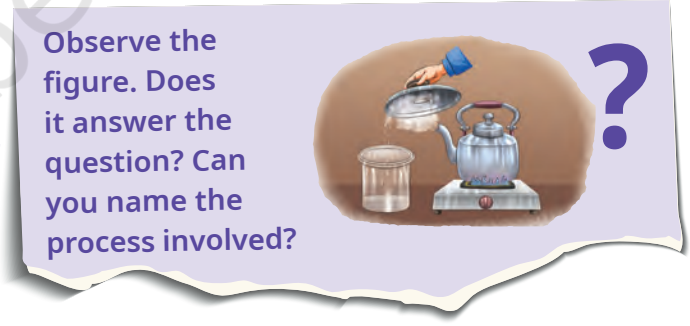


Fig. 9.8: Heating of china dish containing salt solution

Caution
Be careful while heating the china dish.

Did you get the salt back? You can feel the presence of salt in the china dish by touching the salt with your fingers.





It is now time for Malli and Valli to visit *Dada* and *Dadi* (paternal grandparents) residing in Puducherry, located in southern India. They are excited to meet their old neighbourhood friend, Balan. After reaching Puducherry, they start talking about the old times and do not realise that it is already evening, *Dadi's* tea time.

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Fig. 9.9: Decantation

Dada: I shall prepare tea for you.

Children: We will also help you.

As *Dada* makes the tea, he shares tips on how to make a cup of tea.

Balan: After preparing tea, how do you remove the tea leaves?

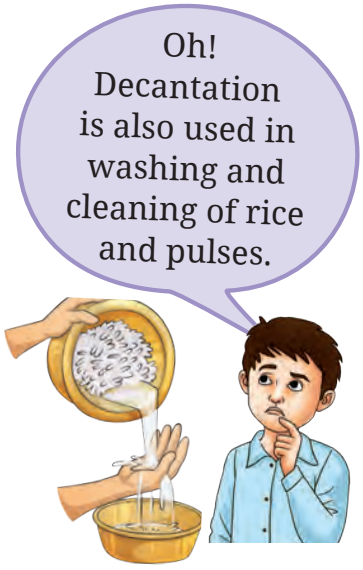
Dada: Obviously, with a strainer. You know if we do not have a strainer, we can still remove most of the tea leaves.

Valli: How?

Dada: Leave the sauce pan (vessel) containing tea undisturbed for some time and gently pour the tea in a cup (Fig. 9.9).

Valli: Oh Yes! And then the tea leaves will be settled at the bottom.

The process of settling down of heavier insoluble component at the bottom of a liquid is called **sedimentation**. When the water (liquid) is removed by tilting the vessel, the process is called **decantation**.



? In the chapter 'Materials Around Us', you have studied that oil does not mix with water and forms a separate layer when left undisturbed for some time. Which method of separation would you use to separate oil and water?

Dada: But I can still get a few tea leaves in my mouth because decantation does not completely separate all the tea leaves from the tea.

Balan: Oh! It means it is not a proper method of separation.

Dada: Yes, you are right. The tea is ready now.

Malli picks up the tea-strainer from the shelf and gives it to his *Dada*.

Dada: Let me pour the tea through this strainer. You can see all the tea leaves collected in the strainer.

This process of separating tea leaves from tea is called **filtration**.

Balan asks Malli if he could use a tea strainer to filter muddy water. Let us try and find out.

Dada: Also, try to filter the muddy water through a piece of cloth and observe the difference.

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Malli: Why should we use a piece of cloth?

Dada: In a piece of cloth, there are very small holes or pores between the woven threads. These pores in the cloth can be used as a filter. People in ancient times also followed this practice.

But if the water is still muddy, impurities can be separated using a filter with even smaller holes or pores. A filter paper is one such filter that has very fine pores in it.

Activity 9.4: Let us experiment

- Try to fold the filter paper yourself and make a cone as shown in Fig. 9.10.

A filter paper *One-fold* *Two-folds* *Cone*

Fig. 9.10: Folding a filter paper to form a cone

- Place it inside a funnel kept on a conical flask and pour muddy water into it (Fig. 9.11).

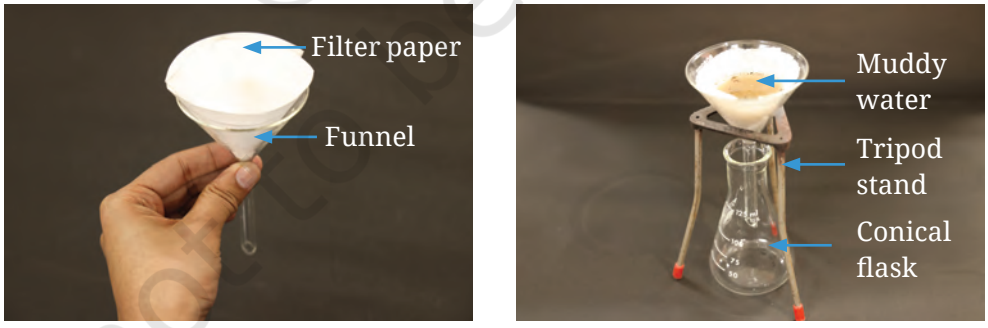

Fig. 9.11: Filtration

- What do you observe? Do the mud particles pass through the filter paper?
- The water coming from the funnel will be collected in the conical flask.

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- You will get mud as a residue on the filter paper and clear water as filtrate in the conical flask.

More to know!

Other than the filter paper, many materials such as cotton, charcoal, and sand can be used as filters. The choice of filter depends upon the size of the particles of the materials to be removed.

Activity 9.5: Let us design and create

Valli goes for a nature walk with her *Dadi* and collects some water from a pond in a container. She observes some unwanted substances in it. **Design** and **create** a working model of water filter using low-cost materials.

Do you know?

Tea bags were initially made of soft cloth, like silk, because it could hold the tea leaves and let water pass through. Silk was strong and did not fall apart when it touched hot water. Later, people started using gauze or muslin. Eventually they began using filter paper, which is what most tea bags are made of today.

Malli and Valli go on a boat ride in a nearby river with their *Dada* and his friend, Otukkam. Otukkam is a fisherman. As they cast the fishing net, water drains out through the mesh. Valli recalls the filtration method she had learnt and realises that this method of catching the fish is somewhat similar. Malli is taken aback when he sees plastic bags, broken bottles, a large fish with a straw stuck in its mouth, and food wrappers along with the other fish trapped in the net.

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Let us raise awareness about the issues related to river and ocean pollution by composing a poem.

A few lines have been written here, add more lines—

Piece of plastic in my neck,
As in pain I cry,
Koilas, Koilas...where are you dear?
Papa fish cries and Mama fish has tears.

Aware of the harm, yet they let it flow,
Koilas faintly hears mother's sorrow,

Stop plastic pollution at source,
Rivers are our huge resource.

Discuss with your parents

A bowl of milk in your home has gone sour. Discuss with your parents how you can use it in another way. Also, which method of separation will you use in the process?

Malli and Valli take blessings from their *Dada* and *Dadi*, bid goodbye to Balan and travel to Madhya Pradesh.

The train reaches Bhopal in Madhya Pradesh. The sun is rising and it is getting hot. On their way to *Maasi's* (maternal aunt's) home, they drink *chhach* (buttermilk) in the *dhaba* (roadside eatery). Malli asks the shopkeeper about the big painting, hanging on the wall of the *dhaba.* The shopkeeper explains that the picture shows a lady performing

Churning

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the process of **churning** curd using a big *mathni* (churner) to separate butter. In this process, the butter being lighter floats at the top, while the buttermilk is left behind.

Their stay at *Maasi's* place has become enjoyable and they are looking forward to share all their memories with their friends upon returning home. Now, it is time for them to reach their final destination of the trip, Shillong, the capital of Meghalaya.

On their arrival at their *Bua's* (paternal aunt's) house in Shillong, they notice a carpenter making a wooden door. While working, he accidentally drops a few iron nails in the sawdust.

Fig. 9.12: Magnetic separation

The carpenter starts handpicking the iron nails. The children tell the carpenter to wait. They get a magnet from their *Bua*. They ask the carpenter to move the magnet through the sawdust. All the nails get attracted to it (Fig. 9.12). Which method of separation did the carpenter use? Recall the chapter 'Exploring Magnets'.

The substances which are attracted towards a magnet are called magnetic substances. Iron is a common example

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of a magnetic substance. Separation of magnetic and non-magnetic substances by using a magnet is called **magnetic separation.**

More to know!

Nowadays, recyclers use magnets to separate iron articles from a heap of waste.

In many industries, the waste material often contains scrap iron. This is separated from the heap of waste materials using magnets fitted to a crane.

The scrap iron can be recycled and reused.

Magnetic separation

Malli and Valli had delightful holidays and the '*Bharat ki Yatra*' (tour of India) filled with fun will be an ever lasting memory for them.

They not only enjoyed exploring different regions of India but also gained a lot of knowledge about various methods of separation of substances.

Activity 9.6: Let us play

Write the following phrases on small slips of paper—

1. Separating small stones from pulses.
2. Churning curd to obtain butter.
3. Taking out green chillies from cooked *dalia* (dish made of broken wheat) or *poha* (dish made of flattened rice).
4. Taking out seeds from watermelon.
5. Sorting piles of sawdust and iron nails from a mixed heap of building material.
6. Picking marigold flowers from a heap of other flowers to make a garland.
7. Separating pebbles from sand.
8. Separating coconut pieces from rice flour.
9. Separating oil from water.
10. Separating salt from salt solution.

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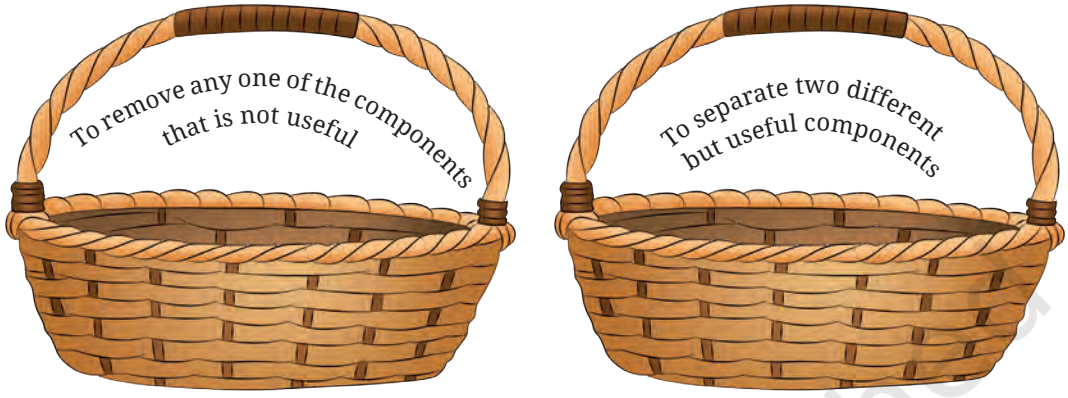
Now, take two baskets, each representing one of the two purposes for which we separate substances. Form two teams and see who will get the maximum correct entries.

Think and start



This activity helps in assessing your understanding as to why we separate substances.

Keywords

Churning
Decantation
Evaporation
Filtration
Handpicking
Magnetic separation
Mixture
Sedimentation
Sieving
Threshing
Winnowing
Create
Design
Experiment
Explore
Infer
Investigate
Observe

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Summary

Key Points

- Handpicking is used for separating solid materials on the basis of differences in size, colour and shape from a mixture.
- The process in which the stalks are beaten to separate grains from them is called threshing.
- The method of separating lighter husk from heavier grains by wind or blowing air is called winnowing.
- The process of separating solids from a mixture based on variations in particle size using a sieve is called sieving.
- Evaporation is the process in which a liquid gets converted into its vapour. It can be used to separate a solid dissolved in a liquid.
- The process of settling down of heavier insoluble component at the bottom of a liquid is called sedimentation. When the liquid is removed by tilting the vessel, the process is called decantation.
- Filtration can be used to separate insoluble solid components from a liquid.
- Churning is used to extract butter from curd.
- Separation of magnetic and non-magnetic substances by using a magnet is called magnetic separation.

Play a Game—WISE FISH

Prepare your own fishing rod with locally available eco-friendly materials. Tie a thread to one end of the rod and a magnet to the free end of the thread. The Tank 1 has red cardboard fish and Tank 2 has blue cardboard slips attached to iron clips. Fish out a red fish representing the method of separation first and then fish out one blue slip related to the red one.

Watch out for your friends. Are they fishing out correctly?

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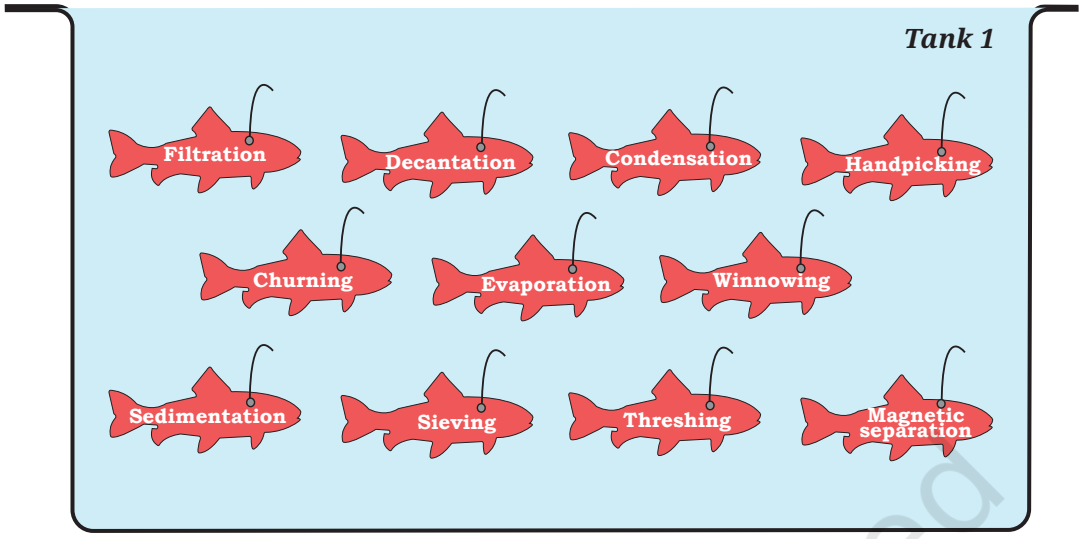
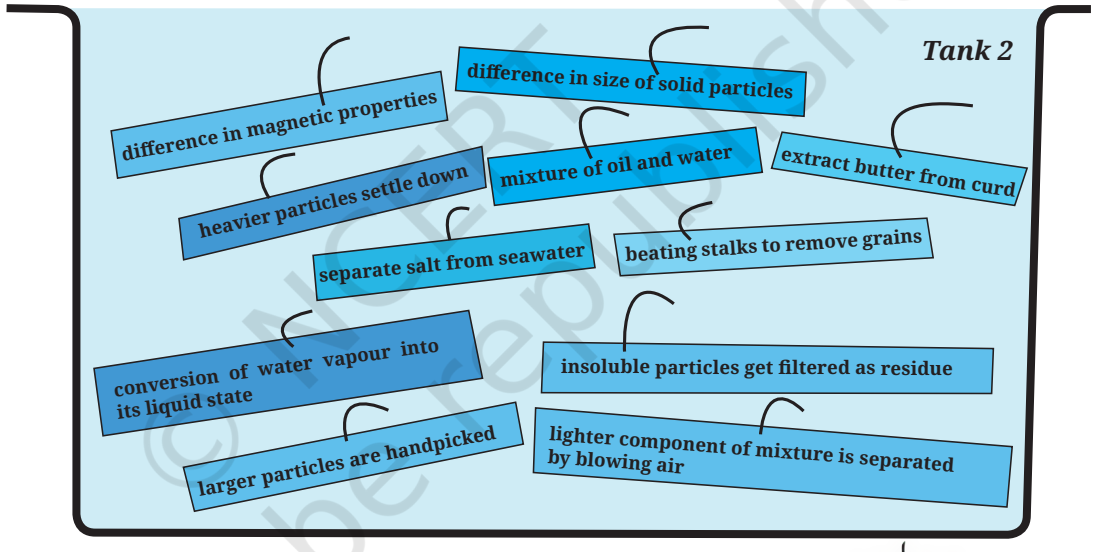
Catch me first!



Then me!



Let us enhance our learning

1. What purpose does handpicking serve in the process of separation?

   (i) Filtration (ii) Sorting
   (iii) Evaporation (iv) Decantation

2. Which of the following substances are commonly separated using the churning method?

   (i) Oil from water (ii) Sand from water
   (iii) Cream from milk (iv) Oxygen from air

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3. Which factor is usually essential for the filtration?

(i) Apparatus size (ii) Presence of air

(iii) Pore size (iv) Temperature of the mixture

4. State with reason(s) whether the following statements are True [T] or False [F]. Also, correct the False statement(s).

(i) Salt can be separated from salt solution by keeping it under the Sun. [ ]

(ii) Handpicking should be used only when the quantity of one component is less. [ ]

(iii) A mixture of puffed rice and rice grains can be separated by threshing. [ ]

(iv) A mixture of mustard oil and lemon water can be separated by decantation. [ ]

(v) Sieving is used to separate a mixture of rice flour and water. [ ]

5. Match the mixtures in Column I with their method of separation in Column II.

Column I	Column II
(i) Gram flour mixed with black gram	(a) Handpicking
(ii) Chalk powder mixed with water	(b) Magnetic separation
(iii) Corn mixed with potatoes	(c) Decantation
(iv) Iron powder mixed with sawdust	(d) Sieving
(v) Oil mixed with water	(e) Filtration

6. In what situations would you use decantation instead of filtration to separate solids from liquids?

7. Can you relate the presence of nasal hair to any separation process?

8. During the COVID-19 pandemic, all of us wore masks. Generally, what material are they made of? What is the role of these masks?

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9. A mixture containing potatoes, salt and sawdust has been given to you. Outline a stepwise procedure for separating each component from this mixture.

10. Read the following story titled 'Intelligent Leela' and tick the most appropriate options. Provide a suitable title of your choice for the paragraph.

Leela was working in the farm with her father when she realised that they left their drinking water at home. Before her father felt **thirsty/hungry**, she went to the nearby pond to fetch some **water/grains**. After obtaining some water in the container, she noticed that the water was muddy and **fit/unfit** for drinking. To purify the water, she kept it for some time and then she **filtered/churned** the muddy water using a piece of **paper/muslin cloth**. Leela, then, **cooled/boiled** the water for about 10 minutes in a covered pan. After **cooling/boiling**, she **filtered/churned** it again and made it **fit/unfit** for drinking. She served this water to her father while having food, who blessed her and appreciated her efforts.

Learning further

- **Fun with parents:** We are proud of our Indian heritage. Under supervision of your elders, try to prepare some herbal remedies using various parts of plants. For example—*tulsi kadha*. Which methods of separation will you use while preparing herbal *kadha*?
- **Stage play:** Imagine you and your friend are Malli and Valli. Write dialogues of a play presenting their entire *'Bharat ki Yatra'*, highlighting the different methods of separation of substances that they observed. Enact the play in your school assembly.
- **Group activity:** Observe and list separation methods you employed and noticed in your surroundings throughout a week. Explain the reasons behind using these methods and compile the ones you utilised or observed the most. Compare your observations with your group members.
- **Be a stalwart of your community:** Interview a ragpicker(s) and prepare a case study about the method(s) of separation he/she uses in his/her daily life. Encourage children of your community below the age of 14 to join a neighbourhood school.

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- **Be a reporter**: (i) Gather newspaper clippings and articles related to various methods of separation implemented in your society, such as in agricultural fields or at construction sites. (ii) Conduct interviews with local farmers to explore the latest agricultural separation methods that they use.

- **Think like a scientist:** You are provided with a mixture of iron nails, sand, black pepper, stones, common salt and water. Which steps will you follow to separate each component of a mixture?

The given steps may help you to think like a scientist.

Reflection Steps

I observe _____. I wonder _____ .

You might have wondered about questions such as—

- Which component should I separate first?
- What method of separation should I use first?
- How can we separate these components effectively?
- Will some of the components be soluble in water?
- What properties of the components can help us in their separation?
- What is the most appropriate sequence?

Activity Steps

- Some possible answers to the questions which occurred in my mind are _____

_____ .

- I performed the following methods of separation—

_____

- My findings are _____ .

Hint: A mixture that has more than two components requires a combination of several methods of separation.

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Notes

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Chapter

10 Living Creatures: Exploring their Characteristics

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Avadhi and Aayush go for a morning walk with their parents. Avadhi notices some shells and tries to pick them up. Her mother advises her not to do so and explains that the shell could be home to a living snail and is actually a part of its body. Avadhi and Aayush wonder how the shell that is not even moving could have a living being inside! Later that day in school, Avadhi and Aayush share this incident with their friends. They approach the teacher to understand how a shell which is not even moving could be a body part of a living snail. The teacher initiates a discussion in the class on living and non-living.

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Activity 10.1: Let us record

We are surrounded by numerous things. Just look around in your classroom and you may find many examples—the pencil that you are holding, the book that you are reading or the pigeon near the window.

- List them in Table 10.1 and **identify** each of them as living or non-living on the basis of your understanding in column II.
- Write a reason for grouping them as living or non living in column III.

Table 10.1: Living beings and non-living things in our surroundings

(I) Name	(II) My guess (Living/ Non-living)	(III) Reason/ Remarks	(IV) Correct answer	(V) Reason/ Remarks for the correct answer
Pencil	Non-living			
Book				
Pigeon	Living			
Car				
Plant				
Any other				

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10.1 What Sets the Living Apart from the Non-living?

Look at Table 10.1. Why do you think a pencil is non-living but a pigeon is living? What do you think are the differences between living beings and non-living things according to you? What similarities do the identified living beings share with each other?

You may have identified movement as one of the similarities among living beings. You have also seen cars moving on a road. Does it mean that a car is living? List the

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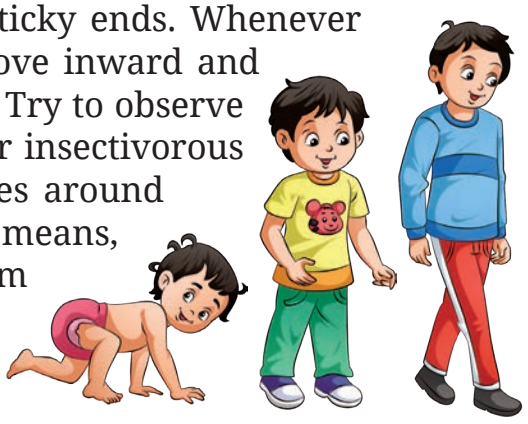
tasks that you can do but a car cannot. You are a wonderful example of a living being. Whenever you attempt to group things around you as living or non-living, you can compare them with yourself. Which characteristics help you in differentiating yourself from a car? For instance, a car does not grow. Does it mean it is non-living? Now, which characteristics have you used to classify a car as non-living? Continue your discussion in a similar way to identify the essential characteristics of living beings.

What are some common characteristics that make living beings very different from the non-living things? Let us learn about them.

Can we consider **movement** as one of the characteristics to differentiate between the living and the non-living? List five things around you that can move on their own. Do you think that all five things that you have listed can be considered as living just because they can move on their own? However, unlike animals, plants do not move from one place to another. Do you consider them as living?

Drosera

Even though plants do not move from one place to another, they do show certain types of movements. Opening of flowers is one of the examples of movement in plants. Another example of movement in plants is seen in insectivorous plants. Insectivorous plants are dependent on insects for their nutrition. Drosera is one of the examples of an insectivorous plant. Drosera is featured with saucer-shaped leaves having many hair-like projections of unequal length with sticky ends. Whenever an insect enters the saucer, hairs move inward and trap the insect with their sticky ends. Try to observe the mechanism of movement in other insectivorous plants. Climbers also wind themselves around any object placed close to them. That means, even though plants do not move from one place to another, they do show some movements.



Growth of a child

Compare yourself with the picture of your childhood. Can you

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wear the dress that you used to wear four years ago? No, because you have become larger in size. This is due to **growth** in your body. Plants and other living beings also grow. Can we consider growth as a characteristic of living beings?

Living beings need food (**nutrition**) for their growth and development. List five living beings that require food to grow.

Now, think of a process without which we cannot live. Count the number of breaths you take per minute after a normal walk, after a run, and after a few dance steps. Record the data and observe. Do you notice any difference in the number of breaths after each situation? Do you notice the process of breathing in other animals like dogs, cats, cows and buffaloes? Notice the movement of their abdomen while they are taking rest.

In the process of breathing, when we inhale, the air moves from outside to inside our body. When we breathe out, the air moves from inside our body to outside. Breathing is part of a process called **respiration**. Do plants also respire? There are tiny pores called stomata on the surface of leaves. These pores help plants in taking air in and out. Interact with senior class students in your school and request if they can demonstrate stomata using a microscope in your class. All living beings respire.

Have you noticed white patches forming on shirts around the armpits during summers? These patches are formed due to sweat. The sweat consists of water and salts removed by the body as waste products. Removal of waste products from the body is called **excretion**. Urine is also formed as a product of excretion in animals. Do you know that plants also excrete? You may notice plants excrete excess water and minerals in the form of small droplets on leaves. For example, grasses and roses. All living beings excrete.

Water droplets on grass

Let us look at another characteristic. What is your reaction if you unexpectedly step on a sharp object, such as a thorn,

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while walking without shoes, or you accidentally touch a hot cup of tea? Stepping on a thorn and touching a hot object are stimuli. Any thing or any event that prompts living beings to respond is called a **stimulus**. List three stimuli (plural of stimulus) and your body's instant **response** to them.

Touch-me-not (chhui-mui) plant

Do plants also respond to stimuli? Yes, plants also respond to stimuli. For example, touch-me-not (mimosa, *chhui-mui, lajjalu)* plants fold their leaves when we touch them. Have you also observed that certain plants fold their leaves after sunset? Specifically, the leaves of certain plants facing each other tend to come together. This can be observed in the sleeping leaves of *amla* (Indian gooseberry) tree. All living beings **respond to stimuli**. Find a few more plants in your neighbourhood which fold their leaves after sunset.

Why do the leaves of *chhui-mui* and *amla* plants respond in this way? Which stimulus could be responsible for their behaviour?

Have you seen young ones of cats, dogs or other animals? List young ones of five different animals. Have you seen young ones of any non-living things such as a pencil, a chair or an electric bulb?

All living beings reproduce. **Reproduction** is the process of producing new ones of one's own kind. Why is reproduction necessary? It is necessary for the continuity of life.

When a living being is not able to exhibit all of the above mentioned characteristics, despite the availability of all resources (like food, air and water) needed for being alive, it is said to be **dead**.

From the above discussion, we can understand that all **living** beings share some common characteristics. For example, all living beings show movement, they need

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food, and they grow. They also respire, reproduce, excrete, respond to stimuli, and eventually, die. Absence of any of these features indicates that they are **non-living** things.

Now that you know how to identify a living being, fill up the remaining two columns (IV and V) of Table 10.1 and complete the activity.

In which category would you place a seed—living or non-living? Why?

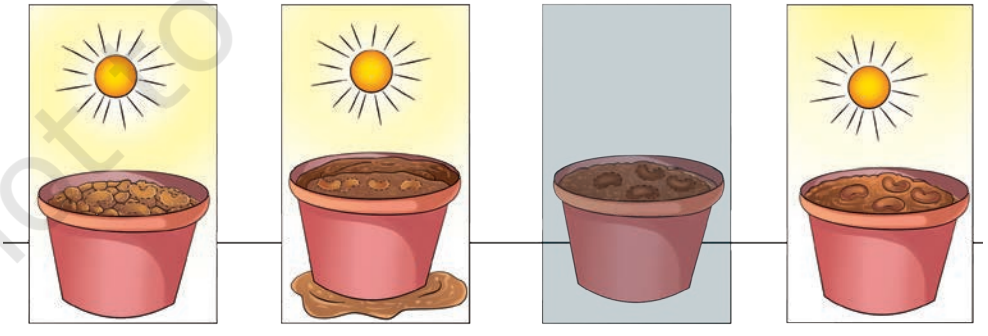
Let us **explore** how a seed germinates to observe some of these essential characteristics in plants.

10.2 Essential Conditions for Germination of a Seed

Have you observed a seed germinating? You might have wondered what conditions are required for **germination** of a seed. What conditions do you think are required for seed germination? How will you investigate whether these conditions have an effect on the germination of a seed?
Let us find out by performing Activity 10.2.

Activity 10.2: Let us experiment

- Take four identical pots filled with garden soil. Sow four bean seeds in each pot. Now, keep these pots in the following conditions for 15 days.
  - Pot A: Do not water the soil. Place this pot in direct sunlight.



(a) Pot A kept in direct sunlight, no water | *(b) Pot B kept in direct sunlight, excess water* | *(c) Pot C with moist soil, kept in the dark* | *(d) Pot D with moist soil, kept in direct sunlight*

Fig 10.1: Bean seeds exposed to different conditions

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- Pot B: Add excess water to the soil such that water is always present above the soil. Keep adding water on a regular basis if water reduces. Place this pot in direct sunlight.
- Pot C: Keep the soil in this pot slightly moist by adding a moderate amount of water on a regular basis. Place this pot in a dark location.
- Pot D: Maintain the soil in this pot slightly moist by adding a moderate amount of water on a regular basis. Place this pot in direct sunlight.

- Indicate the availability of air, sunlight and water for the seeds in each of these cases in Table 10.2.
- When a seed turns into a sprout, it is said to have germinated. Predict whether the seeds in each pot will germinate. Record your **predictions** for each pot kept under different conditions in Table 10.2.

Table 10.2: Effect of certain conditions on seed germination

Pot with bean seeds	Availability of			Seed germination		Possible reason for the observation
	Air	Sunlight	Water	Prediction	Observation	
A: In direct sunlight and without water			No			
B: In direct sunlight and excess water						
C: In complete dark and moist soil						
D: In direct sunlight and moist soil						

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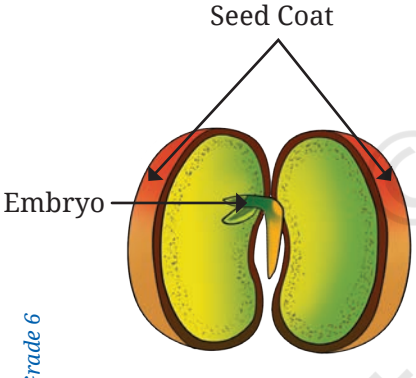
- Regularly observe the pots for 7–10 days to check the status of germination of the seeds. Record your **observations** in Table 10.2.
- Compare your predictions with your observations.

Do you think sunlight is necessary for germination of seeds? Do the seeds in all the pots receive air, water and sunlight? Is there any pot in which air is not available to the seeds? If so, why is it not available? What happens to the seeds in the pot where water is provided in excess? Which seeds receive both air and water? Identify the pots where you can notice the germination of seeds.

Do your observations match with your predictions? Write possible reasons in favour of your observations in Table 10.2. Based on your observations, state the conditions which favour seed germination.

Which of the following are essential for seed germination– air, water and sunlight? Compare the available conditions in each pot. Germination of bean seeds requires the right amount of water and air. Why do seeds require these conditions for germination? Do you think that the absence of one or more of these conditions will affect seed germination?



Germinated bean seed

Let us understand how these conditions help in seed germination. The effects of the following conditions have been seen in Activity 10.2.

Water: Seeds require water for germination. Water enables the seeds to carry out the processes necessary for their growth. The outer covering of the seed is called seed coat. Water softens the seed coat and helps the tiny embryo inside it to develop into a plant.

Air and Soil: Seeds need air for germination. They use the air available in the spaces between soil particles. Moreover, spaces between the soil particles allow roots to grow easily.

Light and/or dark conditions: We have learnt that for the bean seeds, presence of light is not essential for their germination. In general, most seeds do not require light for germination. But after germination, sunlight is required for further growth of the seedling.

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Do you know?

Some seeds of flowering plants, like Coleus and Petunia, require light to germinate. Covering these seeds with soil inhibits their sprouting. Seeds of flowering plants, like Calendula and Zinnia, need darkness to germinate. These seeds should be covered with sufficient soil.

In the Chapter 'Mindful Eating: A Path to a Healthy Body', you have learnt that human beings need a balanced diet for good health and proper growth. Similarly, plants too need favourable conditions and nutrients for their proper growth and development. What other conditions do you think would affect seed germination?

In Activity 10.1, what are the characteristics of living beings which made you place plants in living beings? Do plants show growth in Activity 10.2? Are there any other characteristics of living beings that these plants show?

How would you now categorise a seed, as living or non-living?

Let us study another characteristic that can be seen clearly in plants—growth and movement.

10.3 Growth and Movement in Plants

How do plants respond to sunlight? Does sunlight affect the direction of growth of different parts of plants? In which direction would the root and shoot of a plant grow and move if the plant is placed inverted? How would you **design** an activity to find answers to these questions?

Activity 10.3: Let us design

- Take some bean or gram seeds and allow them to germinate on a moist cloth or a moist tissue paper.
- Let them germinate until each of them develop into a seedling having a small root and a small shoot.
- Now, take three glass beakers or tumblers, and label them as A, B and C.

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- Take three glass plates and attach a thick blotting paper to one side of each plate using a thick soft cotton thread.
- Fix one seedling on each plate using a thick soft cotton thread, as shown in Fig. 10.2, ensuring that the plant is not damaged.
- Now, place one glass plate upright with a seedling attached into each of the beaker A and beaker C, as shown in Fig. 10.2a and Fig. 10.2c.
- In beaker B, arrange the plate such that the shoot of a seedling is directed downwards and the root is directed upwards, as shown in Fig. 10.2b.

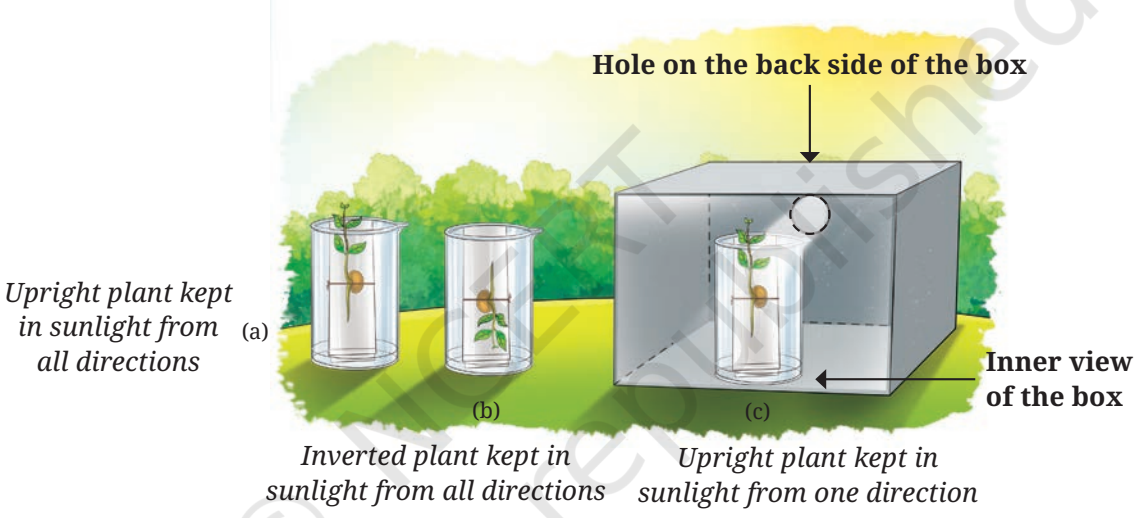

Fig. 10.2: Set-up showing plants kept in different conditions

- Pour water into all the three beakers to ensure that the seedling in each beaker remains above the water level.
- In each case, let the bottom of the blotting paper get completely wet by soaking in the water. In this way, the seedling will get the moisture from the wet blotting paper.
- Place beaker A and beaker B in sunlight as shown in Fig. 10.2a and Fig. 10.2b.
- Position beaker C as shown in Fig. 10.2c. Place a cardboard box in such a way that the seedling gets light from one direction only through a small circular hole.
- Fill Table 10.3 with your predictions and observations.

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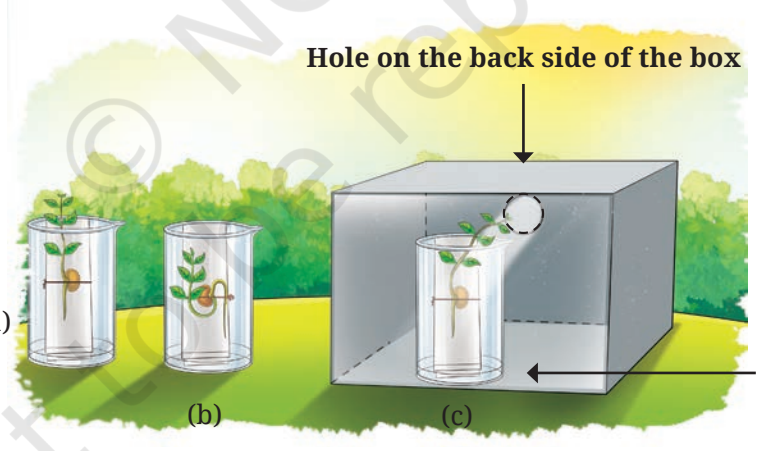
Table 10.3: Growth of root and shoot under different conditions

Beakers	Direction of sunlight	Direction of plant	Direction of growth of root and shoot		
			Shoot/ Root	Predictions	Observations
A	All directions	Upright	Shoot		
			Root		
B	All directions	Inverted	Shoot		
			Root		
C	Only from one direction	Upright	Shoot		
			Root		

What is the direction of growth of root and shoot in beakers A, B and C based on your observations? Do your predictions match your observations? What do you **conclude** from this activity?



Upright plant kept in sunlight from all directions

Inverted plant kept in sunlight from all directions

Upright plant kept in sunlight from one direction

Fig. 10.3: Direction of growth of root and shoot under different conditions

From the results of this **experiment** (Table 10.3 and Fig. 10.3), we note that—

1. When the plant is kept upright, the root grows downwards and the shoot grows upwards.

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2. When the plant is kept inverted, the root bends and grows downwards. Also, the shoot bends and grows upwards.
3. When the plant gets sunlight only from one direction, the shoot grows in the direction of light while the root continues to grow downwards.

After conducting Activity 10.3, we can conclude that shoots of plants grow upward and exhibit movement towards sunlight but roots of plants grow downwards.

Know a scientist

Jagadish Chandra Bose (1858–1937) was an Indian scientist who did some fascinating experiments with plants. He built a machine called a crescograph to record how plants respond to stimuli like light, heat, electricity and gravity. With this machine, he could measure how fast plants grow. He also showed that plants can sense and respond to stimuli.

10.4 Life Cycle of a Plant

We have learnt about conditions required for germination and how plants grow and exhibit movement. Let us now explore the changes a plant undergoes in its whole life.

Activity 10.4: Let us explore

- Plant a bean seed and provide suitable conditions for its growth. Observe regularly for three months.
- Record your observations in Table 10.4 as and when changes become visible.
- Note the date when any change is observed. Record answers for the following questions—
  - How long does it take for any change to occur? Make sketches of various changes that you observe in Table 10.4.
  - After how many days does the first flower appear?

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- After some parts of the flower have dried, can you see any further growth?
- Which structure do the remaining parts of flower develop into?
- Can you notice a pod or a fruit with seeds develop from a flower?
- What happens to the plant after the fruits containing seeds are formed?

Table 10.4: Changes observed during the growth of the plant

Date	Observations	Sketches
	Seeds are sown	

Go through the observations you recorded regarding the growth of the bean plant in Table 10.4. What changes do you observe after the fruits are formed? Does the plant become yellow and dry even when you continue watering it? Sow the seeds obtained from your bean plant. Watch how the seeds give rise to a new generation of bean plants. Compare the sketches that you have drawn in Table 10.4 with Fig. 10.4.

A seed grows into a young plant and matures to produce flowers and fruit. The fruit, in this case a pod, contains seeds which give rise to a new generation of bean plants. The entire process from a seed to a plant, and then, to the next generation of seeds is called the **life cycle** of a plant (Fig. 10.4). When a plant stops growing and all activities of life gradually come to an end, even after the availability of all the necessary conditions, the plant is considered dead.

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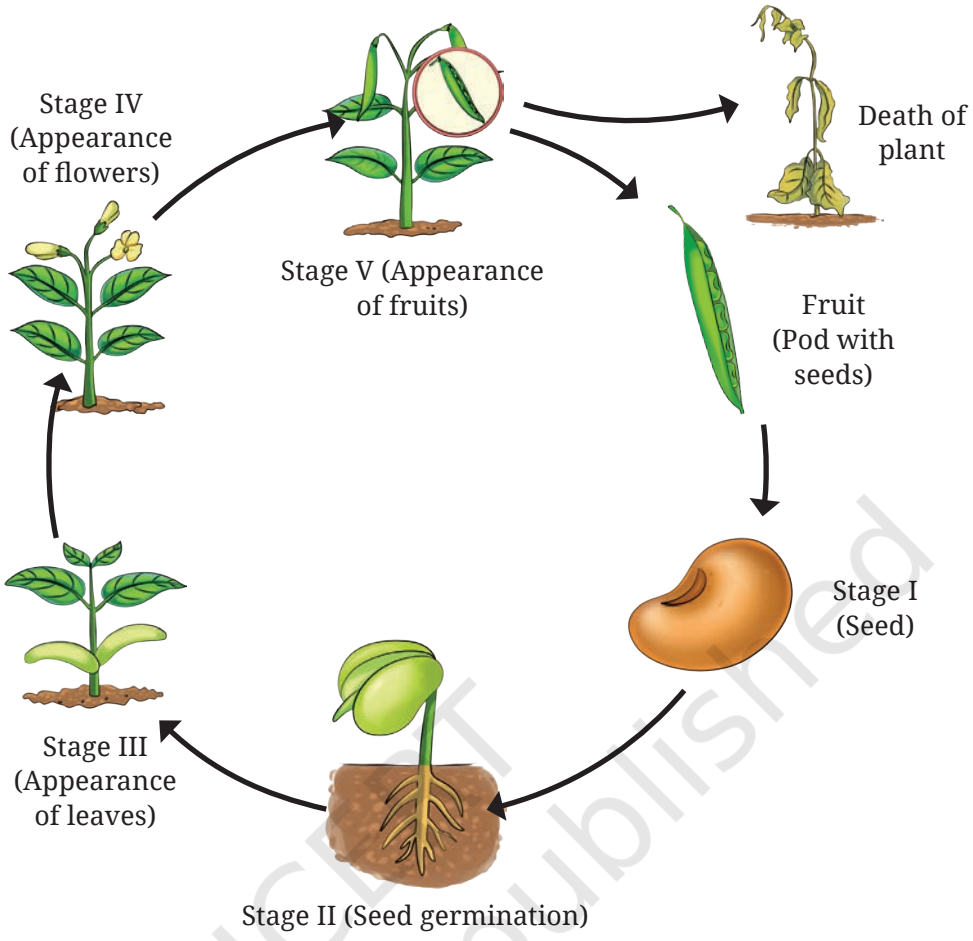

Fig. 10.4: Life cycle of a bean plant

10.5 Life Cycle of Animals

We have learnt about the life cycle of a plant. We have seen that a plant goes through many changes in its life cycle. Have you ever observed how animals grow over time? Draw sketches of their young ones and name them.

10.5.1 Life cycle of a mosquito

Mosquitoes buzzing around is a common experience for all of us. Female mosquitoes are bloodsucking insects that transmit several diseases like malaria, dengue and chikungunya. You might have learnt from newspapers, school noticeboards or awareness campaigns that mosquito breeding should be prevented. We are advised not to allow water to stagnate anywhere in our surroundings. Why is it so? Does stagnant water have any relation with mosquitoes laying eggs?

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Conduct a safety audit in your school, or at your home and surroundings to check for stagnant water (if available, carry a hand lens to observe any small creatures). Some common places where stagnant water is likely to gather are desert coolers, planted pots and any open container. You may find two different types of worm-like creatures (Fig. 10.5). They are **larva** and **pupa**, two distinct life stages during the development of mosquito. In case you observe larvae and pupae, report to your teacher. Discuss with the teacher and classmates about the necessary measures one can take to prevent breeding of mosquitoes. What differences do you observe in the shape of larvae and pupae?

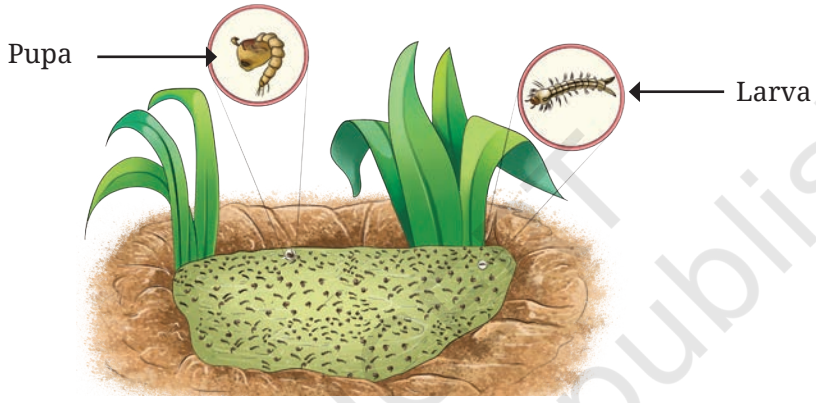

Fig. 10.5: Larvae and pupae of mosquitoes in a stagnant water body

Mosquito larvae and pupae observed in water bodies repeatedly come to the water surface. What can be the reason for this? Mosquito larvae and pupae live in water and require air to respire. They move to the surface of the water for air.

How can the life cycle of a mosquito be disrupted?

I have seen my mother spraying kerosene oil on stagnant water. Why does she do so?

Kerosene oil forms a thin layer over the water surface. This layer separates water from air, and does not allow larvae and pupae to inhale air. As a result, they die.

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Activity 10.5: Let us analyse

Let us solve an interesting puzzle.

How will you decide which stage (larva or pupa) comes immediately after the egg stage?

Suppose you are given a container with water from a puddle containing larvae and pupae. Design an activity to find out the correct sequence of these stages.

You can take help of the following activity designed by Avadhi to **create** your own activity—

Step 1: I have a water container with mosquito larvae and pupae.

Step 2: I will separate 4–5 larvae and pupae into two separate containers with the same water.

Step 3: I will observe them every day until I see them changing to the next stage.

Step 4: If the larvae change into pupae, it would mean that the larval stage comes before the pupal stage or vice-versa.

Step 5: I will keep watching both the containers to see in which one a mosquito appears first.

These observations will help us to learn the correct sequence of growth.

Now, suppose you are given a container filled with water from a puddle which contains larvae and pupae. Without separating them from the container, how would you design an activity to decide which stage, out of the two, gives way to the next?

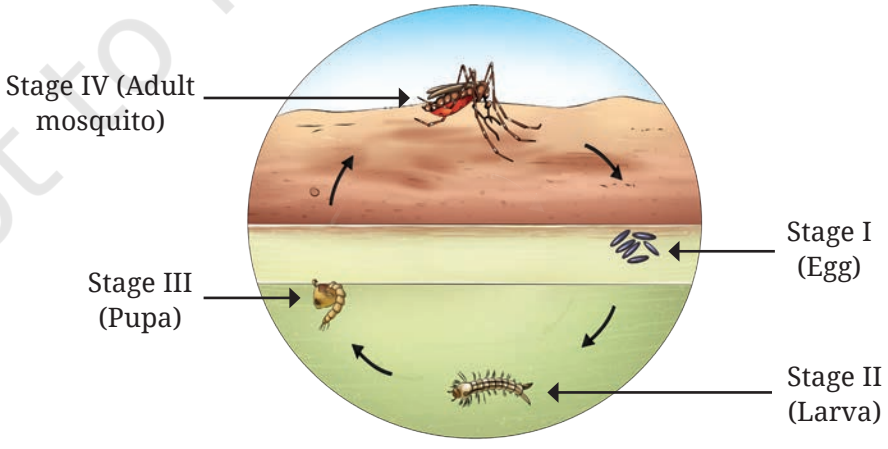

Fig. 10.6: Life cycle of a mosquito

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Let us learn more about these stages in the life cycle of a mosquito.

Mosquitoes pass through four stages in their life cycle—egg, larva, pupa and adult (Fig. 10.6).

The adult mosquito that emerges from the pupa rests briefly on the surface of water and then flies away. The adult mosquito may survive for 10 to 15 days.

We have seen that a mosquito begins its life as an egg (stage I), the egg develops into a larva (stage II), the larva grows into pupa (stage III), and the pupa transforms into an adult mosquito (stage IV). The adult female mosquito lays eggs directly on or near water, and the cycle continues.

Significant changes occur in the appearance, body shape and structure during the various stages in the life cycle of a mosquito. The shape of the egg is quite different from the larva; the larva appears very different from the pupa. The pupa appears very distinct from the adult mosquito. Is it easy to imagine that a mosquito emerges from a pupa?

Do you know?

The silk moth also passes through four life stages—egg, larva, pupa and adult. Eggs hatch into larvae, which then grow in size. Larvae secrete thread-like material which they wrap around themselves, before changing to pupae. These are the fibres that are used to make silk fabric. In India, the Khadi and Village Industries Commission (KVIC) has set up several centres for silk production.

10.5.2 Life cycle of a frog

Activity 10.6: Let us analyse

Avadhi and Aayush are dressed up in full sleeves shirts and full pants today. It has been raining intermittently for a week. They are going out with their classmates for an activity. After a brief walk led by their science teacher, they reach a shallow pond. It is surrounded by trees and tall grasses. The teacher cautions them to watch everything from a distance

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without causing any disturbance. You may also go to a small water body during the rainy season with a facilitator and explore it by taking due safety precautions.

You may notice a white jelly-like substance on the surface of water towards the edge of the pond (Fig. 10.7). This may also be attached to plants growing in or around the water. This jelly-like substance is actually a cluster of eggs of a frog and is known as **spawn**.

Observe the features of all the stages of a frog shown in Fig. 10.7. How will you decide the sequence of the given stages (A, B, C, D, E, F)? Some of the stages show distinct changes in their initial and final shapes. Record these changes in Table 10.5.

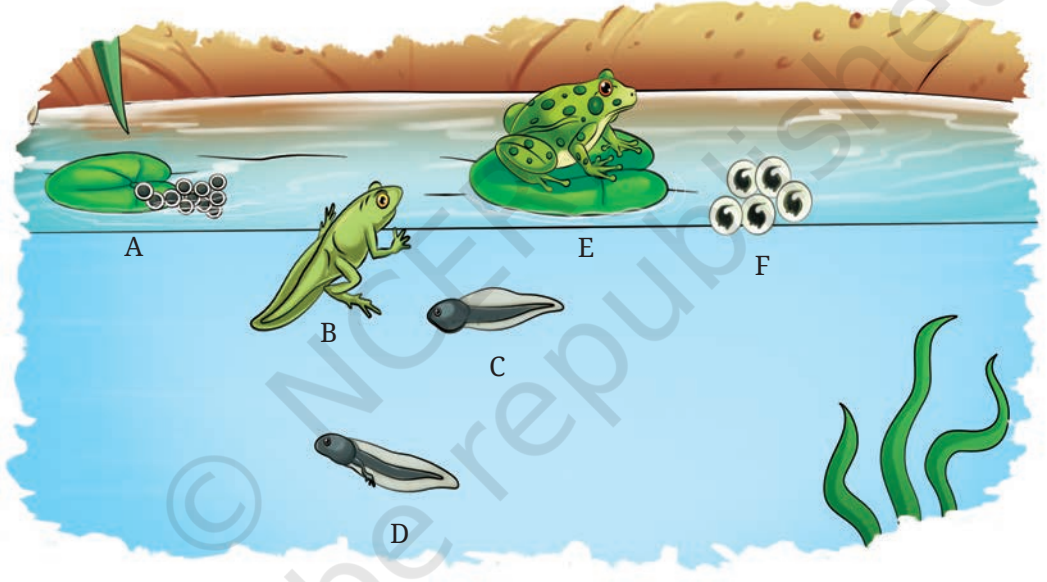

Fig 10.7: Different stages of a frog in a pond

Based on the observations listed in Table 10.5, draw the life cycle of a frog. Compare the figure drawn by you with Fig. 10.8.

Table 10.5: Changes in different life stages of a frog

A	B	C	D	E	F
			It is similar to 'C' but it has two legs.		

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Some of the stages have been clubbed together, for example, stages A and F in Fig. 10.7 have been kept under stage I. You will find four stages in the life cycle of a frog—the egg stage, which progresses to the embryo stage; the **tadpole** stage, consisting of an early stage with a tail and no legs, and a late stage with hind legs; the **froglet** stage, and the adult frog stage (Fig. 10.8).

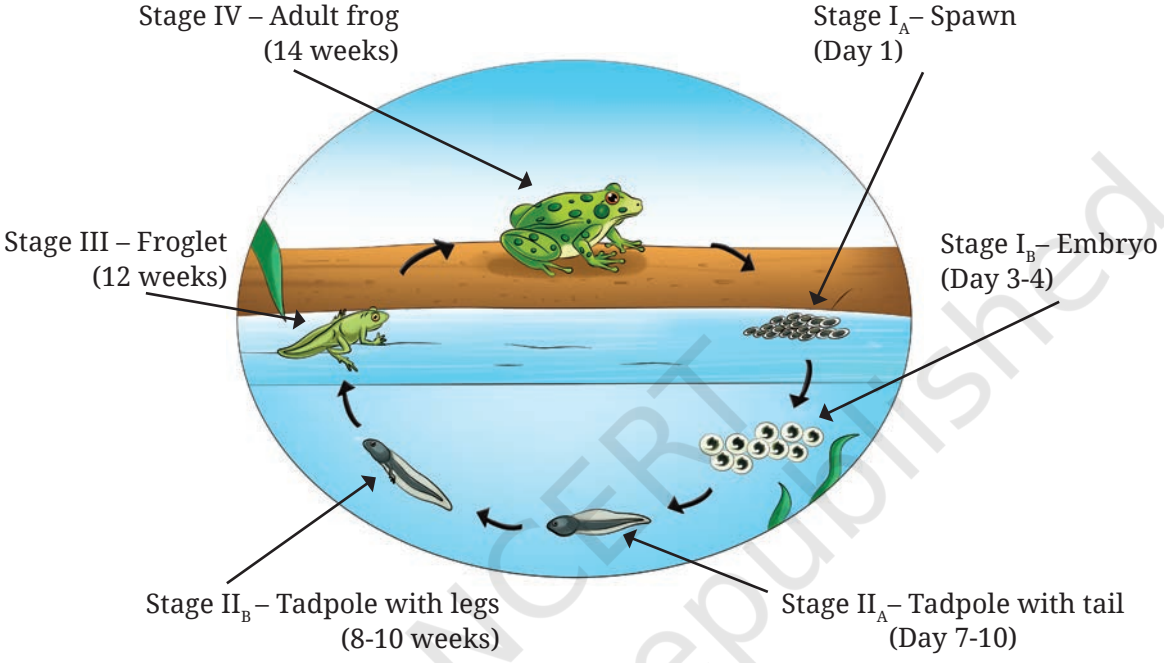

Fig. 10.8: Life cycle of a frog

Discuss in the class along the following points:

- How are these eggs of a frog different from the other eggs that you may have seen?
- Which stage has the shortest duration?
- Is there a change in the habitat during the various stages in the life cycle of a frog?
- How do the special features support that stage?

Observe Fig. 10.8. You will see that tadpoles develop legs but still have tails. Tails help them swim in water. Tadpoles grow gradually and start looking like little frogs called froglets. They still live in water but begin to spend some time on land. They continue to grow and lose their tails completely. Their legs become strong to help them jump and land. They become fully developed adult frogs who live both in water and on land.

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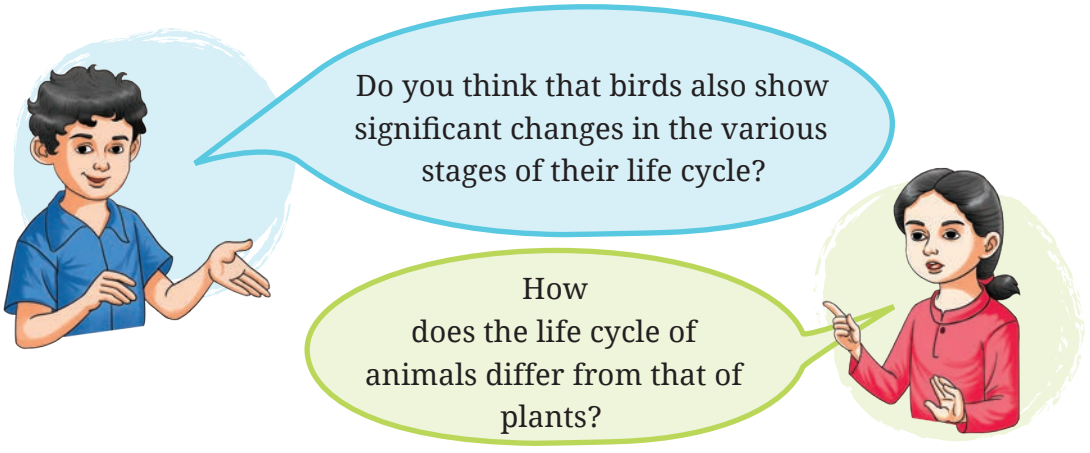

Plants and animals are a part of the living world. They go through various changes during the course of their lives. We have learnt that a tiny plant grows and develops into a big tree. We have also learnt how animals grow and change from young ones to adults. This journey varies for each animal, making it unique and special. We have seen pupae change into insects, and tadpoles change into frogs. Such changes are important for plants and animals to survive and to maintain continuity of their kind. We should also take care of them and their homes. By nurturing and preserving their homes, we contribute to this flourishing living world.

Keywords

Breathing
Death
Excretion
Froglet
Germination
Growth
Larva
Life cycle
Living
Movement
Non-living
Nutrition
Pupa
Reproduction
Respiration
Response
Stimulus
Tadpole
Conclude
Create
Design
Experiment
Explore
Identify
Observation
Prediction

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Summary

Key Points

- The objects around us can be categorised into two types living and non-living.
- The essential features of living beings are that they move, eat, grow, breathe, excrete, respond to stimuli, reproduce and die. Absence of any of these features indicates that they are not living beings.
- Each living being goes through several stages during its life.
- Germination of seeds depends upon the availability of water, air and suitable light and/or dark conditions.
- During germination of seeds, roots generally grow downwards, while shoots grow upwards.
- A plant's life cycle starts with seed germination, followed by several stages of its growth and development. These include flowering and seed production. Seeds produced during their life cycle would germinate into new plants and the cycle continues.
- The life cycle of an animal as a result of reproduction, begin with a newborn that undergoes various stages of growth and development followed by an adult stage and finally death. The process of reproduction maintains the continuity of its kind.
- Mosquitoes pass through the stages of egg, larva, pupa and adult. The life stages of a frog include eggs, tadpoles, froglets and adults.
- In some living beings, such as mosquitoes and frogs, significant changes occur during the various stages of their life cycles. These changes can be seen in body shape, structure and sometimes even in the habitat.

Let us enhance our learning

1. List the similarities and differences in life cycles of plants and animals.
2. The table on the next page shows some data. Study the data and try to find out examples appropriate for the conditions given in the second and third columns. If you think that

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an example for any of the conditions given below is not possible, explain why.

S. no.	Does it grow?	Does it respire?	Example	Remarks
1.	No	No		
2.	No	Yes		
3.	Yes	No		
4.	Yes	Yes		

3. You have learnt that different conditions are required for seed germination. How can we use this knowledge for proper storage of grains and pulses?
4. You have learnt that a tail is present in a tadpole but it disappears as it grows into a frog. What is the advantage of having a tail in the tadpole stage?
5. Charan says that a wooden log is non-living as it cannot move. Charu counters it by saying that it is living because it is made of wood obtained from trees. Give your arguments in favour or against the two statements given by Charan and Charu.

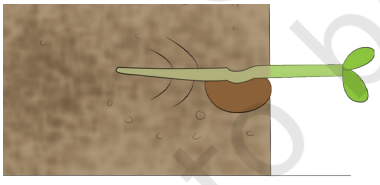

Fig. 10.9: Pot kept along the ground

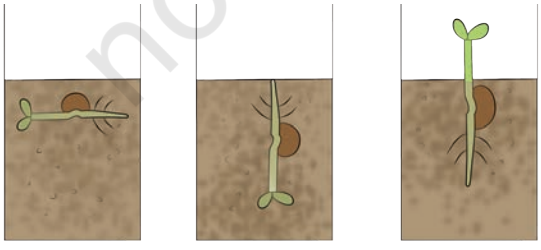

Fig. 10.10: Experimental set-up

6. What are the similarities and distinguishing features in the life cycles of a mosquito and a frog?
7. A plant is provided with all the conditions suitable for its growth (Fig. 10.9). Draw what you expect to see in the shoot and the root of the plant after one week. Write down the reasons.
8. Tara and Vijay set up the experiment shown in the picture (Fig. 10.10). What do you think they want to find out? How will they know if they are correct?
9. Design an experiment to check if temperature has an effect on seed germination.

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Learning further

- Make a field trip to a local garden. Interact with a gardener to learn about various conditions and the time required for the growth of various plants.
- Can we grow plants without germinating their seeds? Explore and cite some examples.
- Observe the life cycle of five plants grown at home, school, or in a nearby garden. Create a picture book containing pictures of various stages of their growth. Write the name of each plant and the duration of each of its stage.
- Try to observe some of the stages in the life cycle of a butterfly or a moth. Are these stages similar to the stages in the life cycle of a mosquito?
- In your opinion, would the environment affect the life cycles of insects? Explore and list the factors that affect the life cycles of insects.

Let us create

Add more lines to the incomplete poem given below. Include information on the different stages in development of a frog. You may also draw and paint each stage as it appears in your poem.

In shaded and grassy bogs,
There lived a group of frogs.
They happily sang from dusk to dawn,
In double bass going on and on.
One day sitting beside a reed,
Female frogs think it's time to breed .....
.....

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Notes

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Chapter 11

Nature's Treasures

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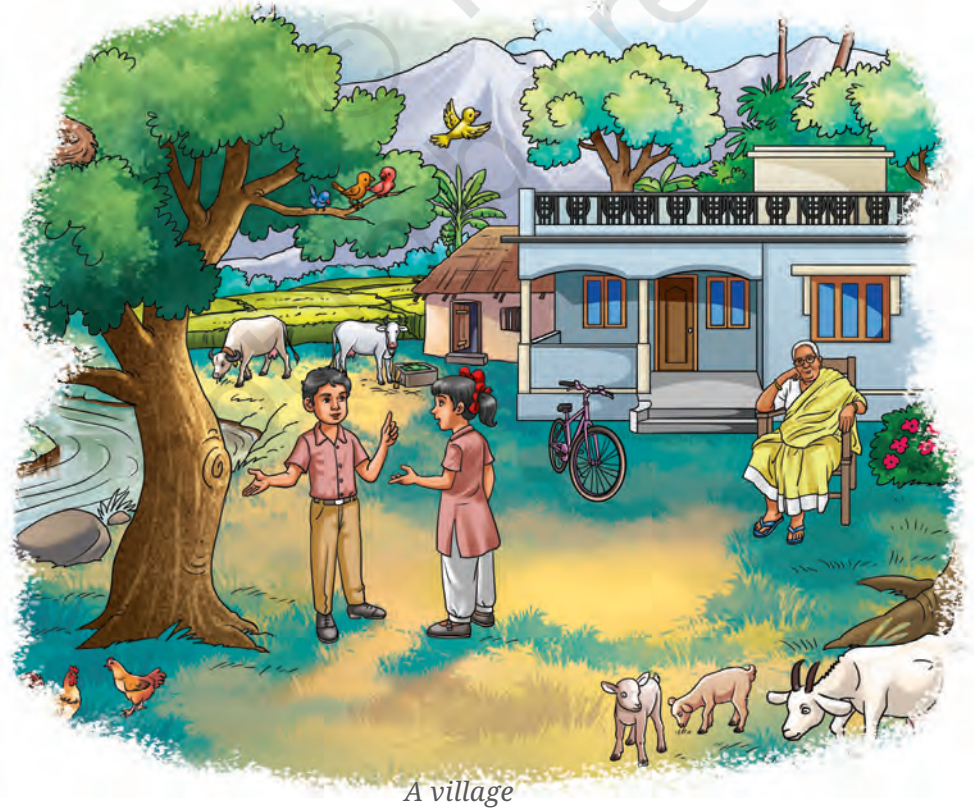
School vacations are always fun for Bhoomi and Surya. This vacation, they visit their *Ajji* (grandmother). *Ajji* lives in a village on the edge of a forest in the Western Ghats. The air in the village is fresh and cooler than in the city. They can see beautiful hills, streams, and many interesting plants, animals and birds around them.

One afternoon, Bhoomi and Surya ask *Ajji* to tell them more about the place. *Ajji* says, "Children, do you know that this place has several treasures of nature that enrich our lives? The pure air is refreshing and the soil is so fertile that it supports a variety of living beings. Moreover, this place gets plenty of sunlight which is useful in many ways. Different varieties of trees provide food and shelter to animals including various birds and insects. Can you think of more such treasures of nature?"



A village

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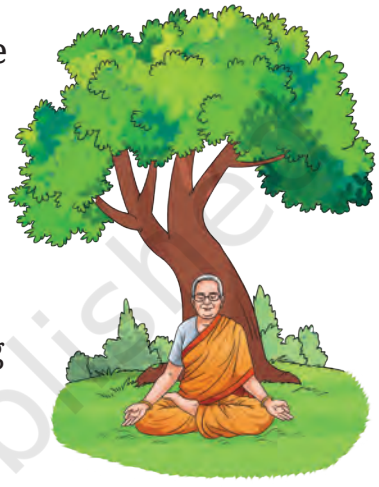
Bhoomi replies, "*Ajji*, we use water for drinking and growing vegetables." *Ajji* says, "Yes. We need these treasures for our survival and for making our lives more comfortable. Without these treasures of nature, any form of life on Earth is not possible." We all are a part of nature.

Ajji explains the importance of air around us and how it is essential for our survival. Let us find out more about air.

11.1 Air

One morning, Bhoomi and Surya see *Ajji* performing some breathing exercises. *Ajji* asks them to join her. She says, "I am taking deep breaths in, and letting them out. This helps in getting more fresh air in the lungs to stay healthy." Bhoomi and Surya sit with *Ajji* and start taking deep breaths.

Let us also perform a breathing exercise.



Breathing exercise

Activity 11.1: Let us experience

- Take a deep breath in, and then breathe out slowly.
- Take a deeper breath in again.
- Hold your breath for as long as you can and then breathe out slowly.
- How long can you hold your breath?
- How do you feel when you hold your breath?

Caution

Do not hold your breath for so long that you start feeling uncomfortable.

From this activity, we find that it is difficult to hold our breath for a long time. The air which we breathe in has oxygen. Our body needs oxygen to perform its functions. When we hold our breath for a long time, the body does not get enough oxygen to perform its functions. Thus, we need oxygen for our survival. Similarly, most of the living beings also need oxygen for their survival.

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Do you know?

We can survive without food or water for a few days, but we cannot survive without oxygen for even a few minutes.

The air which surrounds the Earth is a mixture of gases. Can you name some gases which are present in the air? Air contains nitrogen, oxygen, argon, carbon dioxide and other gases in small quantities. Fig. 11.1 gives the composition of air in percentage. Notice that in Fig. 11.1 there are 100 squares. Out of 100 squares, 78 are occupied by nitrogen, 21 are occupied by oxygen, and 1 by argon, carbon dioxide and other gases.

More to know!

Percentage is the number of parts in 100. It is denoted by the symbol '%'.

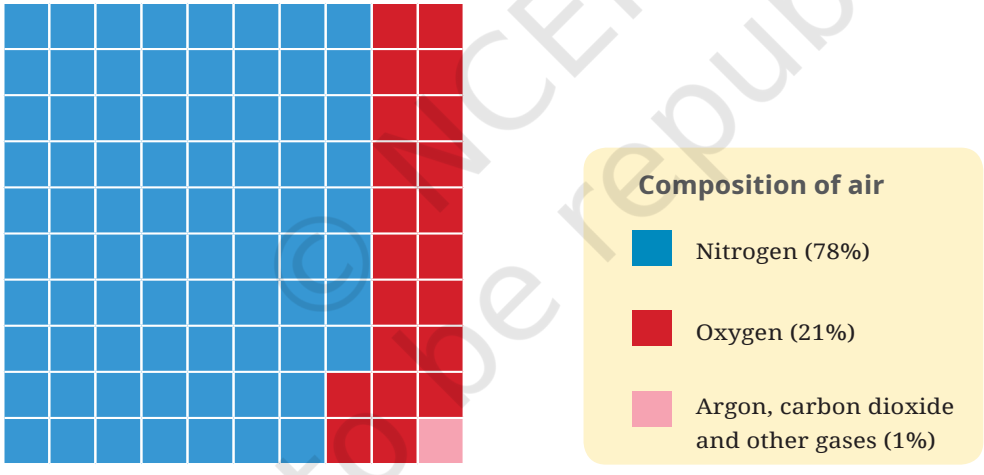

Fig. 11.1: Composition of air

You notice the presence of air when the leaves of a tree rustle, the clothes hanging on a clothes line sway, or the pages of an open book begin to flutter once a fan is switched on.

Moving air is called wind. Sometimes it blows fast, for example, during a storm, and sometimes it blows gently as a breeze. You must have played with a *firki* (paper pinwheel) many times. Let us make a *firki* by performing Activity 11.2.

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Activity 11.2: Let us make and decorate

- Take a square paper of size 15 cm x 15 cm, a pair of scissors, an all-pin and a soft stick.
- Follow the instructions shown in Fig. 11.2 to make a *firki*.

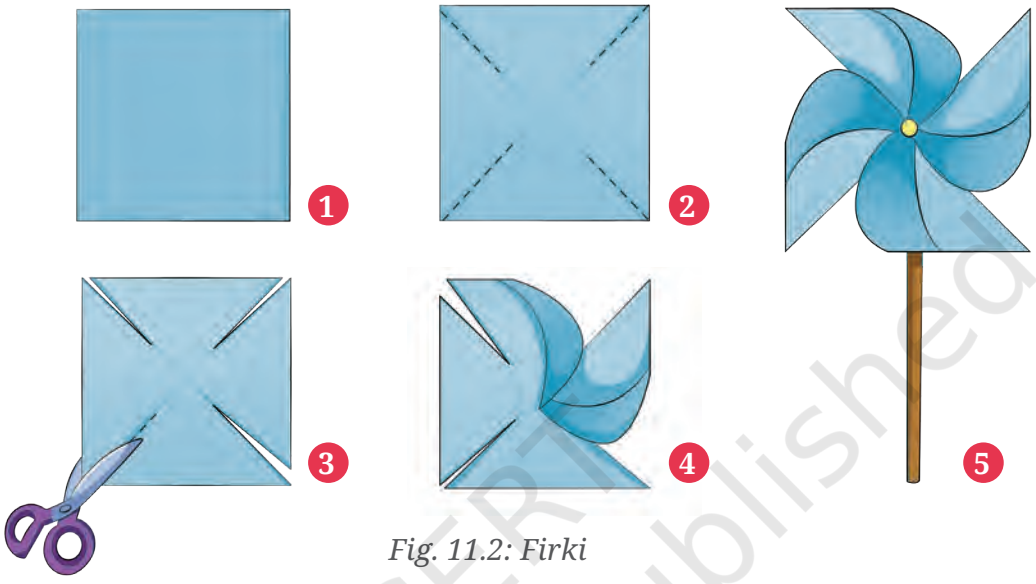

Fig. 11.2: Firki

Now, you can hold the *firki* in your hand and run. You can also blow air on it. What do you observe? Does the *firki* rotate? When you move it a little back and forth, the *firki* rotates. What makes a *firki* rotate? It is the wind that makes a *firki* rotate.

The working of a windmill is similar to that of a *firki*. Wind rotates the wings of a windmill. Windmills can be used to run flour mills, to pull up water from a well, or to generate electricity. In India, there are many windmill farms. A windmill farm is an area that has a large number of windmills which use the energy of the wind to generate electricity (Fig. 11.3).

Fig 11.3: A windmill farm

More to know!

Muppandal Wind Farm in Tamil Nadu, Jaisalmer Wind Park in Rajasthan and Brahmanvel Wind Farm in Maharashtra are some of the leading windmill farms in our country. Find out more other windmill farms in our country.

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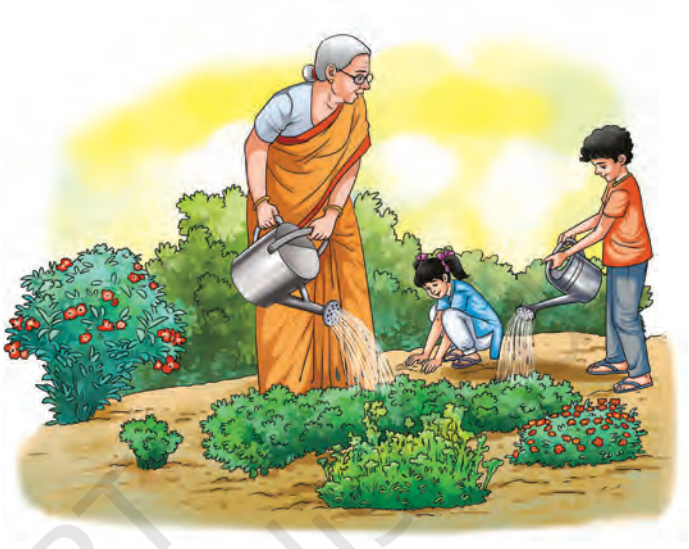
We have learnt that air is very important for us. Water too is essential and precious for us. How do you feel when you cannot get water to drink, especially when you are thirsty? Let us find out more about water.

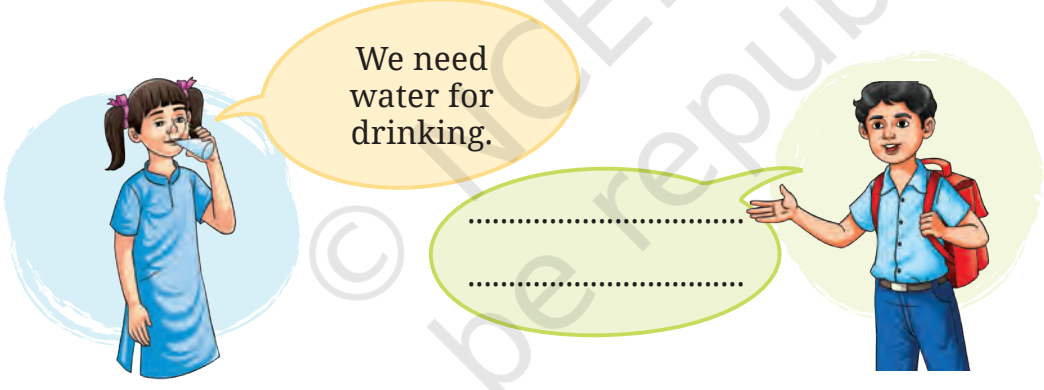
11.2 Water

Bhoomi and Surya help *Ajji* in filling the troughs of water for the cows. They also help her in watering plants such as vegetables and medicinal herbs in the garden. *Ajji* teaches them how to water the plants so that every drop is used and none of it goes waste.

Can you think of some more uses of water in your daily life? Write down your responses in the blank bubble.



Watering the plants



We need water for many daily activities, such as drinking, cooking, bathing, washing and cleaning. It is also used for growing crops and for industrial purposes. Where do we get water from? Make a list of the different sources of water.

Water covers about two-thirds of the Earth's surface. Most of the water is found in oceans and seas. However, this water is saline or salty. This saline water is not fit for domestic, agricultural and industrial use. For all these activities, we need freshwater, which is present in the form of ice sheets or snow, rivers or lakes on the surface of the Earth, and underground. Freshwater present in ice sheets

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and snow, or underground water is difficult to access. A very small fraction of the freshwater present in ponds, rivers, lakes and wells is easily accessible. Water is precious, that is why *Ajji* guides them to use it with care.

Do you feel that water is being used efficiently in our daily activities? Have you observed water being wasted in your daily activities? Let us find out activities where water is wasted and how this wastage can be reduced.

Activity 11.3: Let us find out

Fill the Column II and Column III in Table 11.1.

Table 11.1: Wastage of water in your daily activities

Column I	Column II	Column III
Activity	**How is water wasted?**	**Suggest ways to reduce wastage of water.**
1. Hand washing		
2. Washing clothes		
3. Washing utensils		
4. Taking shower		
5. Cooking		
6. Gardening		
7. Brushing teeth		

What conclusion can you draw from the information you gathered in the table? What can you and your family do to reduce this wastage of water? There are many ways to reduce wastage of water. For example, turning off taps when not in use and fixing water leakages. Recycling water and water harvesting also help in saving water.

Our country is blessed with numerous rivers, streams and lakes. Have you ever noticed plastic bags and wrappers floating on the surface of water? We pollute freshwater

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sources by throwing trash (waste materials) in them. Waste from homes and industries pollute our water sources when it is dumped into them. Identify other human activities that lead to water pollution. Discuss with your friends in the class what you can do to reduce water pollution. Polluted water is not fit for consumption by living beings.

As freshwater sources are limited, there is a shortage of water in many parts of India. At some places, people have to walk long distances to fetch drinking water. Everyone does not have the same kind of access to water. It is important for us to conserve water and use it judiciously. We must also prevent it from being polluted so that water remains fit for consumption by all living beings. In what ways can you conserve water?

Water harvesting is one of the methods for conserving water. In many buildings, rainwater is collected and stored in large quantities for later use. This is called **rainwater harvesting** (Fig. 11.4a). Do you know that rainwater is also harvested in many homes, residential societies or schools? It is an age-old practice in India.

Fig. 11.4 (a): Rainwater harvesting

For example, stepwells (Fig. 11.4b), commonly known as *Bawadi* in Rajasthan and *Vav* in Gujarat are built for water harvesting as a response to the scarcity of water in these regions. These stepwells have a unique system of water harvesting. They store not only rainwater but also water seeping from nearby lakes, ponds and rivers. The walls of the trenches (long deep holes dug in the ground) are lined with blocks of stones that allow seepage of water. Find traditional water harvesting practices in your locality. Discuss with your teachers and parents to learn more about it.

Fig. 11.4 (b): Bawadi (Toorji ka Jhalra, Jodhpur in Rajasthan)

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Do you know?

World Water Day is observed on 22nd March every year. Find out its importance.

In the chapter 'A Journey through States of Water', we have learnt about the water cycle, where the Sun plays an important role in the evaporation of water. Have you ever observed your mother or grandmother cut raw mangoes and expose them to the hot sun for several days to dry? Let us explore more about energy from the Sun.

11.3 Energy from the Sun

On a sunny day, Bhoomi and Surya are helping *Ajji* dry chillies in the Sun. *Ajji* says, "We use the heat from the Sun to dry it. We can use dried chillies when fresh ones are not available. I will give you some to take home. Do you know that the Sun is the main source of energy on Earth? All plants and animals are dependent on it."

We use heat and light from the Sun for various purposes. What are some of the activities for which we need heat and light? Bhoomi draws some pictures to show the uses of heat and light from the Sun. Help her by adding more examples. Draw the pictures and write their descriptions in the space provided.

Plants make food

Drying of clothes

---------- ---------- ----------

One afternoon, Bhoomi and Surya pass by the field near *Ajji's* house, where they see a cow grazing the grass. They talk about the Sun being the main source of energy. Read the conversation carefully and answer.

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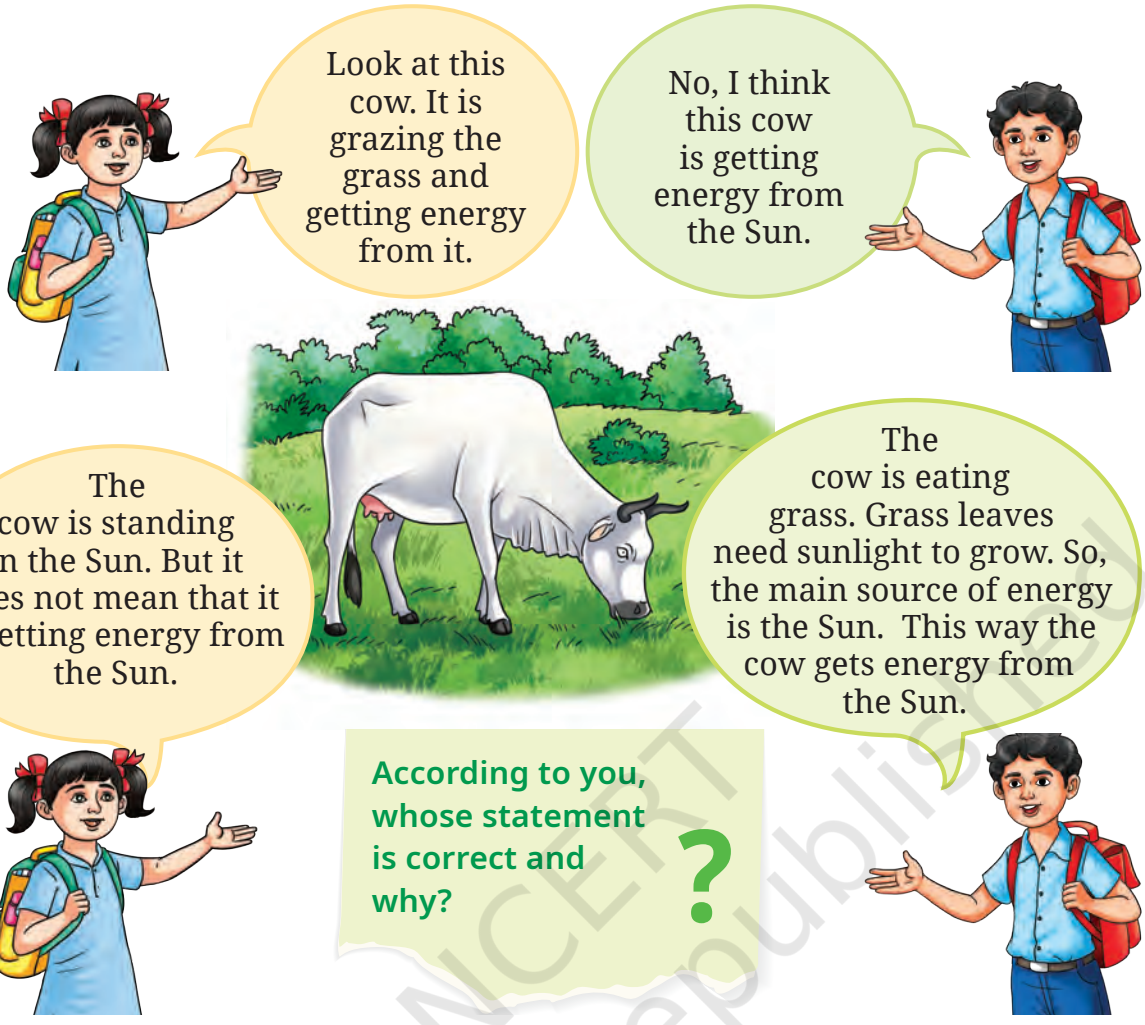
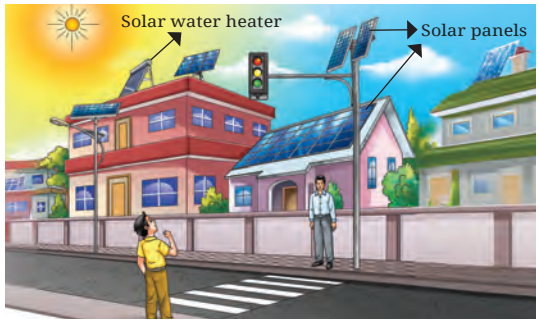


Sunlight helps plants prepare food. The Sun also provides all the living beings on Earth with heat and light. It is their main source of energy.

Do you know?

In many households in India, water is offered to the Sun early in the morning as an expression of gratitude to the Sun.

Have you seen solar panels on rooftops, on top of street lights or on traffic signals? The solar panels capture the Sun's energy and produce electricity. Energy from the Sun can also be directly used for cooking in a solar cooker or for heating water in a solar water heater.



Uses of solar energy

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What will happen if the Sun is not visible for a few days?

1. We may have to depend on artificial lighting during day time also.
2. ----------
3. ----------

?

One cannot imagine life on Earth without the Sun. The Sun is the main source of energy on the Earth. Plants get energy from the Sun and produce food. Animals eat plants and grow. We get food from both plants and animals. This cycle on Earth is possible due to the Sun. So, we all are dependent on the Sun as the main source of energy. Where do we find a large variety of plants or animals? Let us explore.

11.4 Forests

One morning, *Ajji* takes Bhoomi and Surya for a walk in the forest. They find a variety of herbs, shrubs and trees in the forest. *Ajji* explains, "Forests are large areas with dense growth of various types of plants." On the way, they collect some *nellikai* (Kannada term for Indian gooseberries) that have fallen on the ground. *Ajji* tells them, "We have a tradition in the village not to pluck fruits from the trees; they are left for animals and birds to eat."

A forest

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Discuss with your friends and make a list of at least five products that we get from forests.

Forests are a natural home for many wild animals, including birds and insects. Forests provide food and shelter to them. In nature, every animal depends on other life forms for survival. The diversity of life forms ensures food for every living being. However, over the years, the forest cover has been decreasing, mainly due to human activities like large scale cutting of trees. It takes many years to grow a new forest or restore lost forests. Therefore, we must preserve and use forests responsibly so that they get enough time to regenerate.

Van Mahotsav is a week-long event celebrated across the country during the month of July. It is a forest festival during which new plants and trees are planted, and awareness about respecting forests is raised. The aim of the event is to increase the green cover. You too can plan a *Van Mahotsav* in your community.

What are the consequences of cutting a large forest area? Make a presentation or do a role play, or write a story or a poem that shows what could happen if we continue to cut down trees in our forests.

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Do you know?

From ancient times, India had a tradition of respecting, protecting and preserving forests. You have already learnt about sacred groves in the chapter 'Diversity in the Living World'. Many efforts have been made by common people to prevent the cutting of trees, and thus, saving forests. One such effort is the famous Chipko movement. It started in the early 1970s in Uttarakhand (previously part of Uttar Pradesh). Local women actively participated in this movement. They encircled and hugged the trees to protect them from being felled.

During their walk in the forests, Bhoomi and Surya notice that there are a lot of leaves on the ground and the soil feels damp. *Ajji* explains, "The roots of plants hold on to the soil and prevent it from being washed away. The leaves that fall from the trees decay and enrich the soil with nutrients. This soil is used by new plants and trees to grow. This is an example of recycling in nature." Let us investigate the soil in more detail.

11.5 Soil, Rocks and Minerals

Fig. 11.5: Soil preparation for planting vegetables

Bhoomi, Surya and *Ajji* come back home from the forest. Bhoomi and Surya help *Ajji* in preparing the soil in the garden for planting some vegetables (Fig. 11.5). *Ajji* asks them to dig the soil gently and loosen the lumps. You have already learnt in the chapter 'Living Creatures: Exploring their Characteristics' that for plants to grow, the space between the soil particles not only provides sufficient air but also space for the roots to grow easily. Bhoomi and Surya could see small pebbles, the roots of plants and a few earthworms too in the soil. Do you realise that earthworms are natural agents that help in turning and loosening the soil?

While Bhoomi and Surya help *Ajji*, let us do our own experiment by performing Activity 11.4.

Activity 11.4: Let us investigate

Caution
Remember to wash your hands thoroughly after touching the soil collected from different places. Sometimes soil that has garbage carries germs that may be harmful to us.

- Collect samples of soils from different areas around your home and school.
- Guess what could be there in different soils.
- Observe carefully each soil sample and note its colour.
- Touch each soil sample and feel its texture.

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- Observe the soil samples with your naked eye. If you have a magnifying lens, look at the soil through it.
- Record your observations in Table 11.2.

Table 11.2: Soil samples

Location from which soil sample was collected	What I guessed about the soil?	Observation of soil with naked eye including its colour and texture	Observation of soil with magnifying lens
Soil from a farm after ploughing			

- Is there any difference between your guess and what you can actually observe when you look closely?
- Do you see any differences in the soil samples taken from different places?
- Do you see differences in what you are able to observe with your naked eye and what you can observe with a magnifying lens?

There are many things in the soil, such as sand, insects and worms. There may be many small organisms that we cannot see with our naked eyes. Plants and animals also become part of the soil as they decompose and decay. The soil samples collected from different places may be of different colours because they may contain different materials.

Have you ever wondered how soil is formed? Soil is formed by the disintegration (breaking apart) of rocks by actions of the Sun, water and living organisms over a long time (thousands of years). There are different types of soils. Some are good for growing certain types of

Ploughing

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plants while some are good for making bricks for buildings. Forests have a variety of soils. Soil is a precious treasure that supports biodiversity.

You may have seen rocks in your surroundings. Rocks are used in the construction of houses, buildings, temples, roads, dams and table tops. Some rocks, like slate, are used for roofing (Fig. 11.6) and laterite can be used as a building material, like bricks (Fig. 11.7). Some of the important rocks are granite, sandstone and marble. Human beings have been using rocks to make tools such as hand axes (Fig. 11.8a) and arrowheads (Fig. 11.8b) since thousands of years.

Fig. 11.6: Rocks used for roofing

Fig. 11.7: Laterite rocks used as bricks

Fig. 11.8 (a): Hand axes

Fig. 11.8 (b): Arrowheads made from stone

Mining of marble

What are rocks made up of? They are made up of minerals. Important metals, such as aluminium, gold, copper and iron are extracted from minerals. Minerals are used in the manufacturing of airplanes, cars, jewellery, cosmetics, and

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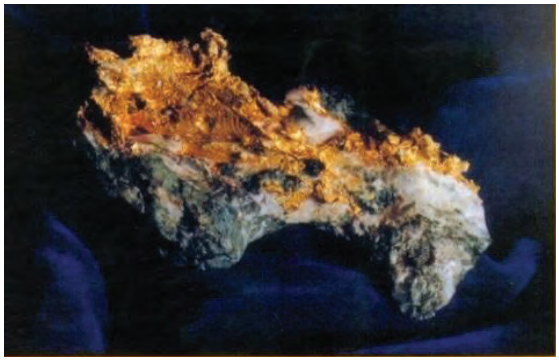
electrical and electronic equipment. For example, the basic mobile phones that we use contain about a dozen minerals like gold, silver, copper, cobalt, etc.

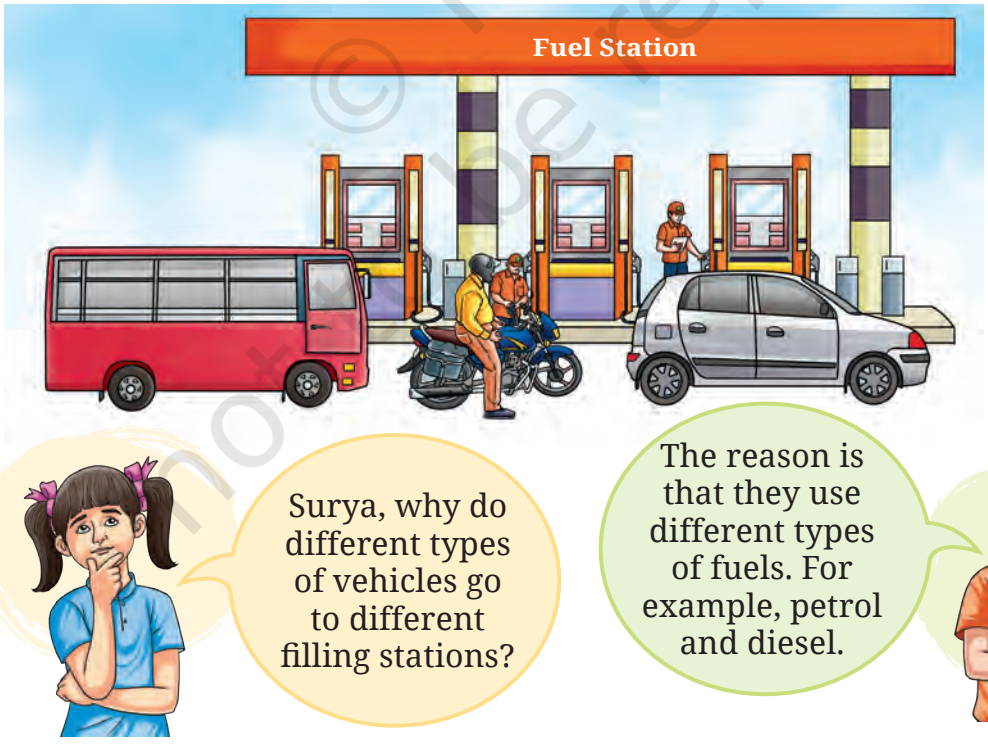


Naturally occurring gold

Some minerals found in nature

Rocks play a vital role in our lives. It takes thousands to millions of years to form rocks. Therefore, it is important to conserve and use them responsibly. Do you know how rocks and minerals are transported from one location to another? Most vehicles that we use for transportation use fossil fuels. Let us explore more about fossil fuels.

11.6 Fossil Fuels



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Let us explore more about it by performing Activity 11.5.

Activity 11.5: Let us conduct a survey

- Conduct a survey of vehicles in your neighbourhood.
- Which types of vehicles are there? What types of fuels do they use?
- Record the information that you collect in Table 11.3.

Table 11.3: Types of vehicles and fuels used

Type of vehicle	Type of fuel used

What are the most common types of fuels used? Petrol and diesel are the two most widely used fuels for vehicles. Petrol, diesel and kerosene are obtained from petroleum. Petroleum along with natural gas and coal are commonly called **fossil fuels.** They are formed essentially from the remains of microorganisms and plants that got buried deep inside the earth, and were converted to petroleum, natural gas and coal. It takes millions of years for these fuels to form.

Natural gas is used for cooking and generating electricity. Nowadays, it is also used in the form of Compressed Natural Gas (CNG) as a fuel for vehicles. It is a cleaner fuel than petrol or diesel. Coal is mainly used for the production of electricity. It is found in several parts of India. Find out the major coal-producing states and mark them in a map of India.

Do you know?

Earlier, coal, wood and dung cakes were used as fuels for cooking. Nowadays, less polluting natural gas and Liquefied Petroleum Gas (LPG) have gradually replaced these domestic fuels.

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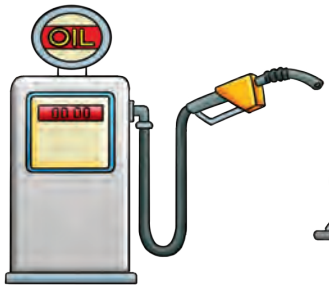
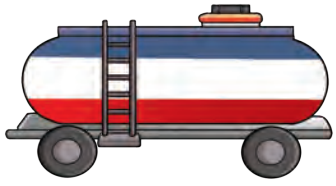
Coal



Petrol



Natural gas

Fossil fuels are found in limited quantities. Hence, we will soon run out of fossil fuels if we continue to use them in the manner that we currently do. To avoid such a situation, we need to explore alternate sources of energy. When fossil fuels are burnt, smoke and carbon dioxide gas are produced which pollutes the air. Over-dependence on fossil fuels for transportation and as domestic fuels has resulted in large scale air pollution.

Let us do our bit to conserve the fossil fuels by—

- Walking or cycling to nearby places.
- Using public transport.

Suggest some more ways.

11.7 Natural Resources: Renewable and Non-renewable

Nature's treasures fulfill our needs. They are essential resources to sustain all life forms on the Earth. For example, we get heat and light from the Sun, water from rivers, and food from plants and animals. These resources which we get from nature are called **natural resources.** We also use natural resources to make many useful things for our convenience. For example, electric bulbs, furniture, solar panels, bicycles, etc., make our lives comfortable. All such resources created by human beings are called **human-made resources.**

You have learnt about various natural resources, such as air, water, energy from the Sun, forests, soil, rocks, minerals and fossil fuels. Some of these natural resources

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get replenished through natural processes over a period of time. If you remember, *Ajji* told Bhoomi and Surya that they could collect only those *nellikai* that had fallen on the ground. This makes sure that there would be enough fruits for other animals and birds. The seeds from the droppings of animals and birds would enable new trees to grow, though it would take some years before we get fruits from these new trees. Thus, resources which get renewed, replenished or restored within a reasonable period of time are called **renewable resources.** Air, water and forest are some of the examples of renewable natural resources. Nature renews them. We should use our natural resources judiciously.

On the other hand, fossil fuels take millions of years to form. They are found in limited quantities and once used, they get exhausted. They are not produced or replenished within a reasonable period of time. These resources are called **non-renewable resources.** Examples of non-renewable natural resources are minerals, soil, rocks, coal, petroleum and natural gas.

11.8 Resources We Use

It is time for Bhoomi and Surya to go back home after a wonderful holiday at their *Ajji's* home. Their *Amma* (mother) comes to pick them up. Bhoomi and Surya show her the vegetable plants that have started to grow in the garden and the dried chillies given by *Ajji* to take home.

They notice changes in the colour of the skyline and the smell of the air once they reach the city. There are very few trees. The air does not smell as good as the air at *Ajji's* place. They can smell smoke from the vehicles. The air is polluted. *Amma* says, "Yes. When we use fossil fuels in our vehicles, smoke is generated. Now, there are vehicles which cause less pollution. For example, there are electric vehicles that do not release any smoke. So, people are making an effort to create alternatives."

Can you list some alternatives for reducing air pollution?

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We use many natural resources in our everyday life. Let us identify some resources that we use by performing Activity 11.6.

Activity 11.6: Let us make a list of natural resources used

Make a list of activities you do in your daily life and write down the natural resources used directly or indirectly for each activity. In Table 11.4, some items are already filled in. Using them as a guide, fill the remaining blank rows.

Table 11.4: Natural resources used

Activity	Natural resource
Washing clothes	Water
Making clay toys	
Collecting firewood	
Making kites	
Having breakfast	

How many natural resources did you list? Compare your list with that of your friend.

You and your friends have listed many natural resources that we use everyday. These resources are air, water, soil, and food from plants and animals. We get these resources from nature and also make things using them for our consumption. Therefore, we must conserve our natural resources and use them responsibly without wasting them. This way, we can continue to fulfill our present needs while also saving for the future, without harming the environment.

"Earth provides enough to satisfy every man's need but not for every man's greed."

– M. K. Gandhi

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Keywords

Air
Coal
Forests
Fossil fuels
Human-made resources
Natural gas
Natural resources
Non-renewable resources
Petroleum
Rainwater harvesting
Renewable resources
Resources
Rocks
Soil
Sun
Water
Classify
Experience
Explore
Investigate
Observe
Survey

Summary

Key Points

- Resources required for our survival are provided by nature.
- Resources provided by nature are called natural resources.
- Some important natural resources are air, water, energy from the Sun, forests, soil, rocks, minerals and fossil fuels.
- Resources created by human beings to meet their needs are called human-made resources.
- Natural resources can be classified as renewable resources and non-renewable resources.
- Resources that get renewed, replenished or restored by natural processes within a reasonable period are called renewable resources.
- Resources that are in limited quantities and do not get replenished within a reasonable period are called non-renewable resources.
- All living beings, including humans, depend on natural resources for their survival so we should use them judiciously.

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Let us enhance our learning

1. Fig. 11.9 shows items related to natural resources. Match them with their jumbled up names. Make another table and write the names of these resources. Classify these resources as renewable or non-renewable.

Item	Jumbled up name
	ocrk
	refost
	ndiw
	atwre

Fig. 11.9: Natural resources

2. State whether the following statements are True [T] or False [F]. If False, correct them.
   (i) Nature has all the resources to meet human needs. [ ]
   (ii) Machines are a resource found in nature. [ ]
   (iii) Natural gas is a non-renewable resource. [ ]
   (iv) Air is a renewable resource. [ ]

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3. Fill in the blanks using the most appropriate option—

   (i) A fuel that is commonly used in two wheelers like scooters or bikes is.....

   (a) Kerosene

   (b) Petrol

   (c) Diesel

   (d) LPG

   (ii) An example of a renewable resource is .....

   (a) Coal

   (b) Water

   (c) Natural gas

   (d) Petrol

4. Classify the following as renewable or non-renewable resources—coal, natural gas, forests and minerals.

5. Why do we say that petroleum is a non-renewable resource?

6. It is difficult to regrow forests. Justify this statement.

7. Make a list of five daily activities in which you use natural resources. Suggest ways by which you can reduce their use.

8. List four activities that are possible due to the presence of air.

9. How can you contribute towards enhancing the green cover of your locality? Make a list of actions to be taken.

10. In the given illustration, we see that food is being cooked.

    Answer the following questions—

    (i) What type of energy is being used for cooking?

    (ii) Name one benefit and one drawback of using this type of energy for cooking.

11. Cutting down trees on a large scale impacts the quality of the soil. Why do you think it is so?

12. Explain two ways in which human activities pollute the air. Propose one action which can help in reducing air pollution.

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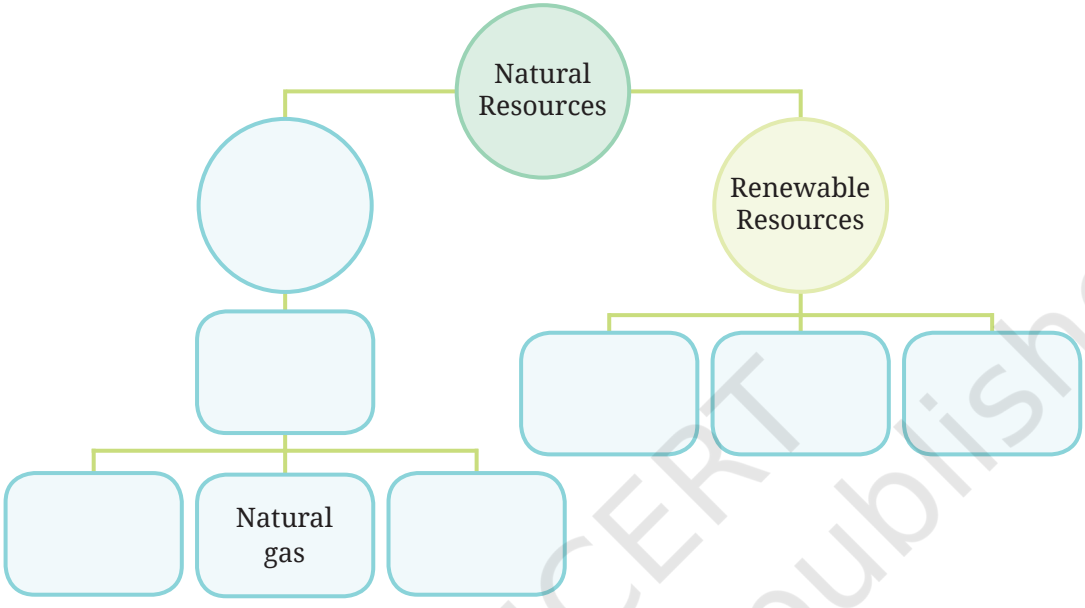
13. A family uses solar panels to generate electricity, a gas stove to cook food and a windmill for pumping water from a well. What would happen if there were no sunlight for a week?

14. Fill up the blanks using the following terms—

(fossil fuels, forest, air, petroleum, coal, water and non-renewable resource)



15. There is an increasing demand of trees to meet the requirements of industries and for housing. Therefore, trees are being felled. Is it justified? Discuss and prepare a brief report.

16. Propose a plan to use less water in your school. What steps would you take to make this plan happen and how would it help the environment?

Learning further

- Rainwater harvesting is an age-old practice in India. Find out some of the traditional rainwater harvesting techniques being used in your state or in other parts of the country.

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- Investigate the effect of air pollution on human health by interacting with your elders or community members and identify the main sources of air pollution in your local area. Based on your findings, suggest two practical steps that your school or community could take to help reduce air pollution.
- Prepare a list of the names and uses of important minerals and rocks that are used in your village/town/city for various purposes.
- You are an eco-club monitor. Organise a tree plantation drive in your school with the help of your teacher. List the steps required for organising this activity. Prepare a one-page report listing the names of the trees planted along with their importance.

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Chapter

12 Beyond Earth

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Nubra is a beautiful region in Ladakh. An eleven-year old girl Yangdol and her twin brother Dorjay live in one of the villages of this region.

Nubra in Ladakh, India

They love their surroundings—the majestic mountain peaks, and the glaciers, but their favourite is the night sky when the entire sky is lit up with thousands of stars (Fig. 12.1). The weather in Nubra is almost cloudless. With almost no air or light pollution, the night sky is very clearly visible. Night after night, Yangdol and Dorjay observe the stars and experience an immense sense of awe.

Fig. 12.1: The beauty of night sky from a very dark location in Ladakh, India

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Growing up, Yangdol and Dorjay have been hearing interesting stories about stars from their elders. They have heard how some particular stars in the clear skies helped the caravans passing through Nubra in finding direction in the ancient days. They wonder how far away and how big the stars are. They also enjoy trying to find some patterns among the stars that remind them of familiar objects. Have you ever looked at the stars in the night sky and tried to connect them with imaginary lines, just like dots and lines in a drawing?

Activity 12.1: Let us draw

- Fig. 12.2 shows bright stars in one part of the night sky.
- Look at it carefully and try to imagine a pattern formed by a group of stars.
- Draw lines to connect the stars and make the pattern.
- Think of an animal or an object that is similar to the pattern drawn by you. Write its name near your pattern.

Fig. 12.2: A part of the night sky

- Repeat the above steps and make some more patterns.
- Now think of an interesting story about your patterns.

Compare your patterns with the patterns drawn by your friends. Are the patterns same or different? Narrate your story to others and listen to their stories. Do you notice that everyone's patterns, names and stories are different? Is it not fun?

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12.1 Stars and Constellations

At night, when we look up at the sky, we see many stars. Some stars are bright and others are dim. Stars shine with their own light.

Some groups of stars appear to form patterns which are like shapes of familiar things. Long ago, when watching stars in the night sky was a favourite pastime of our ancestors, they identified these star patterns with animals, things or characters in stories. Many cultures had names for patterns based on their own stories. These imaginary shapes helped them in recognising stars in the sky.

Recognising stars and their patterns was a useful skill for navigation in the olden times. Before the arrival of modern technology or even before the invention of the magnetic compass, it helped people, particularly sailors and travellers, in finding directions at sea or on land. It is still used in emergencies as a backup method.

In earlier times, groups of stars forming patterns were called constellations. Currently, the regions of sky, which include these groups of stars, are defined as constellations. However, since in constellations, the patterns of stars are often the most prominent, the term constellation is still commonly used for these groups of stars.

More to know!

Since different cultures denoted the constellation boundaries in different ways, an internationally agreed set of constellation boundaries were defined by the International Astronomical Union (IAU) in the early twentieth century. 88 constellations were officially listed, thus, dividing the entire sky into 88 regions. These regions of sky are now defined as constellations.

Some constellations are shown in Fig. 12.3. The stars are joined by imaginary lines, drawn for easy identification. The constellation Orion is often represented as a hunter. There are three stars in the middle, which represent the belt of the hunter. Some people imagine that the hunter Orion, followed by his dog (constellation Canis Major), is battling a bull (constellation Taurus). Canis Major contains a star

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called Sirius, which is the brightest star in the night sky (Fig. 12.3).

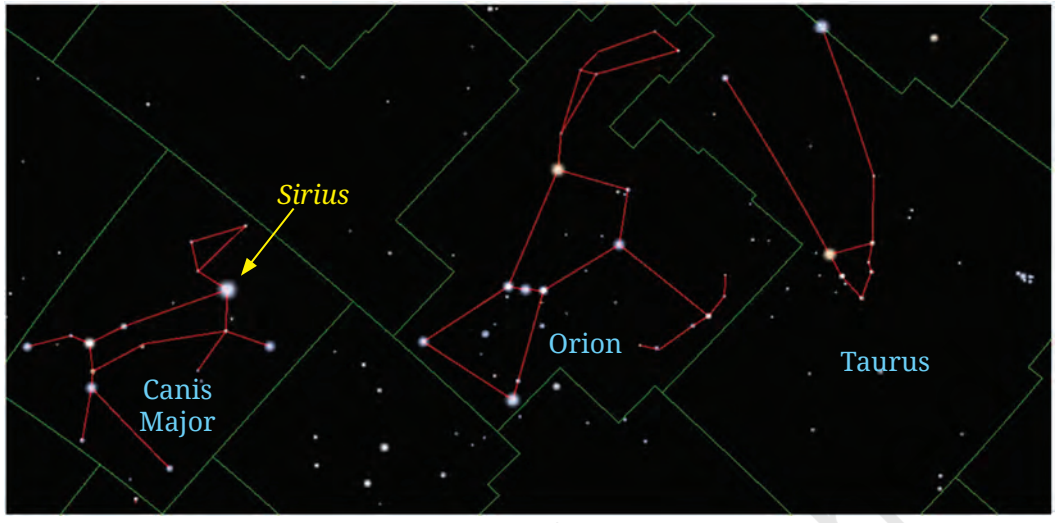
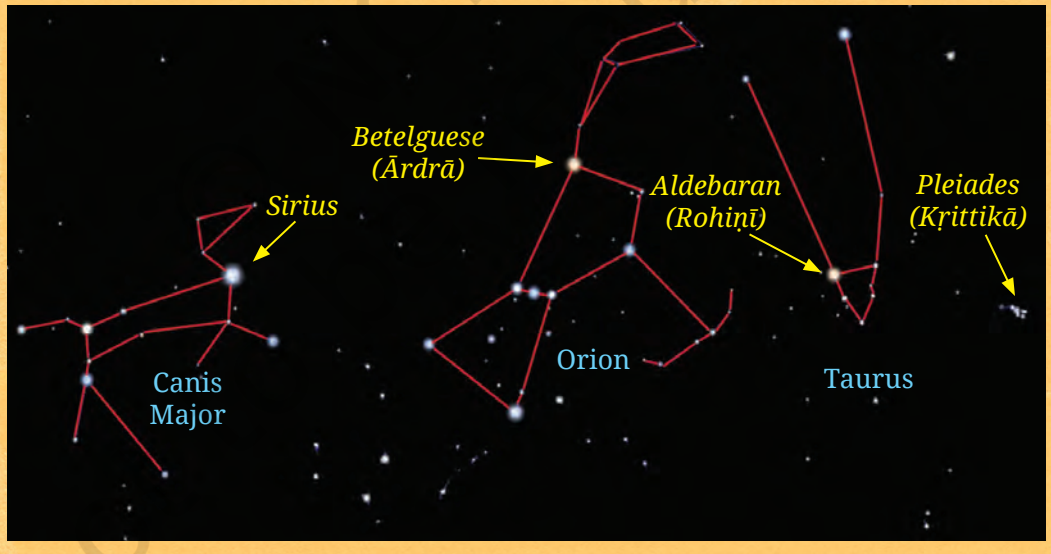


Fig. 12.3: Some constellations and stars

(The red lines indicate the patterns of stars while the green lines indicate the regions of the sky. The lines are not seen in the sky and have been drawn only for easy identification)



More to know!

In Indian astronomy, the term *nakṣhatra* is used to denote either a certain star or a group of stars, such as *Ārdrā* (a star called Betelgeuse in the Orion constellation) and *Kṛittikā* (a group of stars called Pleiades in the Taurus constellation). Aldebaran, a star in the constellation Taurus, is known as *Rohiṇī*.

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Two distinct patterns of stars, the Big Dipper and the Little Dipper, are shown in Fig. 12.4. The **Pole Star** or Polaris, which is part of the Little Dipper is also shown (Fig. 12.4).

The Pole Star appears stationary in the North direction, which helps to locate the North direction in the Northern hemisphere.

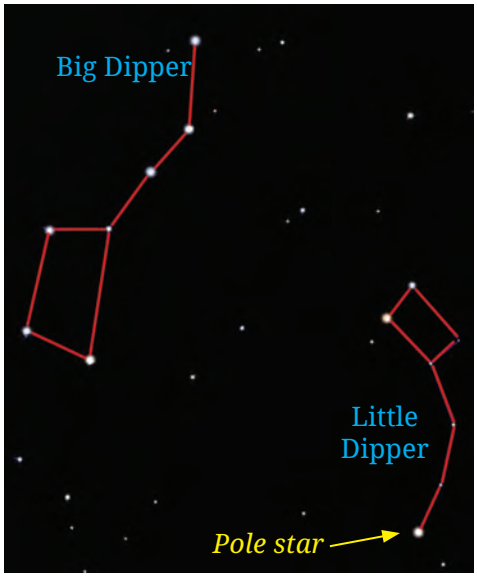

Fig. 12.4: Big Dipper, Little Dipper and Pole Star (The lines are not seen in the sky and have been drawn only for easy identification)

More to know!

The Big Dipper lies in the constellation Ursa Major while the Little Dipper lies in the constellation Ursa Minor. In India, the Big Dipper is known as *Saptaṛiṣhi,* and the Pole Star is known as *Dhruva tārā.*

How can we identify some of these constellations in the night sky?

Do you know?

Apart from common regional stories associated with stars in the constellations, many forest dwelling communities or tribes of India also have their own stories about them. For example, the four stars in the Big Dipper that approximately form a rectangle, are viewed by tribes in Central India as the "grandmother's cot" with the three thieves (other three stars) stealing it. Fishermen along the Konkan coast imagine the four stars as a boat, with the last three stars as the neck of the boat.

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12.2 Night Sky Watching

If it is a clear cloudless night, a large number of stars may be visible in the sky. If you stay in a big city, you may find that the sky is rarely clear and only a few stars are seen in the night sky. This is due to light pollution, smoke and dust. The presence of excessive artificial light at night time is referred to as light pollution. In villages or areas where there is less light pollution, a larger number of stars can be seen. Also, your house may be surrounded by tall buildings and trees, which may block your view. The night sky is best viewed from open dark areas.

Do you know?

Light pollution is growing sharply globally. This is reducing our ability to enjoy and study objects in the night sky. Some dark sky reserves and parks have been established around the world. Light pollution in the reserves is controlled to preserve dark skies for research. There are a few organisations which are working to educate people about reducing light pollution.

Not all stars and constellations are visible from all places on Earth and on all nights in a year. For example, the Pole Star is not visible from the southern hemisphere of Earth. To identify a star or a constellation, you need to know how a particular constellation looks like and where to look for it in the night sky. To get familiar with the pattern of a constellation you may use images such as Fig. 12.3 and Fig. 12.4. To find out when and in which portion of the sky a star or a constellation will be visible from your location, you may take the help of sky mapping apps that can be downloaded on a mobile phone, or other online resources.

More to know!

Sky Map is a very handy app for identification of stars, constellations and planets from mobile phones. Stellarium is another such app. The computer version of Stellarium is free for download and has many features.

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Preparation for night sky watching

- Under the guidance of adults, identify a dark open area for night sky watching. This should be away from lights, tall buildings and trees.
- Choose the date and time based upon what you plan to identify in the night sky.
- Choose a moonless night with no clouds, particularly for the Pole Star which is not very bright.
- It may be useful to have access to a mobile app with a sky map, or print out images of the constellations you plan to view. You may also carry a magnetic compass to find directions and a notebook to note or draw your observations.
- On the particular day and time selected, go to the identified place with an adult, where the night sky watching is to be done.
- After reaching there, wait for about half an hour for your eyes to get adjusted to the darkness. This will help you to see the night sky better (Fig. 12.5).

Caution
Do not go to a dark open place at night time without adults accompanying you.

Fig. 12.5: Night sky watching

You may easily identify the Big Dipper and the Pole Star in the night sky.

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Activity 12.2: Let us try to locate

- Look for the Big Dipper during summer time in the early part of the night, say, around 9 p.m. View the sky above the horizon towards the northern part of the sky and identify the Big Dipper.
- Once you identify the Big Dipper, try to locate the Pole Star. Look at the two stars present at the end of the Big Dipper's cup and imagine a straight line passing through these towards the north. At about five times the distance between these two stars, the imaginary line will lead to another star which is not very bright. This star is the Pole Star.

You may also locate the bright constellation Orion and the star Sirius in the night sky.

Activity 12.3: Let us try to identify

- In India, Orion is best viewed during the months of December to April after sunset. So, look for it during that period.

- Three bright stars in a short straight line are located around the middle of Orion (imagined to be the belt of a hunter). Identify these three stars first, as this is the easiest way to find Orion.
- Once you identify Orion, it is easy to locate the very bright star Sirius which is located close to Orion. Imagine a straight line passing through the three middle stars of Orion and look along this line towards the east. This will lead to Sirius.

12.3 Our Solar System

The Sun

The Sun is a star. It is the star closest to us. It is an extremely hot spherical ball of gases. The Sun gives out a huge amount of energy, and that is why it glows so brightly.

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The Sun produces heat and light, and is the main source of energy on the Earth (Fig. 12.6).

How big is the Sun? It is about 100 times bigger than the Earth in diameter. And still, it looks so small because it is very far from the Earth.

Fig. 12.6: The rising Sun

The distance of the Sun from the Earth is about 150 million km. A useful unit for expressing distances within the solar system is 'astronomical unit' (au) which is approximately the distance between the Sun and the Earth.

More to know!

The Sun, being the brightest object and the source of light and heat on Earth, was elevated in most ancient civilizations to the status of a deity. In India, the Sun is worshipped as *Sūrya*. The heat provided by the Sun keeps the Earth at a temperature that makes life possible. Sunlight is essential for plants to grow, which provide food and oxygen to animals, including humans. The Sun is responsible for climate, seasons, weather, water cycle, winds—all of which are important for sustaining life on the Earth.

However, the Sun is much closer to us than the other stars hence it appears much bigger than the stars. As the stars (other than the Sun) are much farther away, they appear like points, even though some of those stars are much bigger

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than our Sun. During daytime, due to the extreme brightness of the Sun, it is not possible to view the other stars.

More to know!

The star nearest to us after the Sun is Proxima Centauri which lies at a distance of about 269000 au. This means that its distance is about 269000 times our distance to the Sun.

There are many more objects in the sky. Our Earth, along with some of these objects, and the Sun together form our Solar System (Fig. 12.7). Most of these objects move around the Sun. The movement of an object around the Sun is called **revolution**.

Planets

A planet is a large, nearly spherical object that revolves around the Sun. Our Earth is a planet as it revolves around the Sun as shown in Fig. 12.7. The Earth takes nearly one year to complete one revolution. Like the Earth, there are other planets that revolve around the Sun.

More to know!

While revolving around the Sun, the Earth is also rotating about its axis. For one full rotation, the Earth takes about 24 hours which is called a day. Like the Earth, other planets also rotate about their axes while revolving around the Sun. You will learn more about this in the next Grade.

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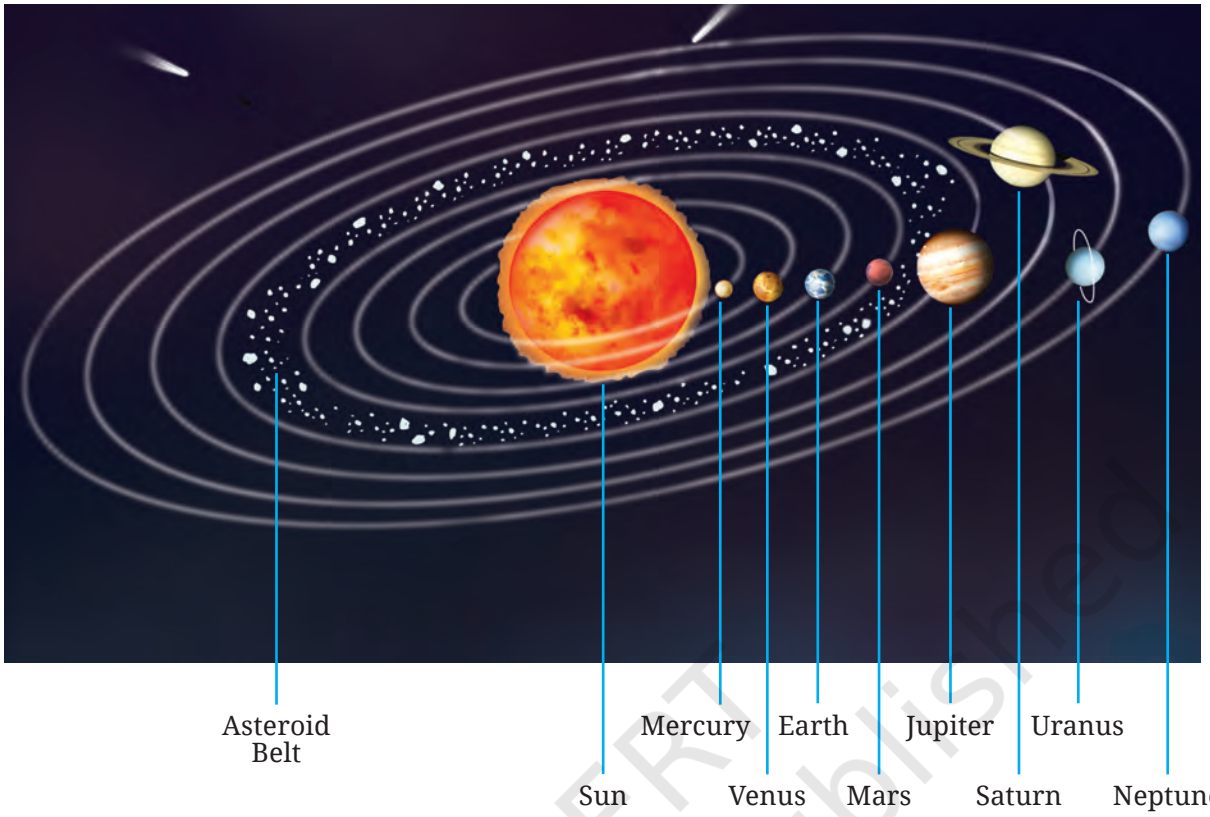

Fig. 12.7: An artist's representation of the Solar System

(To fit this figure within the page, the sizes and distances of various objects are not as per their actual sizes and distances in relation to each other, that is, the sizes and distances are not to scale in the figure)

The eight planets, in order of their increasing distance from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune (Fig. 12.7).

The inner four planets nearest to the Sun—Mercury, Venus, Earth and Mars—are smaller in size. They have solid surfaces with rocks on them.

More to know!

From ancient times, various names have been used across India for the planets visible to the naked eye. For example, *Budha* (Mercury), *Śhukra* (Venus), *Pṛithvī* (Earth), *Mangala* (Mars), *Bṛihaspati* or *Guru* (Jupiter) and *Śhani* (Saturn).

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Venus is usually seen shining brightly at dawn and dusk, and is commonly called the Morning Star or the Evening Star, even though it is not a star. Mars is called the Red Planet because it appears red. This is because the soil on Mars is reddish in colour.

A large portion of the Earth's surface is covered with water and thus, it appears blue from the space. Due to this, the Earth is also called the Blue Planet.

The four outermost planets—Jupiter, Saturn, Uranus and Neptune—are much larger compared to the Earth, and are mostly made of gases. These giant gaseous planets have large flat ring-like structures around them which are made of dust particles and rocky material.

Planets get most of their energy from the Sun. So, the farther they are, the colder they are in general. The presence of an atmosphere on a planet can trap heat which can significantly change the temperature of a planet. That is why Venus, for example, is hotter than Mercury, although it is farther from the Sun.

More to know!

There is another object called Pluto that lies farther than Neptune, and revolves around the Sun. It is smaller than the Earth's Moon. When it was discovered, it was called a planet of the Solar System. But later, when similar more small objects were discovered, the International Astronomical Union (IAU) in 2006 redefined the requirements of an object to be called a planet. As per this definition, these smaller objects, including Pluto, are now called dwarf planets.

Among the planets, it is easiest to identify Venus which is very bright. After the Sun and the Moon, Venus is the brightest object in the sky. Mercury, Mars, Jupiter and Saturn can also be seen with the naked eye. They are

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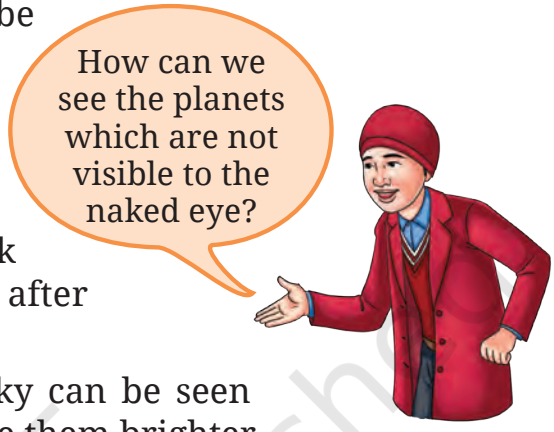
so far away that they look like shining dots, just like stars. So how can we distinguish between planets and the stars? Unlike planets, the stars appear to twinkle a lot.

Activity 12.4: Let us try to identify

- For most of the year, Venus can be located either at dawn or at dusk.
- When you are viewing at dawn, look for it near the Eastern direction before sunrise.
- When you are viewing at dusk, look for it near the Western direction after sunset.



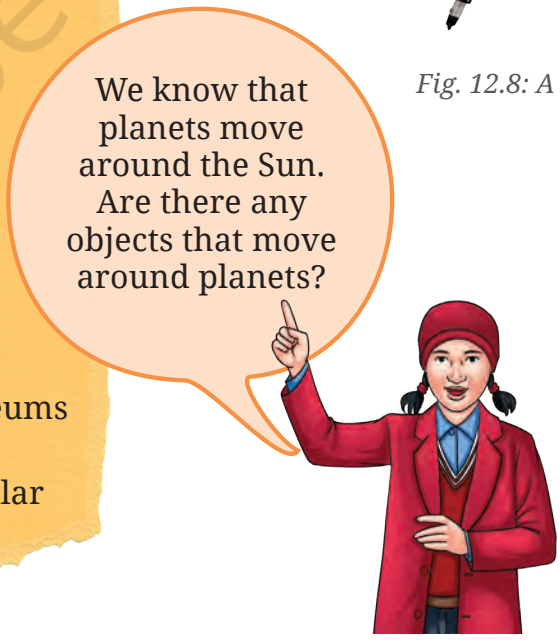
While many of the objects in the sky can be seen with our naked eyes directly, we can see them brighter and larger using a pair of binoculars or an instrument called a telescope (Fig. 12.8). A telescope also helps us view many dim objects not visible by our naked eyes directly.

You may get an opportunity to view the sky through a telescope whenever a night sky watching event is organised in your region.

Fig. 12.8: A telescope

Do you know?

Many Higher Education Institutions conduct night sky watching activities for school students. There are many Amateur Astronomy Clubs all over the country which organise sky watching events periodically. Museums and Planetariums also organise similar events.



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Natural Satellites

Objects that move around planets are commonly called satellites. They are smaller in size than planets. Moons are natural satellites of planets. The Earth has one Moon, while Mars has two moons. Jupiter, Saturn, Uranus and Neptune have a large number of moons.

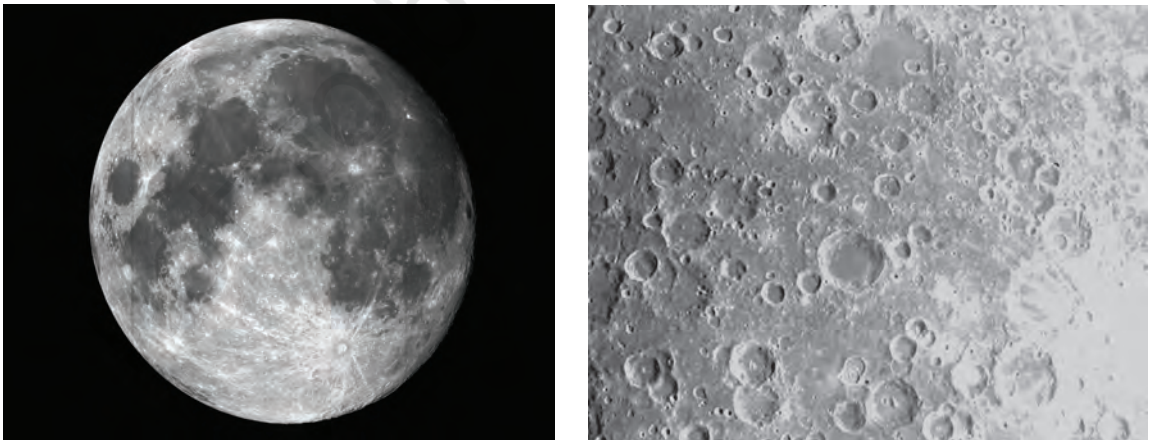
In general, any object that moves around a much larger object can also be called a satellite. For example, Earth can be considered a satellite of the Sun.

More to know!

The Moon is about 3,84,000 km away from the Earth.

The Moon

Earth's natural satellite, the Moon, takes about 27 days to complete one revolution around the Earth. It is our nearest neighbour in the space. Unlike on the Earth, there is hardly any atmosphere on the Moon. How big is the Moon as compared to the Earth? The Moon is about a quarter the size of the Earth in diameter. The Moon's surface shows circular bowl-like structures called craters (Fig. 12.9). Most of these craters have been formed due to the impact of asteroids or rocks from the space hitting the Moon's surface. Since there is no



(a) (b)

Fig. 12.9: The Moon
(a) Image taken by Cartosat, ISRO.
(b) Close-up image by cameras onboard Chandrayaan-3, ISRO.

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atmosphere, water or life on the Moon, these features stay on the Moon's surface for a very long time.

Although the Moon is very far, humans have sent spacecrafts to explore and understand more about the Moon. India has also launched three Chandrayaan missions to study the Moon, and a further mission is being planned.

Do you know?

To improve our understanding of the Moon, India's first mission to the Moon, Chandrayaan-1, was launched in 2008 and the second mission, Chandrayaan-2, in 2019. The third mission, Chandrayaan-3, was launched in July 2023 and its Vikram lander carrying the Pragyan rover successfully soft-landed on the Moon on 23 August 2023. With this mission, India became the first country in the world to achieve a landing near the little explored Moon's south pole. To mark this success, the Government of India declared 23 August to be celebrated as 'National Space Day' in India. A fourth mission, Chandrayaan-4, is being planned which aims to bring back soil and rock samples from the Moon.

Asteroids

The Sun and the planets are nearly spherical in shape. There are many small objects in the Solar System which are rocky and irregular in shape. These are called asteroids. Many of these asteroids revolve around the Sun in paths that lie between those of Mars and Jupiter. This region is called the asteroid belt (Fig. 12.7). Occasionally, asteroids pass very close to the Earth.

More to know!

The sizes of asteroids are from 10 m to about 500 km.

Comets

Sometimes we have visitors from the outer regions of the Solar System! These objects with long tails are called comets (Fig. 12.10). They are made up of dust, gases, rocks and ice. As a comet approaches close to the Sun, the frozen material in it starts evaporating. This evaporating

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material forms the tail of the comet. Comets appear dim as they move away from the Sun and then, it is not possible to see them with the naked eye.

Fig. 12.10: A Comet

Many comets have been found that revolve around the Sun. These comets approach close to the Sun periodically. However, there are a few comets that escape and move out of the Solar System. Few other comets get broken up, or fall into the Sun or other planets when they approach them.

We have learnt about the objects which form the Solar System. Which are these objects? **The Sun, eight planets, their moons, and many smaller objects including asteroids, and comets, together form the Solar System.**

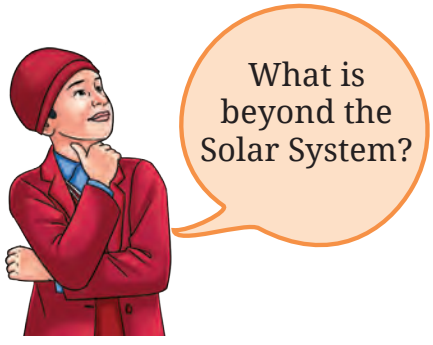
The Sun—our star—is the largest and the heaviest object in the Solar System. The Sun produces almost all the energy in the Solar System. All other objects in our Solar System shine due to the sunlight that they reflect from their surfaces.

One famous comet is the Halley's Comet which appears every 76 years. Its last appearance was in 1986.

More to know!

In Sanskrit and a few other Indian languages, a comet is called *Dhūmaketu*. Various tribes in India also call it *Pucchya-Taro* (star with a tail) or *Zendya-Taro* (star like a flag).

In many cultures, comets have been feared and it was earlier believed that comets bring bad luck. However, thanks to scientists, we now know that these are just icy-rocky visitors making a trip close to the Sun!



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12.4 The Milky Way Galaxy

In the moonless night sky, viewed from dark locations away from city lights, one can see an extended faint band of light from near north to south across the sky (Fig. 12.11). This is our home galaxy called the Milky Way Galaxy or *Ākāśha Gangā*. A galaxy has millions to billions of stars. Our Solar System is part of the Milky Way Galaxy.

Fig. 12.11: Milky Way Galaxy as seen from a very dark location in Ladakh, India

12.5 The Universe

There are many galaxies in the outer space beyond the Milky Way Galaxy. Scientists study them to understand the stars, galaxies and the universe.

We do not know yet if life exists elsewhere in the Universe. The search for life has been directed mostly towards exoplanets—the planets discovered revolving around other stars in our galaxy. Till now, scientists have not found any evidence of life but this search is on and continuing.

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Keywords

Asteroid
Comet
Constellation
Milky Way Galaxy
Moon
Planet
Revolution
Satellite
Solar System
Stars
Sun
Draw
Explore
Identify
Observe

Summary

Key Points

- The sky is divided into regions called constellations, which include groups of stars that appear to form patterns.
- The Pole Star appears stationary in the North direction, which helps in locating the North direction in the Northern hemisphere.
- The Sun is a star which produces heat and light.
- A planet is a large, nearly spherical object that revolves around the Sun.

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- The eight planets, in order of their increasing distance from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.
- The Earth revolves around the Sun in nearly one year.
- Objects that move around planets are commonly called satellites.
- The Moon is Earth's natural satellite.
- The Moon revolves around the Earth in nearly 27 days.
- The Sun, eight planets, their moons, and many smaller objects including asteroids and comets, together form the Solar System.
- Our Solar System is part of the Milky Way Galaxy.

Let us enhance our learning

1. Match the column:

Column I	Column II
(i) Satellite of Earth	(a) Orion
(ii) Red planet	(b) Venus
(iii) Constellation	(c) Mars
(iv) Planet which is commonly called an evening star	(d) Moon

2. (i) Solve the following riddle.
   My first alphabet is in MAN but not in CAN
   My second alphabet is in ACE and also in FAN
   My third alphabet is in RAT and not in CAT
   My fourth alphabet is in SUN but not in FUN
   I am a planet that moves around the Sun.

   (ii) Make two similar riddles by yourself.

3. Which of the following is not a member of our Solar System?
   (i) Sirius (ii) Comets
   (iii) Asteroids (iv) Pluto

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4. Which of the following is not a planet of the Sun?

(i) Jupiter (ii) Pluto
(iii) Neptune (iv) Saturn

5. Which is the brighter star, the Pole Star or Sirius?

6. An artist's representation of the Solar System is given in Fig. 12.12. Is the order of the planets correct? If not, write the correct order in the boxes in the figure.

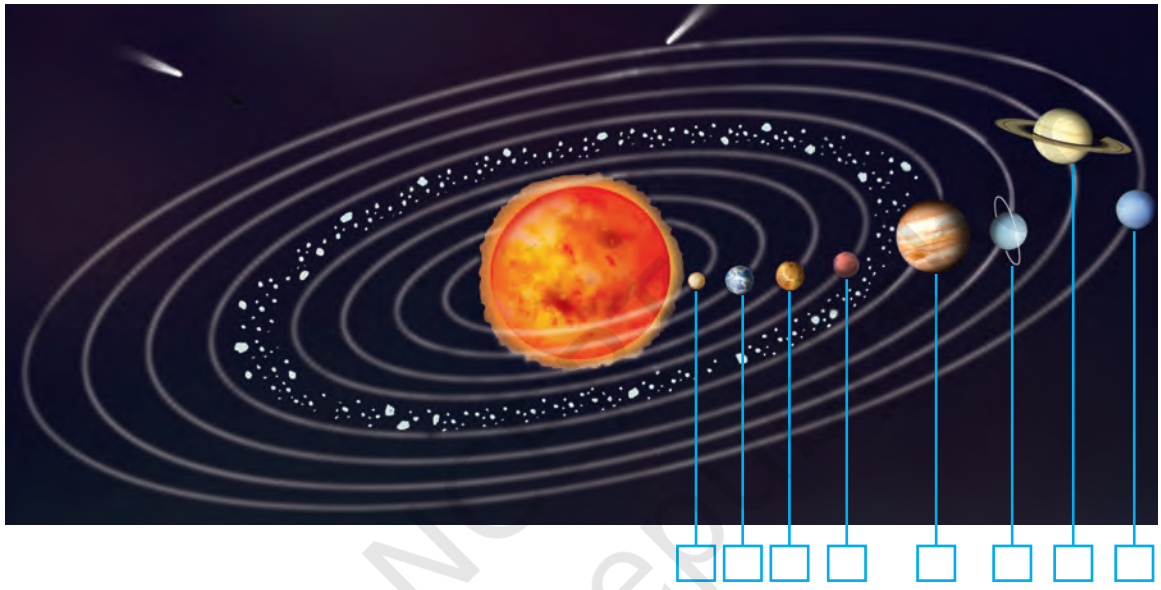

Fig. 12.12

7. A portion of night sky with stars is shown in Fig. 12.13. Look carefully and identify the groups of stars that form the patterns—the Big Dipper and the Little Dipper. Draw lines to connect the stars for these patterns and label them. Also, identify and label the Pole Star. You may refer to Fig. 12.4 for help.

Fig. 12.13

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8. A portion of the night sky is shown in Fig. 12.14. Draw lines to connect the stars for Orion and label the star Sirius. You may refer to Fig. 12.3.

Fig. 12.14

9. You can see stars fading away at dawn and appearing at dusk. During the day we do not see the stars. Explain why.

10. During a clear night, try to observe the Big Dipper 3–4 times at an interval of 2 to 3 hours. Also try to locate the Pole Star each time. Does the Big Dipper appear to move? Draw a rough sketch to illustrate this, mentioning the time in each case.

11. Think about the night sky and write a poem or a story on it.

Learning further

- Try to find out the names of planets in your local language. Also, find out the stories associated with stars and constellations in your region. Present these stories in a pictorial form.
- If there is a planetarium or a science museum nearby, then you can visit it, especially if a night sky observation session is scheduled by them. You will get to see the Moon, the planets and the stars through a telescope. If you visit the planetarium during daytime, you can also see their models, pictures and sky shows.

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Fig. 12.15: Embroidery of constellations

- Find out if the increasing light pollution is causing problems for humans, wildlife and the environment. Write an action that you would take at the personal level to control light pollution.
- Find out the weather conditions due to which the Indian Institute of Astrophysics (IIA) found Hanle, Ladakh a suitable place to set up an observatory.
- If you enjoy doing embroidery, try to embroider on a dark coloured cloth the constellations that you have seen (Fig. 12.15). Otherwise, you may use your creativity and depict constellations in multiple other ways using various art and craft ideas.

More to know!

Indian Astronomical Observatory, Hanle, is situated atop the highest peak of Digpa-ratsa-Ri mountain range in Hanle. This peak has been renamed Mount Saraswati.

It has several telescopes. One of them is called the Himalayan Chandra Telescope, which has been named after the Nobel Prize winning scientist Subrahmanyan Chandrasekhar. It is an observatory at one of the highest locations in the world.

The area surrounding this observatory was notified as the Hanle Dark Sky Reserve (HDSR) in December 2022. The reserve is open to the public throughout the year. Local people have been provided with small telescopes and are trained to be Astronomy Ambassadors for visitors by the Indian Institute of Astrophysics. It is expected to promote astro-tourism in the region.

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It is not the end, my friend!

This might be the last page of this book, but it is certainly not the end of our 'Curiosity'. The title of this book not only drives our journey through the amazing world of science, but also defines what it means to be human. As a species, we are curious. We want to find out more about the world we live in and worlds beyond. By now, you have perhaps read a little bit about the world of plants and animals, done some fun activities, learnt about how we measure, wondered about the stars that shine in the night sky, and so on. But remember, this is just the beginning. Science is a never-ending adventure, with new discoveries coming up all the time. And as you progress through the Middle Stage, the things you come across will help you find out even more about the world around you. The key lies in that curiosity you have nurtured throughout this journey. Keep observing the world around you, keep asking questions, and do not be afraid to experiment. Remember, even the most groundbreaking discoveries often begin with a simple "Why?". There are countless questions waiting to be answered, and countless answers waiting to be questioned. You, my young scientist, can find them out. So, go forth and explore! And see you again in the next Grade for more adventures in science!

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Notes

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Chapter 1

The Wonderful World of Science

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As human beings, we have always been curious about our surroundings. We start exploring our surroundings and asking questions right from our childhood. Did you enjoy discovering and exploring the world around you in the Preparatory Stage of school? As you enter the Middle Stage, we will continue this fascinating journey, trying to explore and understand the beautiful world we live in. And for that, we have a new subject, Science. Welcome to the wonderful world of Science!

What is Science?

Science is a way of thinking, observing and doing things to understand the world we live in and to uncover the secrets of the universe. Think of it as a big adventure—we ask questions, explore the world and try to understand how things work. For this, the most important thing is to have 'Curiosity', which is where the title of this book comes from.

Whether it is studying tiny grains of sand or massive mountains, a leaf of grass or a vast forest, there is always something new and exciting to discover. Have you ever looked up at the night sky and wondered why the stars shine? Or watched a flower bloom and wondered how it knows when to open?

These are just a few of the many mysteries that science helps us unravel. The most wonderful thing about science is that it is everywhere. From the depths of the ocean to the

A mountainous region

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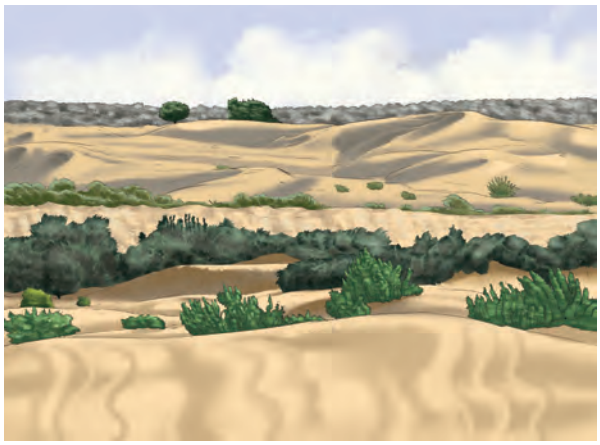

A Desert

A Coast

vastness of outer space, from what is cooking in the kitchen to what is happening on the playground, some of the most groundbreaking discoveries have often come from unexpected places.

An underwater view of an Ocean

A Galaxy

Science is like a giant and unending jigsaw puzzle. Every new discovery we make adds another piece to that puzzle. And you know the best thing about this puzzle? There is no limit to what we can discover, since every new piece of knowledge leads to more questions and more things to find out. Sometimes, we find that a piece of this puzzle has been put in the wrong place and needs to be moved. New discoveries often change our understanding of the world.

As you go through this book, you will encounter interesting ideas, do some thought-provoking experiments, and see how some of what we will find out is useful in our

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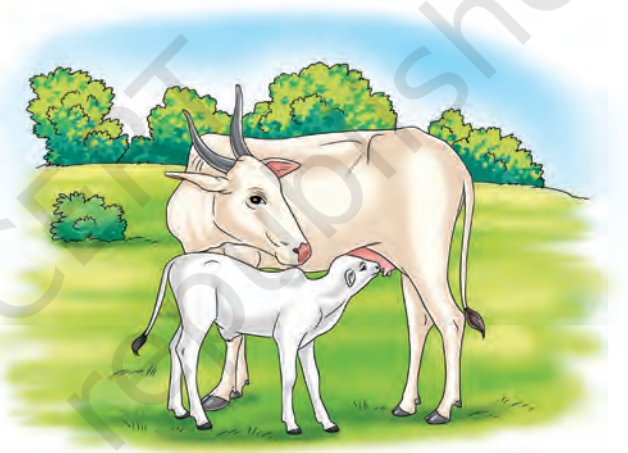
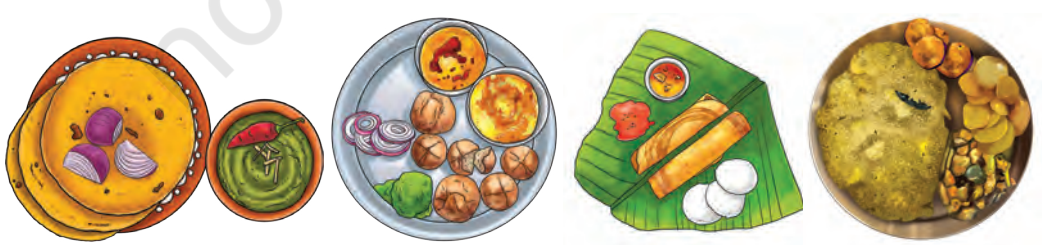
daily lives. And guess what happens as we discover more and more? We start realising that these ideas are all connected.

What will we explore with the help of this book? ?

We will start off by looking at our home, planet Earth. It is the only planet we know that supports life, and it has an environment that we must protect. There is an amazing variety of life on Earth—plants and animals that have managed to survive and thrive in different regions on this planet. You might have seen a seed grow into a plant, a caterpillar transform into a beautiful butterfly and many more such observations. How do these plants and animals grow?



Of course, to grow, we need food to eat, and especially in a large and diverse country like India, food is so fascinating. Across the country, we have different cuisines with their many tasty dishes. What are they made of? How do we find out?



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Along with food, we need water to survive. Water is such a delightful substance. Have you ever jumped in a puddle when it rained? Do you ever wonder why and how it rains?

Have you noticed that water freezes and becomes ice when we cool it and boils and becomes steam when we heat it? Do you enjoy drinking cool water in the summer or showering with warm water in the winter? How do we understand hot and cold? Whether it is water, or our own body when we have fever, finding out how hot something is can be important!

Then again, there are so many different things around us—the paper we write on, the metal key, the plastic ruler and the rubber eraser in our box, the magnet that keeps the box closed, the clothes we wear, the cup we drink milk in and so many other things. What are they made of? Are they made of different materials? How do we separate different materials from one another?

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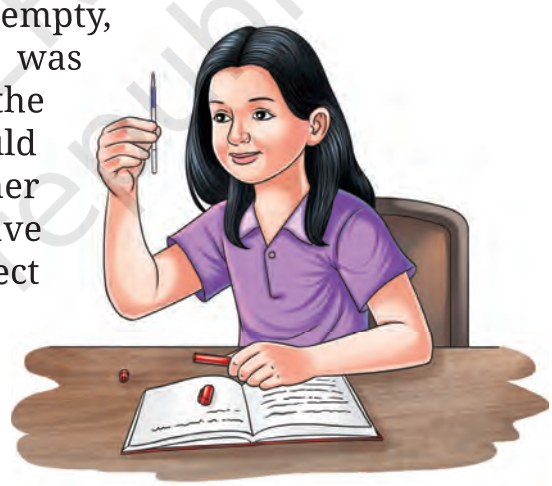
We will have an almost unending list of questions about everything on Earth as we further explore this book. But why limit our questions to the Earth alone? We can ask questions on things beyond—the Sun, the Moon, and the millions of stars that shine in the sky!

Whether you are learning about the structure of a leaf, discovering how things move, or separating the skin of a peanut seed, we hope each chapter of this book will ignite your spirit of inquiry. And hopefully you will have lots of questions on your mind!

How can we try to find answers to our questions on our own?

Even though you may have not realised, you have already been finding answers to many of your questions. Suppose your pen stops writing. What would you do? You would ask yourself the question, "Why did my pen stop writing?" You might guess that the ink finished.

You would then test this guess by opening the pen and checking the ink refill. If it is empty, you would know that your guess was correct. But suppose you found that the ink was not finished. Now what would you do? You would make another guess—perhaps the ink might have dried up. To test if this guess is correct or not, you will try something else.



This is exactly how Science works! The way you tried to find out why your pen stopped writing is an example of the **scientific method.**

Activity 1.1: Let us think and write

- Write about a similar problem that you tried to solve.
- What steps did you take?

Science is not just about memorising facts and figures or doing experiments. It is about following a step-by-step process that helps us find answers to our questions. So what are the steps that we can follow?

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First, we observe something that we find interesting or we do not understand.

This makes us wonder and perhaps think of a question about it.

Then, we guess a possible answer to that question.

We test this guess through experiments or more observations.

We then try to analyse the results to see if it actually answers our question.

Scientists are people who follow the scientific method to solve problems or to discover new things. But anyone who follows the scientific method is working like a scientist. Someone cooking food may be wondering why the *dal* has spilled out of the cooker—was there too much water?

Think of a bicycle repair person trying to find out why a tyre is flat—from where did the air leak out? Or an electrician trying to find why a light bulb is not working—is there some problem with the bulb or the switch? When we try to ask questions and find out answers, we are all, in a way, scientists!

Activity 1.2: Let us think and write

- Describe a daily life situation where you think someone was following a scientific method.

Do you now realise that there are several daily-life situations where we knowingly or unknowingly apply the scientific

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method? Though we all apply the scientific method to some extent, learning science will develop our capabilities for finding solutions to bigger problems and solving more mysteries of the universe. And to be able to learn science well, the first and foremost thing is to be curious and observe your surroundings keenly. And when we are curious, we start posing questions, asking how and why? Just remember, the world is full of things we do not know, things that are waiting to be explored.

Activity 1.3: Let us think and write

- If you have to ask "Why?" about something, what would you ask about?
- Try to write down how you would attempt to find an answer to your question.

Science is rarely done alone. Scientists across the world work together, often in large teams. So, if you cannot find an answer yourself, ask your friends to help you out! It is always more fun to discover things together.

Of course, remember that you will not find answers to all your questions in Grade 6. Do not worry, you are embarking upon a journey of science for the next five years or even beyond!

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Much like children enjoying the rain, science is all about joyful exploration. Enjoy your scientific journey, keep exploring and never stop wondering about the amazing mysteries of the universe and asking questions.

After all, to be a wise person, you must be a "whys" person!

Are you ready to embark upon the exciting journey of science? Let us get started!!

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Chapter 2

Diversity in the Living World

“ छायामन्यस्य कुर्वन्ति तिष्ठन्ति स्वयमातपे ।
फलान्यपि परार्थाय वृक्षाः सत्पुरुषा इव ॥

(सुभाषित)

Trees stand in the Sun and give shade to others. Their fruits are also for others. Likewise, good people bear all hardships and bring welfare to others. They give to others whatever they have earned.

(Wise saying) ”

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It is a pleasant morning after yesterday’s refreshing rain. Dr Raghu and Maniram *chacha* (uncle) have been invited to the school by the science teacher, Madam Sulekha, to

facilitate an exciting nature walk. Dr Raghu is a scientist at the nearby Research Laboratory and Maniram *chacha* is an elderly person from a nearby community. Maniram *chacha* is an expert in mimicking bird calls. He is also brilliant at identifying a variety of plants and animals.

To prepare them for the nature walk, Dr Raghu informs the students that the objective of this walk is to experience the beauty and variety of plants and animals in the nature. The students are excited to join them. They are curious to interact and learn from them. The teacher advises the students to carry a notebook, a pen and a water bottle.

As they walk, they begin exploring the plants and animals around them. Dr Raghu advises the students to notice the variety of smells in the park and emphasises respecting all living creatures and observing them without disturbing. Maniram *chacha* tells the students to not only observe different plants and animals but also to carefully listen to different sounds. The students come across a variety of plants, including grasses, bushes, and large trees. They also observe a variety of birds sitting on the branches of trees, butterflies moving from flower to flower and monkeys jumping from one tree to another. They record their observations in their notebooks and discuss them with Dr Raghu and Maniram *chacha*.

The students can hear the chirping of birds. Dr Raghu informs them that each bird has a unique chirp. This is an example of diversity in nature. Dr Raghu requests Maniram *chacha* to mimic calls of some birds. Maniram *chacha* mimics different bird calls. The students enthusiastically start copying him.

Have you ever observed different plants and animals around you? Share and discuss your observations with your friends and teacher.

2.1 Diversity in Plants and Animals Around Us

Activity 2.1: Let us explore and record

- Plan a nature walk with your teacher to a park or a nearby forest.
- While on the nature walk, **observe** different plants, insects, birds, and other animals. Also, note the weather conditions, whether it is hot, cold, windy and so on.

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- You can collect different types of fallen leaves or flowers and **create** a scrapbook.
- Take care of the plants and animals in nature. Ensure that you do not disturb the plants and animals in the park. Do not pluck leaves and flowers.
- **Record** your observations in Table 2.1 about the features of stems, leaves, flowers and anything interesting in various plants. Some examples have been given for you in Fig. 2.1 and Table 2.1.

(a) Grass *(b) Tulsi (Holy Basil)* *(c) Hibiscus (Gudhal)*

Fig. 2.1: Examples of different features of some plants

Table 2.1: Observations of different plants around us

S. no.	Local name of plant	Stem	Leaves (shape/ arrangement of leaves)	Flowers	Any other observations and features
1.	Common grass	Soft and thin	A single leaf grows alternatively from different points on the stem		Green leaves
2.	*Tulsi*	Hard and thin	Arrangement of a pair of leaves in the opposite directions	Pinkish purple	
3.	Hibiscus	Hard			
4.	Neem	Hard and thick			Leaves with smooth surface
5.	Any other				

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What similarities and differences did you find among the plants that you observed?

You must have observed that plants have a variety of features such as—

- tall/short, hard/soft stem
- different shapes of leaves and their arrangement on the stem or branches
- flowers varying in colour, shape, and scent

Now, create a list of animals you observed during this walk or from your previous experiences. Record the places where they live, the food they eat and the way they move around in Table 2.2. Some examples have been provided for you.

Table 2.2: Observations of different animals around us

Name of the animal (local name)	Place where they live	Food they eat	The way they move around	Any other observations and features
Crow	Tree	Insects	Fly and walk	Carrying a twig in its beak
Ant	Nest in soil and burrow	Leaves, seeds and insects		Have six legs
Cow		Grasses, leaves		
Any other				

What are the similarities and differences among the animals that you have observed and recorded in Table 2.2?

You would have observed that some animals live on land while some others live on trees. Birds live on trees. Fish live in water and some animals like frogs live on land as well as in water. Animals consume a diverse range of foods and exhibit a variety of movements.

Sketch the plants and animals observed by you in your notebook or prepare a scrapbook with leaves, flowers from different plants and feathers from animals. Write all the details you have gathered about them.

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While travelling to and from school, observe your surroundings and look out for a variety of plants and animals. Add the name of any plant or animal that you have not listed before in Tables 2.1 and 2.2.

Activity 2.2: Let us appreciate

- Close your eyes for 30 seconds and think of one plant and one animal that you have closely observed and appreciated very much.
- Now each one of you can draw the plant and animal that you thought of on the blackboard.
- What are your observations about the various plants and animals that have been drawn?

- How many different plants and animals did the entire class draw on the blackboard?
- Do you think that there may be many more varieties of plants and animals other than those drawn on the board?

The variety of plants and animals found in a particular region contributes to the **biodiversity** of that region.

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Each member in the biodiversity of a region has a different role to play. For example, trees provide food and shelter to some birds and other animals, animals help in spreading seeds after eating fruits, and so on. Can you think of more such examples? This shows that plants and animals are dependent on each other.

2.2 How to Group Plants and Animals?

How would you arrange your books and notebooks in groups? Would arranging them in groups help you better organise your school bag?

Now, let us look at the world around us. We are surrounded by a variety of plants and animals with different features about which you have learnt in section 2.1. We can group them based on similarities and differences among them.

Activity 2.3: Let us group

- Collect pictures of various other plants and animals. Cut their pictures from old magazines, newspapers, charts and other sources. Paste each of these pictures on a different card.
- Divide your class in groups of 5–6 students each.
- Pool the cards prepared by the students in your group.
- Observe various features of plants and animals shown on the cards.
- Recall the features of plants and animals that you have listed in Tables 2.1 and 2.2.
- **Group** them on the basis of common features.
- Share and discuss the basis of grouping you have made with other groups in your class.

You will be surprised to see that the basis used by different groups may vary. What do you think are the reasons behind it? Different students might have chosen different common features for the grouping. For example, some students may have chosen the height of plants as the basis for grouping while others might have chosen presence or absence of flowers as the basis for grouping of plants (See Fig. 2.2).

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Fig. 2.2: Some possible criteria of groupings of plants and animals

You may have grouped animals based on varied features, such as what they eat, where they live, what colour they are and how they move.

What is the importance of grouping? Grouping makes it easier to understand and study plants and animals on the basis of their similarities and differences.

You will learn more about the importance of grouping in our daily lives in the chapter, 'Materials Around Us'.

2.2.1 How to group plants?

You must have noticed that plants show variation in the features related to stems, leaves, flowers, and more. The stems of different plants vary in thickness, height, and hardness, while the leaves vary in shape, colour, size and arrangement. You might have tried grouping the plants in Activity 2.3 using one of these features.

You might have also learnt in earlier classes that plants can be grouped into herbs, shrubs, and trees based on their height and types of stem. Let us study the features of plants in more detail and group them on that basis.

Activity 2.4: Let us group

- Let us go on a nature walk again for some more interesting observations.
- Look closely at the height of different plants. Are these plants shorter than you, as tall as you, or taller than you?
- Is the stem brown or green? Touch and feel the stems and try to bend them gently. Can you bend the stem easily, or is it stiff? Take care that the stems do not break.
- Also, observe from where the branches of the plants arise—whether they arise close to the ground or higher up on the stem. Fill in your observations in Table 2.3. A few examples are already given.

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Table 2.3: Grouping of plants based on height and nature of stem

S. no.	Name of the plant	Height	Nature of stem			Appearance of branches		Name of plant group
		Short/ Medium/ Tall	Green/ Brown	Tender/ Hard	Thick/ Thin	Close to the ground	Higher up on the stem	
1.	Mango	Tall	Brown	Hard	Thick		Yes	Tree
2.	Rose	Medium	Brown	Hard	Thin	Yes		Shrub
3.	Tomato	Short	Green	Tender	Thin	Yes		Herb

(a) Tree

What differences do you observe among herbs, shrubs, and trees? How can you group plants as herbs, shrubs, and trees based on the data entered in Table 2.3?

Some plants grow really tall and have hard, thick, brown, and woody stems. Their branches typically start higher up on the stem and away from the ground. These plants are called **trees**. For example, a mango tree (Fig. 2.3a).

(b) Shrub

(c) Herb

Fig. 2.3: Types of plants

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Some plants are not as tall as trees. These plants often have many brown woody stems that start branching very close to the ground. These stems are hard but not as thick as the stem of a tree. These plants are called **shrubs**. For example, a rose plant is a shrub (Fig. 2.3b).

Some plants are typically small with soft and green stems. These are known as **herbs**. For example, a tomato plant is a herb (Fig. 2.3c).

Some plants with weak stems need support to climb and grow, and are called **climbers**. Some plants creep along the ground and are called **creepers**.

What can be other features on the basis of which you can group plants? Let us perform another activity.

Activity 2.5: Let us compare

- Look at the leaves of different plants collected by you, during the nature walk.
- Do you notice any variation in the shape and structure of these leaves?

You may observe thin lines on the leaves of the plants (Fig. 2.4a). These are **veins**. The pattern of veins on the leaf is called **venation**. What differences do you see in the veins of leaves shown in Fig. 2.4a and Fig. 2.4b?

(a) Hibiscus leaf with reticulate venation

(b) Banana leaf with parallel venation

(c) Grass leaf with parallel venation

Fig. 2.4: Leaves showing different types of venation

In some leaves, you can observe a net-like pattern of veins on both sides of a thick middle vein. This pattern is called **reticulate venation**. For example, leaves of hibiscus exhibit reticulate venation (Fig. 2.4a). In some leaves, you may observe that the veins run parallel. This pattern is called **parallel venation**. For example, the leaves of banana plants and grasses exhibit parallel venation (Fig. 2.4b and Fig. 2.4c).

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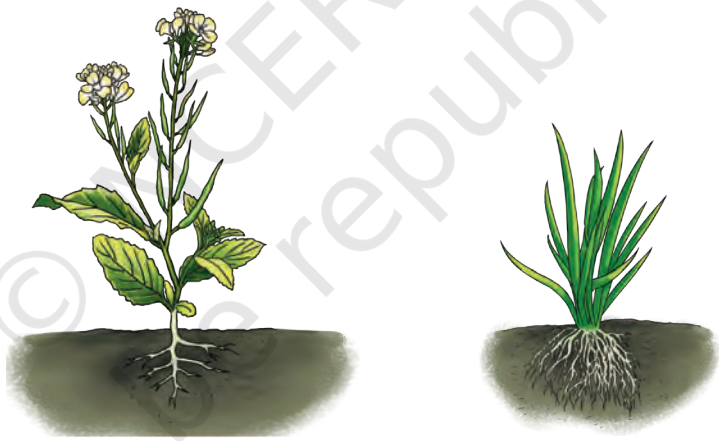
Do you think that plants can be grouped on the basis of venation present in their leaves?

Now, let us try to **explore** roots of the plants. Do all plants have roots? Are these roots similar?

Activity 2.6: Let us find out

- Visit an open area where wild herbs and grasses are growing. You may use small herbs for this exercise.
- Using a *khurpi* (trowel), carefully dig out a few different herbs without damaging the roots. To do this, you may wet the soil and loosen it.
- Wash the roots with water and observe them.
- After you are done observing, make sure to replant the herbs so that they may continue to thrive and grow.

What are the similarities and differences in the roots of the plants collected by you? What differences do you see in the roots of plants shown in Fig. 2.5a and Fig. 2.5b?



(a) Taproot system in a mustard plant

(b) Fibrous root system in common grass

Fig. 2.5: Types of roots

Carefully observe the roots of a mustard plant in Fig. 2.5a. The roots of this plant consist of one main root and small side roots arising from it. The main root is called **taproot**. Another example of a plant having taproots is hibiscus observed by you in Activity 2.1. The plant in Fig. 2.5b is a common grass plant. The roots of this plant appear as a bunch of similar-sized thin roots arising from the base of the stem. Such roots are called **fibrous roots** (Fig. 2.5b). Does your collection include any other grasses? What kind of roots do they have?

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Is there any relation between the type of leaf venation and the type of root of the same plant? How do we find this out?

Activity 2.7: Let us relate and analyse

- Collect saplings of five common plants from your school nursery or any other nurseries to plant in your school garden. Examples of such plants can include lemongrass, marigold, *sadabahar* (periwinkle), and others.
- Before planting them, observe their roots and the venation in their leaves.
- Record your observations in Table 2.4.

Table 2.4: Types of leaf venation and roots

S. no.	Name of the plant	Type of leaf venation (reticulate/ parallel)	Type of root (fibrous/tap)
1.	Lemongrass	Parallel	Fibrous
2.			
3.			
4.			
5.			

Do you observe any relation between the leaf venation and types of root in these plants? A *sadabahar* plant has a taproot and its leaves have reticulate venation. Do other plants with reticulate venation have taproots too? Lemongrass, on the other hand, has fibrous roots and its leaves have parallel venation. Do other plants with parallel venation have fibrous roots too? Generally, plants with reticulate venation have taproots while those with parallel venation have fibrous roots.

Chickpea (*chana*) is another example of a plant with taproots and reticulate venation in leaves. Wheat is an example of a plant with fibrous roots and parallel venation in its leaves.

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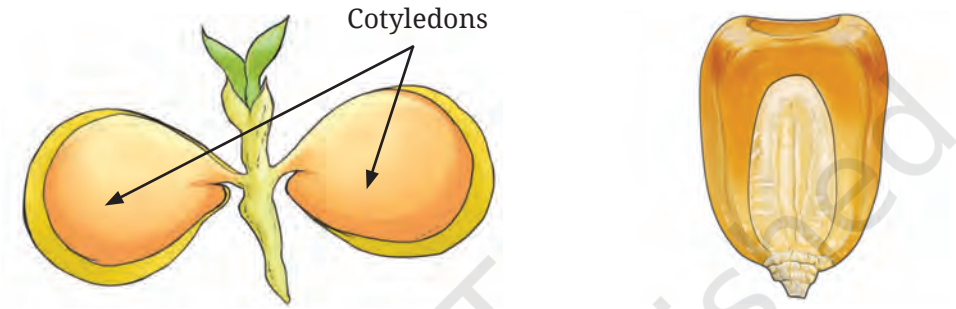
Is there any relation among the seed of a plant, types of root and leaf venation? Are all seeds similar?

Activity 2.8: Let us compare

- Soak some chickpea and maize seeds in water for two or three days.
- Remove the seed coat of a chickpea. Now, observe the structure of the chickpea and maize seeds. Are they similar or different?



(a) Dicot seed (chickpea) *(b) Monocot seed (maize)*

Fig. 2.6: Dicot and monocot seeds

You would notice that chickpea seeds are split into two parts (Fig. 2.6a). Each part is called a **cotyledon**. Plants that have seeds with two cotyledons are called **dicotyledons (dicots)**. Maize has a single thin cotyledon (Fig. 2.6b). Plants with such seeds are called **monocotyledons (monocots)**.

What relation do you observe among leaf venation, root types and the number of cotyledons in seeds of a plant? **Dicot plants** have reticulate venation and a taproot system while **monocot plants** have parallel venation and a fibrous root system.

You have learnt about some features used for grouping plants. Now, let us explore the grouping of animals in more detail.

2.2.2 How to group animals?

Just like plants, animals too are significantly different from one another. How can we group such a wide variety of animals? What features can you think of to group them? In Activity 2.3, you have already set some bases for grouping animals. Let us explore a few of these in more detail.

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Activity 2.9: Let us find out

You have recorded the movement of a few animals in Table 2.2. You may have also observed how other animals move from place to place. Let us now think about the types of movement in animals. A number of animals are shown in Fig. 2.7. You can add more animals that you may have observed and create a poster on the variety of animals. Which body parts are used by the animals in the poster you created and those in Fig. 2.7 for movement?

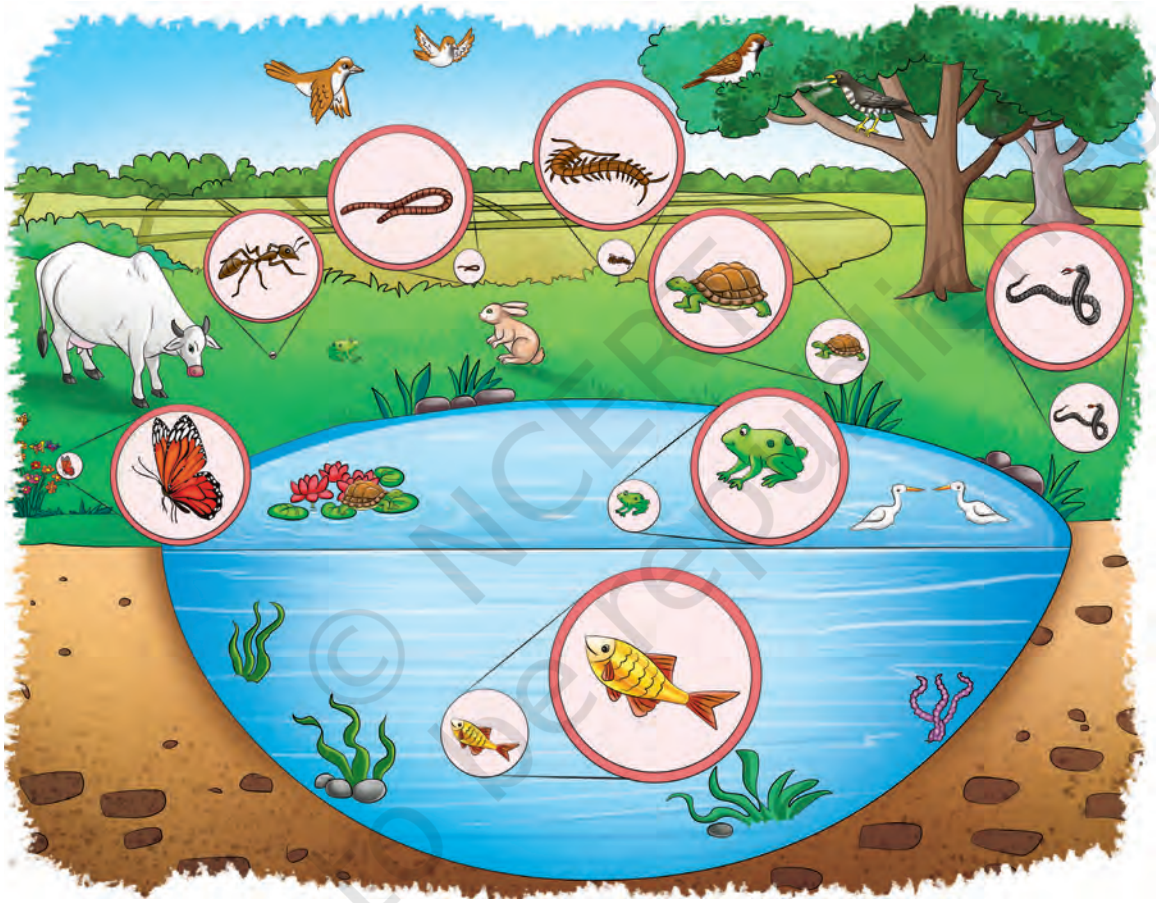

Fig. 2.7: Diversity in animals

- List these animals in Table 2.5.
- Note the ways in which these animals move and name the body parts used for movement. Some examples are given in Table 2.5.

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Table 2.5: Movements in animals and their body parts involved

S. no.	Name of the animal	Type of movement	Body parts used for movement
1.	Ant		Legs
2.	Goat	Walks and jumps	Legs
3.	Pigeon	Walks and flies	Legs and wings
4.	Housefly	Walks and flies	Legs and wings
5.	Fish		Fins
6.	Any other		
7.			
8.			

What conclusions can you draw from the data given in Table 2.5?

Different animals have different types of movement. Animals can fly, run, crawl, walk, hop or jump, and so on. They use different body parts for moving from one place to another. They may use wings, legs, and other parts that help them to move. Here, we have identified animals based on the types of movement and the body parts used for movement. How can we group animals based on their movements? Additionally, many animals differ from each other in shape, size, structure, colour, and other features. Some of these features can also be used to group animals in various ways. Like plants, grouping of animals is important for understanding their diversity.

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Know a scientist

Janaki Ammal (1897–1984) was an Indian botanist dedicated to environmental work and helped to document and preserve India's rich plant biodiversity. She played a key role in the 'Save Silent Valley' movement. As the head of the Botanical Survey of India, she initiated programmes to document the plant diversity of India.

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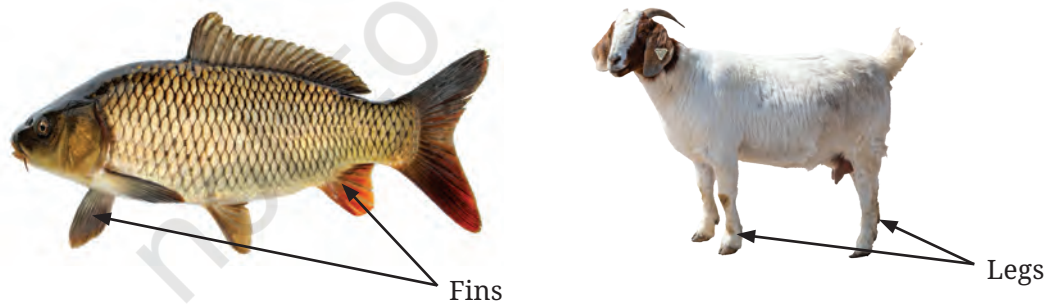
Success Story—Save Silent Valley Movement

This is a real story of a forest in the Palakkad district of Kerala. It is about preserving untouched beauty of a moist evergreen forest and its rich biodiversity. The now-famous Silent Valley was saved by a remarkable movement led by common people who were not even residing in the vicinity of the forest. The battle against the proposal of a hydroelectric dam across the Kunthipuzha river persisted for 10 years. At that time, people used all possible available means, such as widespread awareness programmes, letters to editors, articles in, newspapers, seminars, and petitions and appeals in court. The movement was successful in saving the Silent Valley.

More to know!

2.3 Plants and Animals in Different Surroundings

You might have observed during nature walks that different animals live in different surroundings. You have also recorded movement of animals in Table 2.5. Does the movement of these animals depend upon their surroundings? Let us consider fishes and goat as examples. Fishes live in water. They have streamlined bodies and fins for movement in water (Fig. 2.8a). Goats live in grassy areas and move with the help of legs (Fig. 2.8b). The sizes and shapes of animals also differ from one another.



(a) A fish swims in water with the help of fins

(b) A goat walks on the ground with the help of legs

Fig. 2.8: Body parts used by animals for movement

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Activity 2.10: Let us compare and analyse

- Look at Table 2.6. Recreate a similar table on the blackboard.
- List the names of plants and animals you or your classmates have observed in the regions given in the table or already know about. A few examples are given. You can add more.

Table 2.6: Animals and plants found in different surroundings

S. no.	In the desert	On mountains	In the ocean	In the forest	Any other region
1.	Camel	Deodar tree	Fish	Lion	
2.	Any other				
3.					

Fig. 2.9: Cactus with thick and fleshy stems in a desert

What are your observations regarding plants and animals found in various regions? Discuss your observations with your classmates.

You might observe from Table 2.6 that the plants and animals found in one kind of region are different from those found in another kind of region.

During a discussion in the classroom, Alex recalls that he observed cactus plants with thick and fleshy stems in the deserts of Rajasthan (Fig. 2.9). Maya shares that she saw deodar trees in the Himalayas of Himachal Pradesh (Fig. 2.10). These trees are conical in shape and have flexible and sloping branches.

Notice that these two types of plants found in different regions are different

Fig. 2.10: A deodar tree in the mountains

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from each other. Why is it so? Why does the biodiversity of a region vary from that of another? Let us find out.

There is very little water available in the deserts. A hot desert is typically very hot during the day and very cold at night. Therefore, you will find plants and animals in these areas that can tolerate and survive both the hot conditions during the day and cold conditions at night. The fleshy stems of plants found in the desert can store water and help them tolerate the hot conditions in these places.

The mountains in extremely cold regions experience frequent snowfall. In order to survive in such conditions, some of the trees have the ability to let the snow slide off easily. Conical shape and sloping branches of deodar trees enable them to do so easily.

You must have understood by now that the biodiversity varies from region to region because of diverse conditions.

Look at the images of a camel from the hot desert of Rajasthan (Fig. 2.11) and a camel from the cold desert of Ladakh (Fig. 2.12). What are the differences you observe between them? What advantages do these differences provide to these camels?

Fig. 2.11: A camel living in the hot desert of Rajasthan

Fig. 2.12: A camel living in the cold desert of Ladakh

The camel of the hot desert has long legs with wide hooves. Alex shares that his grandmother told him that the long legs and wide hooves help these camels to walk on the sandy desert without sinking into the sand. On the other hand, the height and legs of camels of a cold desert are comparatively shorter than those found in a hot desert. These short legs allow them to walk easily in mountainous regions.

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In deserts, food is not available easily. Camels store food in their humps. Camels found in the hot desert have one hump each that helps them to survive during the scarcity of food. Camels found in the cold desert have two humps each. These two humps shrink in late winters because there is not much food available in the cold desert and they have to use food stored in their humps during that time. Moreover, they grow long hair from head to neck, which help them survive the cold winters of Ladakh.

What other features can help camels to survive in the desert?

Other students also start sharing their observations. Kashi from Rajasthan says that camels excrete small amounts of urine, their dung is dry, and they do not sweat. As camels do not lose much water from their bodies, they can survive for many days without drinking water.

Maya talks about seeing plants with beautiful bright flowers, **rhododendrons**, in the Shola forests of Nilgiris. Here, rhododendrons are of shorter height and have smaller leaves to survive through the heavy winds on mountain tops. However, Pema, who is from Sikkim, mentions that she has observed rhododendrons in the nearby mountains to be taller (Fig. 2.13). So, even plants such as rhododendrons may exhibit different features in different regions to survive the conditions of those regions.

Fig. 2.13: Different features of rhododendrons

Sagar tells his classmates that he went to the Andaman and Nicobar Islands with his parents for a special event. He saw huge whales and colourful fish in the ocean. His father explained that the streamlined body of fish helps them to swim in water.

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We have learnt that the plants and animals living in a particular region have special features that make them fit to survive there. The special features that enable plants and animals to survive in a particular region are called **adaptations**.

The shape of the deodar tree and the height of the rhododendron are adaptations that enable them to survive in the mountainous regions.

The place where plants and animals live is called their **habitat**. For example, the habitat of sea turtles is the sea or the ocean. The habitat of a camel is the hot or the cold desert, and the habitat of a rhododendron is the mountains. The habitat of plants and animals provides them food, water, air, shelter and other needs for their survival. Many types of plants and animals may share the same habitat. Habitat plays an important role in shaping the biodiversity of a region.

Know a scientist

Salim Ali (1896–1987) travelled across India to observe diversity in birds. He prepared a list of birds and documented their travel routes and habitats. He recorded the regions with high diversity of birds and took measures to conserve these regions. Keoladeo National Park in Bharatpur, Rajasthan and Ranganathittu Bird Sanctuary in Mandya, Karnataka are examples of regions he preserved. He wrote a landmark series of 10 books on birds of the Indian Subcontinent. He is referred to as the 'Birdman of India'. He was awarded Padma Vibhushan in 1976.

What are the different ways in which you can group plants and animals based on their habitats? One way is to group them into those 'that live on land' and those 'that live in water'.

The plants and animals that live on land are said to live in **terrestrial** habitats. Some examples of terrestrial habitats are forests, deserts, grasslands, and mountains.

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The plants and animals that live in water are said to live in **aquatic** habitats. Some examples of aquatic habitats are ponds, lakes, rivers, and oceans.

Some animals, such as frogs, can live in water as well as on land. These are called **amphibians**.

What would happen if the habitat of a plant or an animal is damaged? What would happen if a goat does not get grass to eat? Can a fish survive without water?

Check with your parents, grandparents, and neighbours to know about the plants, birds, insects or any other animal they used to see frequently in their childhood but do not see as often now. These changes often happen when habitats are damaged. The damage to habitats of plants and animals results in loss of their homes, food, and other resources. This leads to the loss of biodiversity.

Do you know?

The population of the Bengal Tiger, Cheetah, and Great Indian Bustard has declined in India due to loss of natural habitats caused by human activities. The Government of India has initiated several projects to conserve our biodiversity. 'Project Tiger' was initiated in 1973 to protect the declining population of the Bengal Tiger. The 'Cheetah Reintroduction Project' was initiated in 2022 to restore the population of the Cheetah. Similarly, habitats of the Great Indian Bustards have been declared as Protected areas in the states of Gujarat, Rajasthan and Maharashtra.

Bengal Tiger

Cheetah

Great Indian Bustard

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Traditionally Protected Forests: Sacred Groves

Sacred groves are undisturbed patches of forests. Their sizes may vary from quite small to very large. Sacred groves are found all over India. They are home to different kinds of plants and animals, including numerous medicinal plants. These are protected by the local community and no one is allowed to harm any animals and cut trees in these groves, or disturb the area. This way, sacred groves are a community protected treasure of biodiversity. Find out about the sacred groves in your region.

Sacred grove from the Western Ghats

More to know!

We must protect biodiversity to ensure our planet is full of life, helping plants and animals to survive and thrive.

Keywords

Adaptation
Amphibians
Aquatic
Biodiversity
Cotyledon
Dicot plants
Fibrous root
Habitat
Herbs
Monocot plants
Parallel venation
Reticulate venation
Sacred groves
Shrubs
Taproot
Terrestrial
Tree
Venation
Analyse
Compare
Create
Explore
Group
Observe
Record
Relate

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Summary

Key Points

- We are surrounded by a large variety of plants and animals. Such variety of plants and animals is a part of biodiversity.
- Plants and animals can be grouped on the basis of similarities and differences among them.
- Plants have similarities and differences based on features associated with roots, stems, leaves, flowers, and so on.
- The method of arranging things into groups based on their common features is called grouping.
- Plants can be grouped into herbs, shrubs, and trees based on their heights, types of stem, and branching patterns.
- Plants can also be grouped as dicotyledons (dicots) and monocotyledons (monocots) based on the number of cotyledons in their seeds.
- Monocots generally exhibit parallel venation in their leaves and possess fibrous roots while dicots typically exhibit reticulate venation in their leaves and possess taproots.
- Animals have different types of movement that can be a basis for their grouping.
- Biodiversity of different regions varies because of distinct environmental conditions.
- The special features that enable plants and animals to survive in a particular region are called adaptations.
- The place where plants and animals live is their habitat.
- Based on their habitats, animals and plants can be grouped as terrestrial and aquatic.
- Due to damage of their habitats, plants and animals lose their homes, food and other resources resulting in the loss of biodiversity.
- We must protect biodiversity to ensure that our planet is full of life, helping plants and animals to survive and thrive.

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Let us enhance our learning

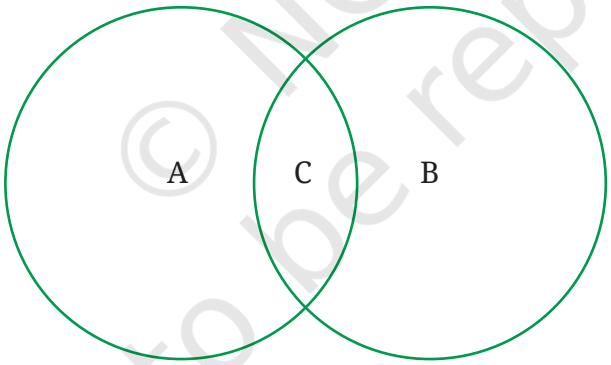
1. Here are two types of seeds. What differences do you find among the roots and leaf venation of their plants?

(a) Wheat

(b) Kidney beans

2. Names of some animals are given below. Group them based on their habitats. Write the names of aquatic animals in the area marked 'A' and terrestrial animals in the area marked 'B'. Enter the names of animals living in both habitats in part 'C'.

   Horse, Dolphin, Frog, Sheep, Crocodile, Squirrel, Whale, Earthworm, Pigeon, Tortoise



3. Manu's mother maintains a kitchen garden. One day, she was digging out radish from the soil. She told Manu that radish is a kind of root. Examine a radish and write what type of root it is. What type of venation would you observe in the leaves of radish plant?

4. Look at the image of a mountain goat and a goat found in the plains. Point out the similarities and differences between them. What are the reasons for these differences?

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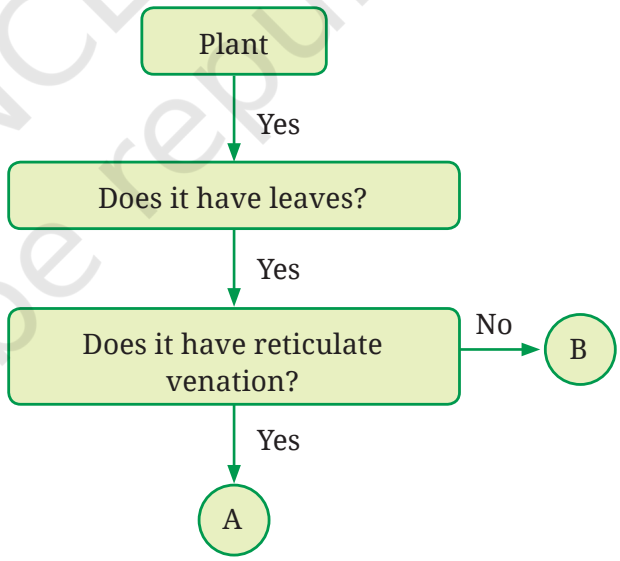
(a) Mountain Goat

(b) Goat found in the plains

5. Group the following animals into two groups based on any feature other than those discussed in the chapter—cow, cockroach, pigeon, bat, tortoise, whale, fish, grasshopper, lizard.

6. As the population grows and people want more comfortable lives, forests are being cut down to meet various needs. How can this affect our surroundings? How do you think we can address this challenge?

7. Analyse the flowchart. What can be examples of 'A' and 'B'?



8. Raj argues with his friend Sanjay that "*Gudhal* (hibiscus) plant is a shrub." What questions can Sanjay ask for clarification?

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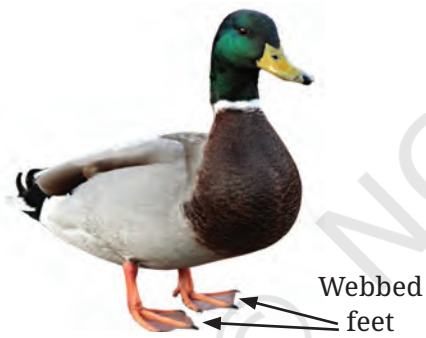
9. Based on the information in the table, find out examples of these plants for each group.

Group	Type of seed	Type of root	Examples
A	Dicot	Taproot	
B	Monocot	Fibrous roots	

(a) What other similarities do plants of group A have?

(b) What other similarities do plants of group B have?

10. Observe the labelled part of a duck in the picture given below. What differences do you observe in the feet of the duck compared to the other birds? Which activity would the duck be able to perform using this part?



(a) Duck

(b) Pigeon

Learning further

- Read about one Indian scientist or a wildlife biologist who is working towards protection of India's biodiversity. Prepare a brief report.
- Explore the contributions of Divya Mudappa, Usha Lachungpa, Ghazala Shahabuddin, Nandini Velho, Vidya Athreya, Uma Ramakrishnan and Divya Karnad towards biodiversity in India. Prepare a report of the work done by any three of them.

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- Label the plants in your school with their local names with the help of your teacher or the gardener. List them in your notebook.
- With the help of your teacher, plan a field visit or a nature walk. Record your observations. Prepare a class biodiversity register by consolidating the observations and notes of all the students taken during the field visit or nature walk.
- Find out about 'Project Tiger' and other similar projects initiated in India to protect our biodiversity. Prepare a presentation for your class.
- Divide your class into groups of six students each. Initiate a discussion in the class on how you can protect biodiversity around you. Prepare a group-wise report that includes suggestions given by members of each group.
- Interact with elders in your family or neighbourhood to find out various plants and animals that they see now but were not seen earlier and vice-versa. Collect pictures of these plants and animals and paste them in a scrapbook. Find out more about them from your teacher.

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Chapter 3

Mindful Eating: A Path to a Healthy Body

> कोऽरुक्? कोऽरुक्? कोऽरुक्?
> हितभुक् मितभुक् ऋतुभुक्
>
> (सुभाषित)
>
> Who is healthy? Who is healthy? Who is healthy? One who eats food that is wholesome, in moderate quantities, and appropriate for the season, time, and place.
>
> (*Wise saying*)

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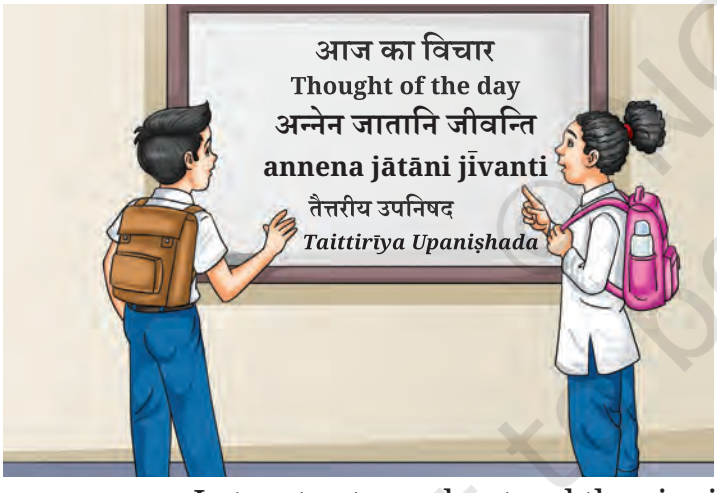

Medu and Mishti read 'thought of the day' on the school noticeboard every day. Today's thought, *'annena jātāni jīvanti'*, makes them curious. Mishti tells Medu that it is a Sanskrit saying which means 'food gives life to living beings.'

Let us try to understand the significance of this saying.

3.1 What Do We Eat?

Activity 3.1: Let us record

All of us eat food every day. Food is an essential component of our daily life. List the food items you have consumed over the week in Table 3.1.

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Table 3.1: Food items consumed over a week

Day	Food items
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

What observations can you make about your food from the data collected in Table 3.1? Do you eat the same kind of food in every meal or do your choices vary? **Compare** your list with those prepared by your friends. Find similarities and differences in the food consumed by you and your friends. What did you find? Record your findings in your notebook. You may have noticed that there is a variety in the food eaten by you and your friends.

Do you think that such diversity in food exists in all states of our country?

3.1.1 Food in different regions

Activity 3.2: Let us explore

- Find out the types of food traditionally consumed and the crops grown in various states of India. You may refer to books in your library, search the internet, and interact with your friends, family and neighbours to collect information.

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- In Table 3.2, add more states and fill the collected data. A few examples are already given.

Table 3.2: Some traditional food items in various states of India

State	Locally grown crops	Traditional food items eaten	Beverages
Punjab	Maize, wheat, chickpea, pulses	*Makki di roti, sarson da saag, chhole bhature, parantha,* halwa, *kheer*	Lassi, *chhach* (buttermilk), milk, tea
Karnataka	Rice, ragi, *urad*, coconut	Idli, dosa, sambhar, coconut chutney, ragi *mudde*, *palya*, rasam, rice	Buttermilk, coffee, tea
Manipur	Rice, bamboo, soya bean	Rice, *eromba* (chutney), *utti* (yellow peas and green onion curry) *singju*, *kangsoi*	Black Tea
Any other			

Why do we see diversity in traditional food consumed in various states of our country?

Analyse the data collected by you in Table 3.2. Are there food items that are common across states? Make a list of those food items. You may find that some food items are common in many states while some are eaten only in a particular state.

What relation do you find between the traditional food items and the locally grown crops? You must have observed that the traditional food of any state is usually based on the crops grown in that state. India is an agricultural country with diverse soil and climate types. Various crops are grown in its different regions depending on the soil types and climatic conditions.

In various regions of India, the choice of food may vary according to the **cultivation** of food crops in that particular region, taste preferences, culture, and traditions.

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3.1.2 How have cooking practices changed over time?

You have learnt that food habits vary across states. Our food choices as well as practices of food preparation may differ from one another. Have our food habits and cooking practices changed over time?

Activity 3.3: Let us interact and find out

- Prepare a list of questions for gathering information from elderly people about their food habits and cooking practices. Following are some of the sample questions—
  - What kind of food do you still eat and what is new?
  - What are the changes in cooking practices over time?
  - What has caused these changes?
- Conduct interviews with some elderly people based on the questions prepared.

(a) Chulha (Traditional stove)

(b) Modern gas stove

(c) Sil-batta (Stone grinder)

(d) Electrical grinder

Fig. 3.1: Change in cooking tools over time

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What are your findings from the interviews you conducted? Cooking practices, also called **culinary practices**, have changed over time. There is a significant difference between traditional and modern culinary practices. Earlier, most cooking was done using a *chulha* (Fig. 3.1a). Nowadays, most of us cook using a modern gas stove (Fig. 3.1b). Earlier, most grinding was done manually using a *sil-batta* (Fig. 3.1c). These days, we use an electrical grinder for ease of grinding (Fig. 3.1d). Find out what were the other ways of cooking and grinding. Why have these culinary practices changed over time? These changes may be due to factors such as technological development, improved transportation and better communication.

3.2 What are the Components of Food?

Medu and Mishti visit the 'Traditional Food Festival' organised in their school. The theme of the festival is 'Eat Healthy, Live Healthy'.

The festival features various stalls displaying different kinds of traditional dishes. Dr Poshita, a nutritional expert, explains to students that 'Health is the Ultimate Wealth'.

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Let us understand what Dr Poshita means by this statement.

Have you ever missed a meal? How do you feel when you miss a meal?

We feel tired and less energetic when we do not eat for some time. Why do you think a marathon runner drinks glucose water during and after a race?

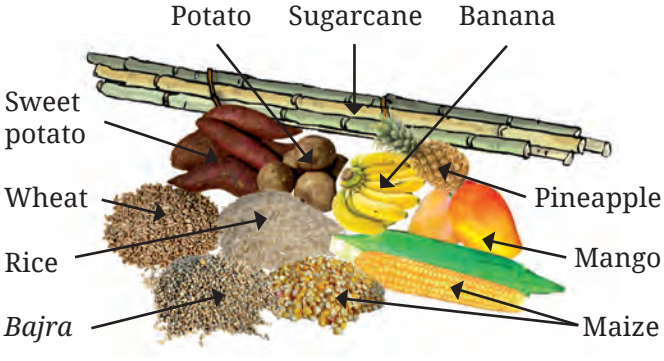


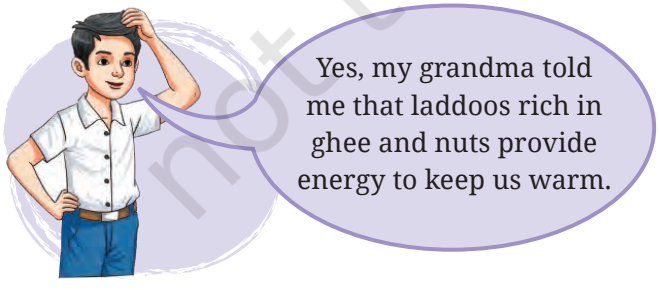
Fig. 3.2: Some sources of carbohydrates

Glucose provides instant energy. Glucose is an example of a carbohydrate. **Carbohydrates** are one of the primary sources of energy in our diet. Cereals like wheat, rice, and maize, vegetables like potato and sweet potato, and fruits like banana, pineapple, and mango are some sources of carbohydrates (Fig. 3.2).

Do you know that common sugar is also a type of carbohydrate?

Why do you think we prefer to have *laddoos* as a part of our traditional diet in winters?

Besan or wheat flour (*aata*) and ghee are among the main ingredients of laddoos along with *goond* (edible gum), nuts, and seeds. Ghee and various kinds of oils are grouped under another kind of food component, which is called **fat**.



Sources of fats can be from plants or animals (Fig. 3.3). Nuts, such as groundnuts, walnuts, coconuts, and almonds, and seeds, such as pumpkin seeds and sunflower seeds, are some sources of fat. Fat is a source of stored energy.

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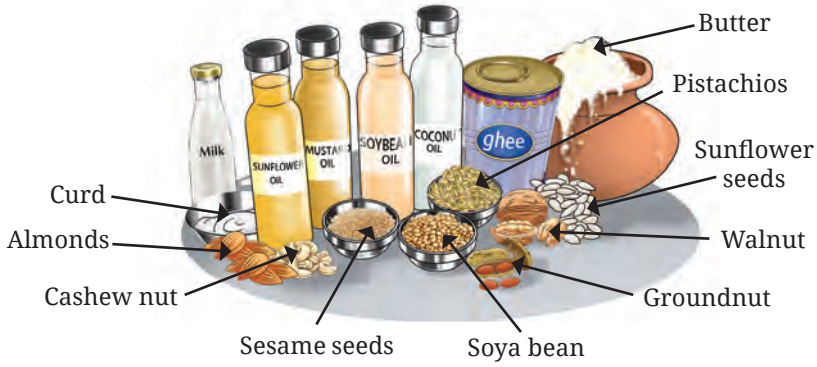


Fig. 3.3: Some sources of fats

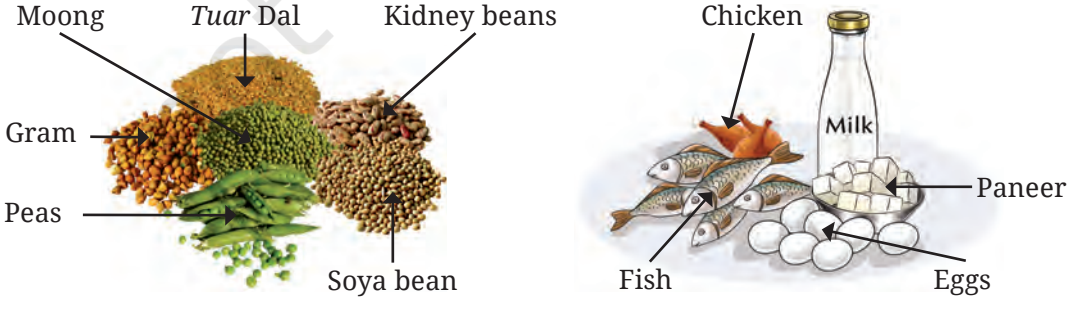
Carbohydrates and fats provide us energy for performing various activities. Therefore, they are called **energy-giving foods.** Identify more food items that are rich sources of carbohydrates and fats .

Polar bear

Polar bears accumulate a lot of fat under their skin. This fat serves as an energy source. It supports them during their months-long winter sleep (hibernation), enabling them to survive without eating.

More to know!

Proteins are also an important part of our food. Milk products and pulses are good sources of protein. Sportspersons need proteins in larger quantities to build their muscles. People get proteins from plants as well as animals. Some excellent plant sources of protein are pulses, beans, peas and nuts (Fig. 3.4a). Animal sources of protein are milk, paneer, egg, fish and meat (Fig. 3.4b). Protein-rich foods help in growth and repair of our body. These are, therefore, called **body-building foods**.



(a) Plant sources *(b) Animal sources*

Fig. 3.4: Some sources of proteins

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The right amount of protein must be included in the diet of growing children for their proper growth and development. Which of these food components are part of your daily diet?

More to know!

Have you ever seen mushrooms? They grow mostly in dark and moist places. Edible mushrooms are good sources of protein.

Mushroom

Why do you think we are advised to include servings of fruits, vegetables and other plant-based foods in our daily diet? Let us understand the importance of some other **food components** by reading the following two cases—

Case 1

In earlier times, during long voyages, sailors often suffered from bleeding and swollen gums. During a voyage in 1746, Scottish physician James Lind observed that sailors who consumed lemons and oranges recovered from these symptoms. Bleeding and swollen gums are symptoms of a disease called **scurvy**.

What do you **interpret** by reading Case 1? What cures scurvy? Lemons and oranges help in curing scurvy. Scurvy is caused due to deficiency of Vitamin C. **Vitamin C** present in citrus fruits like lemons and oranges helps in curing this disease.

Case 2

In the 1960s, Indian scientists found that among the human population in the Himalayan region and the Northern plains of India, symptoms of swelling at the front of the neck were prevalent. As per norms of the Government of India, an effort was made to supplement common salt with iodine for preparing **iodised salt**. Consumption of iodised salt visibly reduced the above symptoms. These symptoms were due to a deficiency of iodine in the soil of this region resulting in a lack of iodine in the local food and water supply. Swelling at the front of the neck is a symptom of a disease called **goitre**.

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What do you **infer** from Case 2?

You may have learnt about iodised salt through newspapers, advertisements or by reading about it on a salt packet. What does it mean? Iodised salt is simply common salt mixed with required quantities of salts of iodine.

Salt farming is a traditional practice of a tribal community named *Agariyas*. They practice salt farming in the Little Rann of Kutch and other parts of Gujarat. For eight months, they live in the extreme heat of the desert and work very hard to get salt from seawater.

More to know!

How would you find out more about other food components that protect our body from various diseases?

Activity 3.4: Let us conduct a survey

- Study the chart given in Fig. 3.5 to explore the functions and sources of various food components. Find out more sources of vitamins and minerals. Also, understand the symptoms of the diseases caused by the lack of these food components.
- Visit your neighbourhood, interact with people and find out if any individual shows the symptoms listed on the chart (an investigatory project of this kind can be taken by the students under the guidance of a teacher).
- Correlate these symptoms with their diet and identify the deficiency disease(s) or disorder(s).
- Suggest the possible cause(s) for the symptoms observed and changes required in the diet for improvement.
- Suggest them to visit a doctor for further advice.

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Food component (Vitamin/ Mineral)	Functions	Some sources	Deficiency disease/ disorder	Symptoms
Vitamin A	Keeps eyes and skin healthy	Papaya, carrot, mango, milk	Loss of vision	Poor vision, loss of vision in darkness (night blindness), sometimes complete loss of vision
Vitamin B_1	Keeps heart healthy and supports body to perform various functions	Legumes, nuts, whole grains, seeds, milk products	Beriberi	Swelling, tingling or burning sensation in feet and hands, trouble in breathing
Vitamin C	Helps body to fight diseases	*Amla*, guava, green chilli, orange, lemon	Scurvy	Bleeding gums, slow healing of wounds
Vitamin D	Helps body absorb calcium for bone and teeth health	Exposure to sunlight, milk, butter, fish, eggs	Rickets	Soft and bent bones
Calcium	Keeps bones and teeth healthy	Milk/soya milk, curd, cheese, paneer	Bone and tooth decay	Weak bones, tooth decay
Iodine	Helps to perform physical and mental activities	Seaweed, water chestnut (*singhada*), iodised salt	Goitre	Swelling at the front of the neck
Iron	Important component of blood	Green leafy vegetables, beetroot, pomegranate	Anaemia	Weakness, shortness of breath

Fig. 3.5: Chart of vitamins and minerals, their functions, some sources, related deficiency disease(s)/disorder(s) and symptoms

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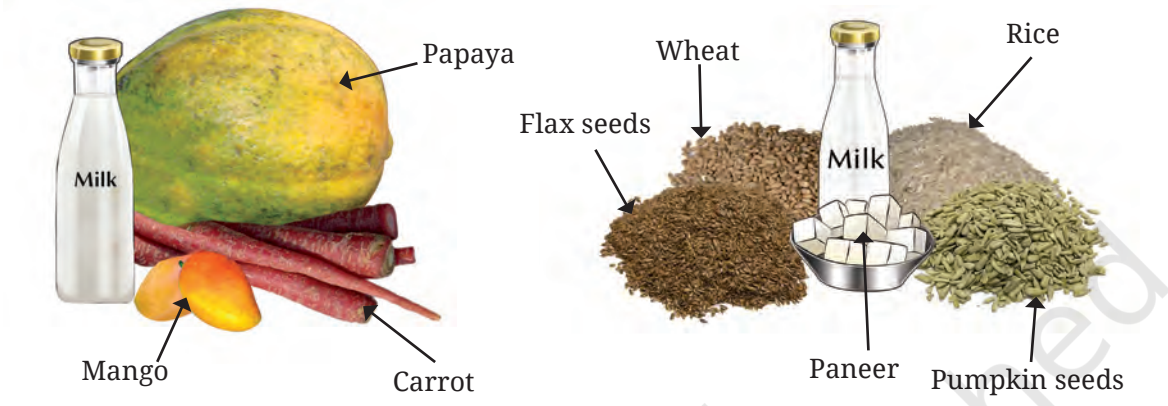
From Fig. 3.5, you have learnt that **vitamins** (A, B_1, C and D) and **minerals** (calcium, iodine, and iron) are two groups of food components that protect our body from various diseases. But, how can we overcome vitamin and mineral **deficiency diseases** or disorders?



(a) Some sources of Vitamin A

(b) Some sources of Vitamin B_1

(c) Some sources of Vitamin C

(d) Some sources of Vitamin D

Fig. 3.6: Some sources of different vitamins

Food components that provide energy, support growth, help repair and protect our body from diseases, and maintain various bodily functions are called **nutrients**. The major nutrients in our food include carbohydrates, proteins, fats, vitamins and minerals.

Vitamins and minerals are also called **protective nutrients.** These nutrients protect our body from diseases and keep us healthy. Your parents may have advised you to have

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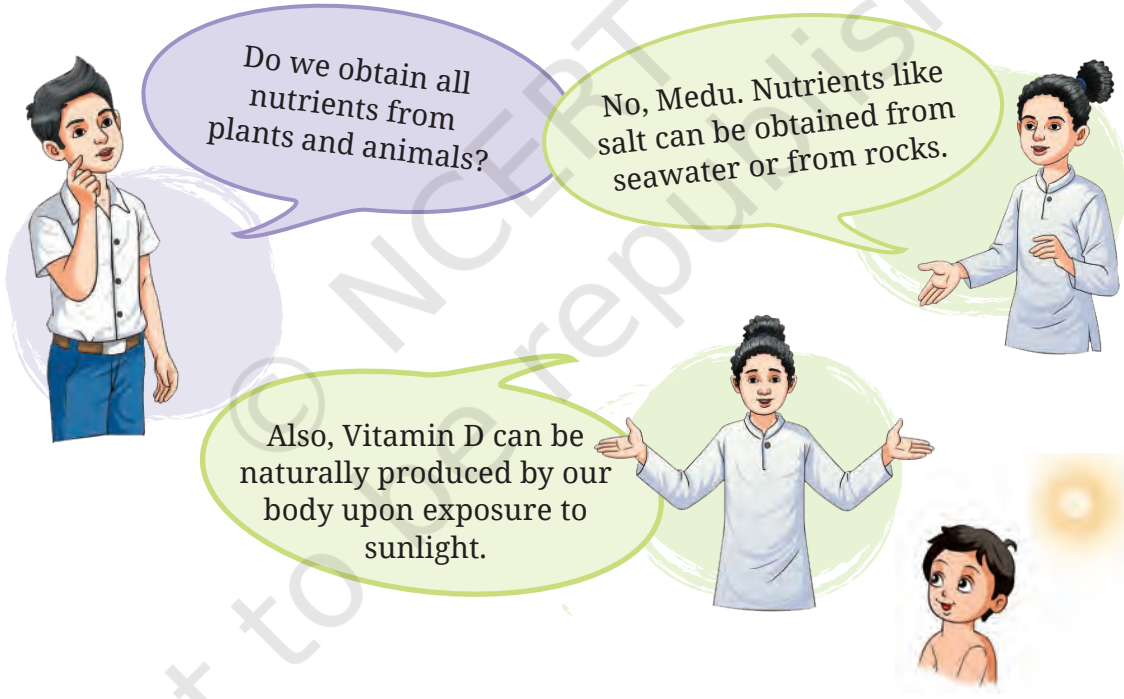
milk, green vegetables, fruits and wholegrains regularly. These food items are some sources of vitamins (Fig. 3.6) and minerals. Although vitamins and minerals are required in small amounts, they are essential to keep our body healthy.

What differences do you **observe** in raw and cooked vegetables? Have you ever noticed that vegetables sometimes lose their bright colour, or become softer and less crisp when cooked? Some nutrients like vitamin C and others are lost during cooking due to high heat. Would it not be wise to include fruits and uncooked vegetables into our diet? Washing cut or peeled vegetables and fruits may also result in the loss of some vitamins. However, it is highly recommended that all fruits and vegetables be thoroughly washed before consumption.



Fruits and vegetables are rich in dietary fibres. Let us see how dietary fibres are beneficial for us.

In addition to the essential nutrients, our body needs dietary fibres and water. Dietary fibres, also known as **roughage**, do not provide any nutrients to our body. However, they are an essential component of our food. They help our body get rid of undigested food and ensure smooth passage of stools. Roughage in our food is provided mainly by suitable plant products.

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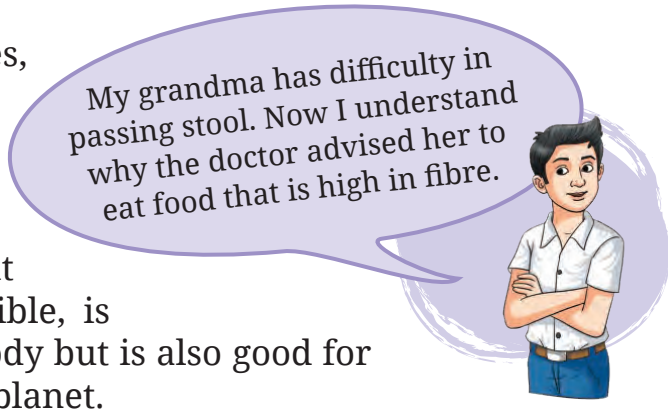
Green leafy vegetables, fresh fruits, wholegrains, pulses and nuts are good sources of roughage.

Eating food that is locally grown and plant based, to the extent possible, is not only healthy for the body but is also good for our environment and our planet.



What are the food sources that provide water to our body? List a few of them. ?

Water is also an essential part of our diet. It helps the body absorb nutrients from food. It removes waste from the body through sweat and urine. We should drink sufficient water regularly to keep ourselves healthy.

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Know a scientist

Coluthur Gopalan (1918–2019) initiated nutrition research in India. He analysed more than 500 Indian foods for their nutritional value and recommended an appropriate diet in the Indian context. He led surveys on the nutritional status of the Indian population, identifying widespread deficiencies in protein, energy, and other food components. This led to the implementation of the Mid Day Meal Programme in 2002, now a 'PM POSHAN' initiative, to provide balanced food in the government-run and government-aided schools of our country. This scheme has played a role in improving the health and nutrition of millions of children nationwide.

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3.3 How to Test Different Components of Food?

Let us find out which nutrients are present in various food items.

Some nutrients like **starch** (a type of carbohydrate), fat and protein can be detected using fairly simple tests, while others can be detected only in a well-equipped laboratory. Let us explore how we can detect the presence of starch, fat and protein in some food items.

3.3.1 Test for starch

Activity 3.5: Let us investigate

- Take a small quantity of the food items such as a slice of potato, cucumber, bread, some boiled rice, boiled gram, crushed peanuts, oil, butter and crushed coconut. You can take other food items too for testing.

Fig. 3.7: Testing for the presence of starch in various food items

- Place a small piece of each item on a separate dish.
- With the help of a dropper, put 2–3 drops of diluted iodine solution on each food item (Fig. 3.7).
- Observe if there are any changes in the colour of the food items. Have they turned blue-black? Record your observations in Table 3.3.

A blue-black colour indicates the presence of starch.

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3.3.2 Test for fats

Activity 3.6: Let us investigate

- Take a small part of the food items that you tested for the presence of starch in Activity 3.5.
- Place each food item on a separate piece of paper.
- Wrap the paper around the food and press it. Be careful not to tear the paper.
- If a food item contains a little water, allow the paper to dry.

Does the paper develop an oily patch? What do you think is the reason for this patch? If oil or butter is present in the food item, it leaves an oily patch on the paper. Now, hold the paper against light. Can you see the light faintly shining through this patch? An oily patch on the paper shows that the food item contains fat. Which of these items contain fats?

Record your observations in Table 3.3.

3.3.3 Test for proteins

Activity 3.7: Let us investigate

This activity may be demonstrated by the teacher.

- Take the food items tested in previous activities.
- Make a paste or powder of the food item using pestle and mortar (Fig. 3.8).
- Put about half teaspoon of each food item in a separate clean test tube.

Precautions

- These chemicals are harmful and need to be handled with care. Do not touch any of these chemicals unless asked to do so.
- If any chemical gets spilled on your body, immediately wash the affected area with water.
- Do not put any of these chemicals into your mouth, or try to smell them.

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- Add 2–3 teaspoons of water to each test tube and shake them well.
- Add two drops of copper sulphate solution to each test tube using a dropper.
- Now, take another dropper and add 10 drops of caustic soda solution to each tube (Fig. 3.8).
- Shake well and leave the test tubes undisturbed for a few minutes.

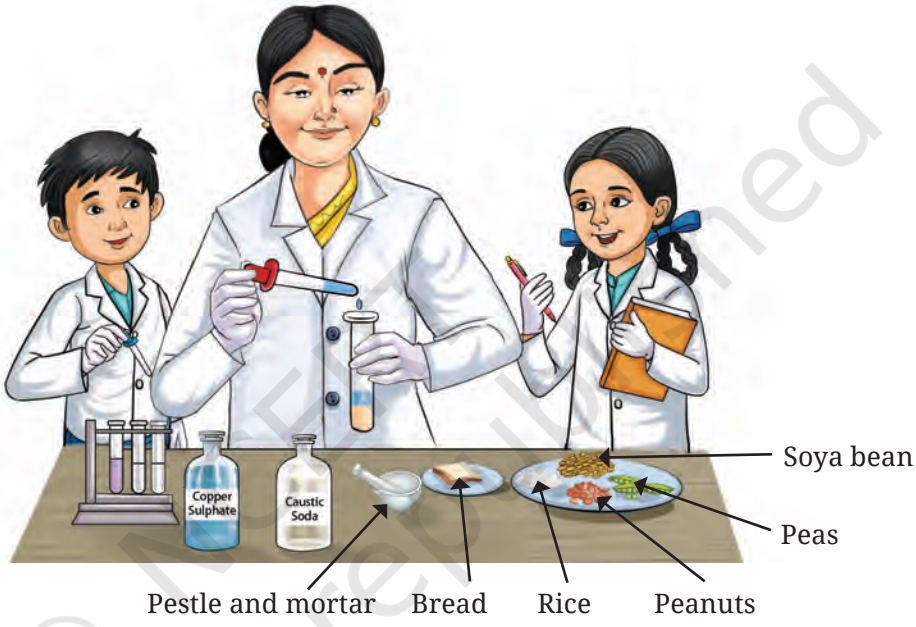

Fig. 3.8: Testing for the presence of protein in various food items

What did you observe? Did the content of some test tubes turn violet? This violet colour indicates the presence of proteins in the food item. Write your observations in Table 3.3.

What conclusions can you draw from Table 3.3? Which food items show the presence of more than one nutrient? Which food items show the presence of both proteins and fats? Peanuts show the presence of both proteins and fats. This indicates that any food which we eat may contain multiple nutrients. Is there a food item that lacks any of these nutrients? Which of these foods do you consume daily? Try to find out other foods that are good sources of starch, fats, and proteins.

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Table 3.3: Exploring nutrients present in various food items

Name of the food item	Colour of the food item for starch test		Oily patch for fat test		Colour of the food item for protein test		Starch present (Yes/ No)	Fat present (Yes/ No)	Protein present (Yes/ No)
	Before iodine test	After iodine test	Predic-tion (Yes/No)	Observa-tion (Yes/No)	Before protein test	After protein test			
Potato									
Cucumber									
Boiled rice									
Boiled gram									
Peanuts									
Bread/ Chapati									
Butter									
Coconut									
Any other									

3.4 Balanced Diet

Are nutritional requirements the same for everyone? Do you and your grandparents need the same type or the same amount of nutrients? Requirements of the type and amount of nutrients in a diet may vary according to age, gender, physical activity, health status, lifestyle, and so on.

Activity 3.8: Let us find out

You have listed food consumed by you during the week in Activity 3.1. Check whether your food contains all the nutrients and other essential components necessary for growth and development. If not, check which nutrients or other food components need to be added.

A diet that has all essential nutrients, roughage, and water in the right amount for proper growth and development of the body is known as a **balanced diet**. What changes would you make in your diet to make it a balanced diet?

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Activity 3.9: Let us compare

Read the nutritional information given below for a packet of potato wafers and a packet of roasted *chana* shown here.

(a) Potato wafers

(b) Roasted chana

Nutritional Information (per 100 g)	
Energy	536 kcal (kilocalories)
Fats	35.0 g
Carbohydrates	53.0 g
Proteins	7.0 g
Dietary Fibre	4.8 g

Nutritional Information (per 100 g)	
Energy	355 kcal (kilocalories)
Fats	6.26 g
Carbohydrates	58.58 g
Proteins	18.64 g
Dietary Fibre	16.8 g

Based on the nutritional information on the food packets given above, which food would you choose? Why?

Some foods have high calories due to high sugar and fat content. Moreover, they contain very low amounts of proteins, minerals, vitamins, and dietary fibres. These foods are called junk foods. These foods include potato wafers, candy bars and carbonated drinks. Consuming these foods frequently is not good as these are not healthy for our body. They make a person obese. Such a person may suffer from several health problems. You should always remember Dr Poshita's statement that 'Health is the Ultimate Wealth.' We should take care of our body to stay healthy. Eating a balanced diet and avoiding junk food contribute towards

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a healthy body. Good health is essential for leading a happy life.

Which of the two foods you studied in Activity 3.9 could be labelled as junk food?

Packaged food items must have information about the nutrients on their cover. The information should list the amount of each nutrient. Sometimes, more nutrients are added to the food during processing (fortification) to improve its nutritional quality. Iodised salt and some baby foods are examples of fortified foods. The Food Safety and Standard Authority of India (FSSAI) is a government agency that regulates food quality in India.

More to know!

3.5 Millets: Nutrition-rich Cereals

You may have heard of *jowar*, *bajra*, *ragi*, and *sanwa* (Fig. 3.9). These are native crops of India (Fig. 3.9). These can be easily cultivated in different climatic conditions. These highly nutritious grains are also called **millets**. Have you ever had food items made from these millets?

Fig. 3.9: Sanwa (Barnyard millet)

Millets are small-sized grains and have been an integral part of the Indian diet for centuries. They have regained popularity due to their numerous health benefits. They are good sources of vitamins, minerals like iron and calcium, and dietary fibres as well. That is the reason they are also called nutri-cereals. They contribute significantly to a balanced diet required for the normal functioning of our body.

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3.6 Food Miles: From Farm to Our Plate

How does food reach from a farm to our plate? What are the steps involved in this process? Who are the people involved in this process? Do you know how much time and effort is required to get the wheat flour once seed grains germinate in the farm? Let us look at Fig. 3.10 to understand the entire process of making the chapati that we eat.

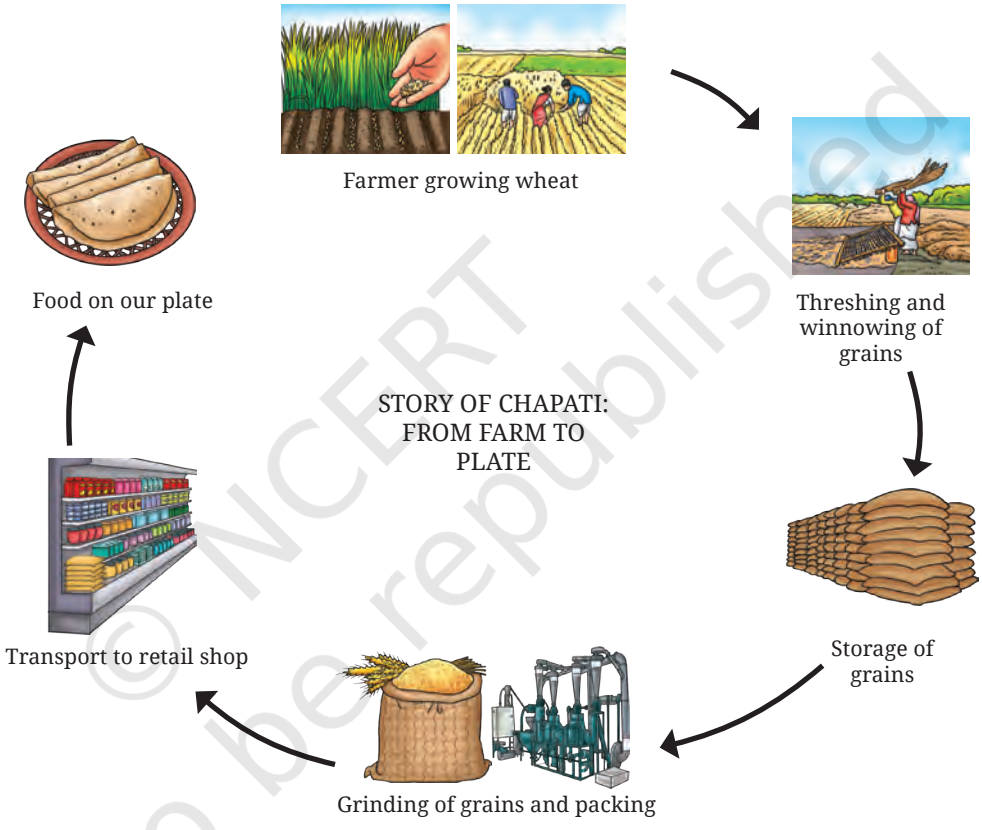

Fig. 3.10: From farm to plate

The entire distance travelled by a bag of wheat or any other food item, from the producer to the consumer, is known as its **food miles**. Reducing food miles is important because it helps to cut down the cost and pollution during its transport; it helps support local farmers; and it also keeps our food fresh and healthy.

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Many people waste food, leaving it unconsumed on their plates. One must remember the time and effort put by our farmers and other community members in getting the food from the farm to our plate. We must take only as much food as we can consume. It would reduce food wastage. Try to find the timeline for the various processes involved in getting the food from farm to plate (Fig. 3.10).

How would eating local food help reduce food miles?

Eat healthy, share, and respect food. Support local producers!

Keywords

Carbohydrate	Millets	Analyse
Culinary practices	Minerals	Compare
Deficiency diseases	Nutrients	Infer
Fats	Proteins	Interpret
Food components	Rickets	Investigate
Food miles	Roughage	Observe
Iodized salt	Scurvy	Prediction
	Vitamins	Survey

Summary

Key Points

- People across India eat diverse types of food, containing various food components.
- Choice of food may vary according to the cultivation of food crops in a region, taste preferences, culture and traditions, and so on.

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- Culinary practices have changed over time. There is a significant difference between traditional and modern methods of cooking food.
- Food provides us energy, support growth, repairs our bodies and protects us from diseases.
- The major nutrients in our food are carbohydrates, fats, proteins, vitamins, and minerals. In addition, food also contains dietary fibres and water.
- Carbohydrates and fats are primary energy sources, while proteins are body-building nutrients.
- Vitamins and minerals strengthen our body, protect us from infections, and keep us healthy.
- A balanced diet provides all the essential nutrients in the right quantities, along with adequate roughage and water.
- Deficiency of one or more nutrients in our diet for a long time can lead to deficiency diseases and disorders.
- Junk foods are unhealthy as they contain high levels of sugar and fats but little protein, minerals, vitamins, and dietary fibres.
- Millets are known as nutri-cereals as they provide most of the nutrients required for the normal functioning of our bodies. They can be easily cultivated in different climatic conditions.
- Eating food that is locally grown and plant-based, to the extent possible, is not only healthy for our bodies but is also good for our environment and our planet.
- The distance travelled by a food item, from the place of its production to the consumer, is called food miles. We must aim to minimise food miles.
- We should never waste food and only take as much as we can consume.

Let us enhance our learning

1. Pick the odd one out and give reasons:
   (i) *Jowar*, *Bajra*, Ragi, Chana
   (ii) Kidney beans, Green gram, Soya bean, Rice

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2. Discuss traditional versus modern culinary practices in India.

3. A teacher says that good food may act as medicine. Ravi is curious about this statement and has some questions for his teacher. List at least two questions that he can ask.

4. Not all delicious foods are necessarily healthy, while not all nutritious foods are always enjoyable. Share your thoughts along with a few examples.

5. Medu does not eat vegetables but enjoys biscuits, noodles and white bread. He often has stomach ache and constipation. What changes should he make in his diet to get rid of these problems? Explain your answer.

6. Reshma had trouble seeing things in dim light. The doctor tested her eyesight and prescribed a particular vitamin supplement. He also advised her to include a few food items in her diet.

   (i) Which deficiency disease is she suffering from?

   (ii) Which food component may be lacking in her diet?

   (iii) Suggest some food items that she should include in her diet to overcome this problem (any four).

7. You are provided the following:

   (i) Canned fruit juice

   (ii) Fresh fruit juice

   (iii) Fresh fruit

   Which one would you prefer and why?

8. Gourav got a fracture in his leg. His doctor aligned the bones and put on a plaster. The doctor also gave him calcium tablets. On the second visit, the doctor gave him Vitamin D syrup along with calcium tablets. Refer to Fig. 3.5 and answer the following questions:

   (i) Why did the doctor give calcium tablets to Gourav?

   (ii) On the second visit, why did the doctor give Vitamin D syrup along with calcium tablets?

   (iii) What question arises in your mind about the choices made by the doctor in giving the medicines?

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9. Sugar is an example of carbohydrates. Sugar is tested with iodine solution but it does not change to blue-black colour. What can be a possible reason?

10. What do you think of Raman's statement, "All starches are carbohydrates but not all carbohydrates are starches." Describe the design of an activity to test your answer.

11. While using iodine in the laboratory, a few drops of iodine fell on Mishti's socks and a few fell on her teacher's saree. The drops of iodine on the saree turned blue-black while the colour on the socks did not change. What can be a possible reason?

12. Why are millets considered a healthy choice of food? Can eating just millets suffice for the nutritional requirements of the body? Discuss.

13. You are given a sample of a solution. How would you check the possibility of it being an iodine solution?

Learning further

- Help your mother in unpacking the packets of various food items after shopping for grocery next time. Read the nutritional information of at least three fortified food items and analyse those.
- The Apatani tribe of Arunachal Pradesh produces a salt called *tapyo* to fulfil their dietary requirements. Collect more information from the internet about their salt making process and the need to make their own salt. Collect pictures and paste them on a chart paper. Also, write a paragraph about the process of making this salt and its usefulness.
- Vegetables or fruits that grow naturally in the forest or nearby fields without being cultivated by farmers are considered wild varieties. Traditionally, many tribal groups in India depend on these wild varieties, which form a part of their food. Read about *ranbhajis* from Maharashtra and edible mushrooms from Himachal Pradesh. Are you aware of any such wild varieties of food from your region? Discuss in class.

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- List junk foods you eat frequently. Ask your friends also to make such lists. On the basis of these lists, write a letter to your principal requesting to ban certain junk foods inside the school campus. Suggest some healthy options.
- Find out the variation in nutritional requirements of different individuals based on age, physical activity and health conditions. Record your observations. Discuss and analyse.
- Prepare a diet chart to provide a balanced diet to a twelve-year-old child. The diet chart should include food items that are not expensive and are commonly available in your area.

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Notes

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Chapter 4

Exploring Magnets

Reshma lives in a coastal town of Kerala and is very fond of writing short stories. Her grandmother loves listening to her stories, so Reshma was writing a new story to share with her grandmother on her 60th birthday.

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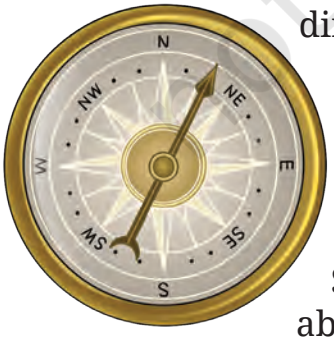
The story was based on a ship carrying spices from Kerala for trade in the olden days. Reshma was aware that in those days, the sailors used stars to find directions at night. But in her story, a situation arose wherein the sailors got caught in a storm with an overcast sky and stars were not visible. Reshma could not take her story forward as she could not think of a way for sailors to find directions.

She searched for information on the internet and her school library. She learnt that the travellers used a device, known as a magnetic compass, for finding directions.



Reshma had seen pencil boxes and purses which had magnets to keep them closed. A writing board in her school also had a duster with a magnet. But she had never looked at those carefully. She now became curious to learn more about magnets and magnetic compasses.

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Fig. 4.1: Some common items that have magnets attached to them

The magnets used by sailors in the olden days were based on naturally occurring magnets, known as lodestones which were discovered in ancient times. Later on, people found out that magnets could also be made from pieces of iron. Nowadays, we have magnets made of different materials. The magnets that you find in your school laboratory and those used in pencil boxes, stickers, toys are all artificial magnets (Fig. 4.1). The magnets can be of various shapes, some of which are shown in Fig. 4.2.

Bar magnet *U-shaped magnet* *Ring magnet*

Fig. 4.2: Magnets of different shapes

Do magnets stick to objects made of certain materials only?

4.1 Magnetic and Non-magnetic Materials

Activity 4.1: Let us explore

- Collect a few objects made of different materials and also a magnet.
- **Predict** which of the objects will stick to the magnet. Write your prediction in Table 4.1.
- Now hold a magnet in your hand and bring it near the objects one by one (Fig. 4.3). **Observe** which of the objects stick to the magnet.

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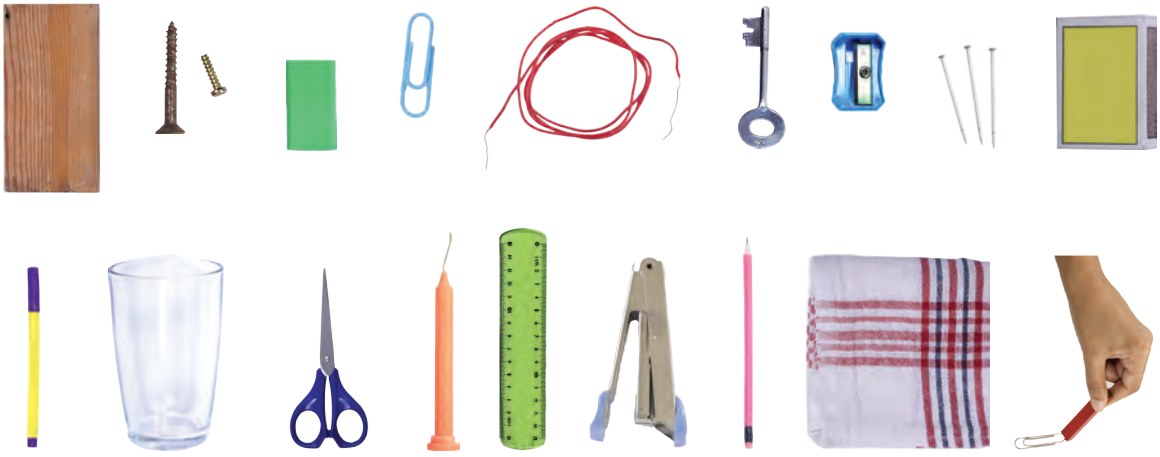

Fig. 4.3: Identifying the materials attracted by a magnet

- **Record** your observations in Table 4.1.

Table 4.1: Identifying the materials attracted by a magnet

Name of the object	Material which the object is made of (plastic/wood/glass/ iron/any other)	Attracted by the magnet (Yes/No)	
		Prediction	Observation
Pencil	Wood		
Eraser	Rubber		

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Was your prediction correct for all objects? Which materials stuck to the magnet? What conclusion can you draw?

Through this activity, we found out that some of the objects were attracted to the magnet and stuck to it, while others were not. The materials which are attracted towards a magnet are called **magnetic materials**. The metal iron is a magnetic material. Nickel and cobalt are other metals that are also magnetic. Some of their combinations with other metals are also attracted towards magnets. The materials which are not attracted towards a magnet are called **non-magnetic materials**.

Which materials listed in Table 4.1 were found to be non-magnetic?

Do all parts of a magnet attract magnetic materials equally? ?

4.2 Poles of Magnet

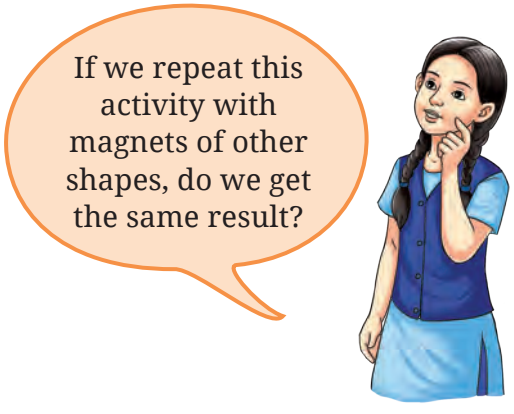
Activity 4.2: Let us investigate

- Spread some iron filings (very small pieces of iron) on a sheet of paper.
- Place a bar magnet over them. Tap the paper and observe carefully what happens to the iron filings.

Do you observe anything special about the way they stick to the magnet? Do the iron filings stick all over the magnet uniformly? Or do the iron filings stick more at some places?

We find that maximum iron filings stick near the ends of the bar magnet, as shown in Fig. 4.4, while a very few iron filings stick at the remaining part of the magnet.

Fig. 4.4: Iron filings sticking to a bar magnet



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These ends of the magnet are called the two poles of the magnet—the North pole and the South pole. Most of the iron filings stick to the poles of a magnet of any shape.

It is not possible to obtain a magnet with a single pole. If a magnet is broken into smaller pieces, North and South poles always exist in pairs even in the smallest piece of the magnet. A single North pole or a South pole cannot exist.

Can we find a magnet with a single pole? ?

4.3 Finding Directions

Activity 4.3: Let us experiment

- Suspend a bar magnet with a thread tied to the middle of the magnet as shown in Fig. 4.5. You may need to adjust the position of the string till the magnet is balanced horizontally.
- Now rotate the magnet gently in the horizontal direction and let it come to rest.
- Mark the position corresponding to the ends of the magnet on the ground (or on a piece of paper stuck to the ground). Join these two points on the ground with a line. This line indicates the direction along which the magnet comes to rest.
- Now again rotate the magnet by giving a gentle push at its one end and wait till it comes to rest. Does the magnet rest along the same line?

Fig. 4.5: A freely suspended bar magnet

What direction does this line indicate along which the magnet rests? How can we find it out?

If we have noticed the direction where the Sun rises or sets, we have an approximate idea of where East or West is. Hence, we can locate the direction along which the magnet rests.

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A freely suspended magnet comes to rest along the north-south direction. The end of the magnet that points towards north direction is called the North-seeking pole or the **North pole of the magnet**. The other end that points towards the South direction is called the South-seeking pole or the **South pole of the magnet**. A freely suspended magnet rests along the north-south direction because our Earth itself behaves like a giant magnet.

Repeat this activity with a small iron bar in place of the bar magnet. What do you observe? Does it always rest along north-south direction? It does not. It can rest along any direction. This implies that only magnets rest along north-south direction. This activity provides us with a way to test whether a piece of metal is a magnet or not.

The property of a freely suspended magnet to always rest along the north-south direction is used to find directions. Based on this, a small device called a magnetic compass was developed in olden days for finding directions. It has a magnet in the shape of a needle which can rotate freely (Fig. 4.6). The needle of a magnetic compass indicates the north-south direction.

Fig. 4.6: A magnetic compass

The compass is kept at the place where we wish to know the directions. After some time, the needle comes to rest in the north-south direction. The compass box is then gently rotated until the north and south marked on the dial are aligned with the needle. Now all directions at that place are as indicated on the dial.

More to know!

A magnetic compass is usually a small circular box with a transparent cover on it, as shown in Fig. 4.6. The magnet, in the shape of a needle, is mounted on a pin standing on the bottom of the box. This needle is balanced on the pin in such a manner that it can move around this point easily, that is, it can rotate freely. The end of the needle which rests in the North direction is usually painted red. Below the needle, there is a dial with directions marked on it.

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Activity 4.4: Let us construct

- Collect a few materials like a cork piece, iron sewing needle, a permanent bar magnet, a glass bowl, and water.
- Place the iron sewing needle on a wooden table. Then keep any one pole of the magnet at one end of the needle. Move the magnet over the needle along its length as shown in Fig. 4.7a. When it reaches the other end of the needle, lift it up.

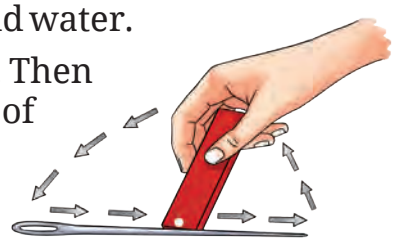


Fig. 4.7(a): Making an iron needle a magnet

- Bring the same pole of the magnet you started with to the same end of the sewing needle from which you began, and repeat the previous step. Repeat this process at least 30 to 40 times.
- Bring some iron filings or steel pins near the needle. If the pins or iron filings get attracted to the needle, then that means that the needle has become a magnet.
- Pass this needle through the cork horizontally. Float the cork in a glass bowl filled with water, such that the needle always remains above the level of water as shown in Fig. 4.7b.

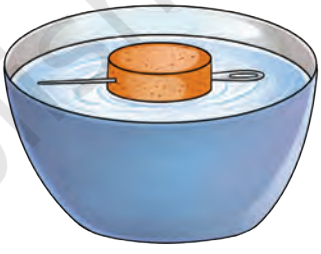
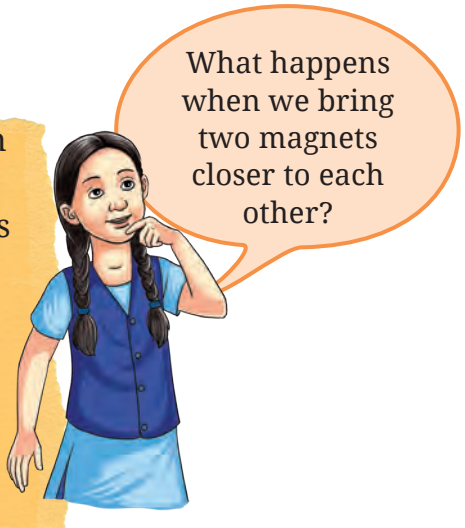


Fig. 4.7(b): A compass needle in a bowl of water

- When the needle comes to rest, your magnetic compass is ready for use. Note the direction in which either side of the needle points.
- Rotate the cork gently and wait till it stops rotating. Repeat this a few more times. Do the ends of the needle always point in the same direction?

Do you know?

Much before the widespread use of the modern magnetic compass (Fig. 4.6), a device similar to the compass needle made by you (Fig. 4.7b) was used by Indians for navigation at sea. It consisted of a magnetised fish-shaped iron piece, kept in a vessel of oil. It was called *matsya-yantra* (or *machchh-yantra*).



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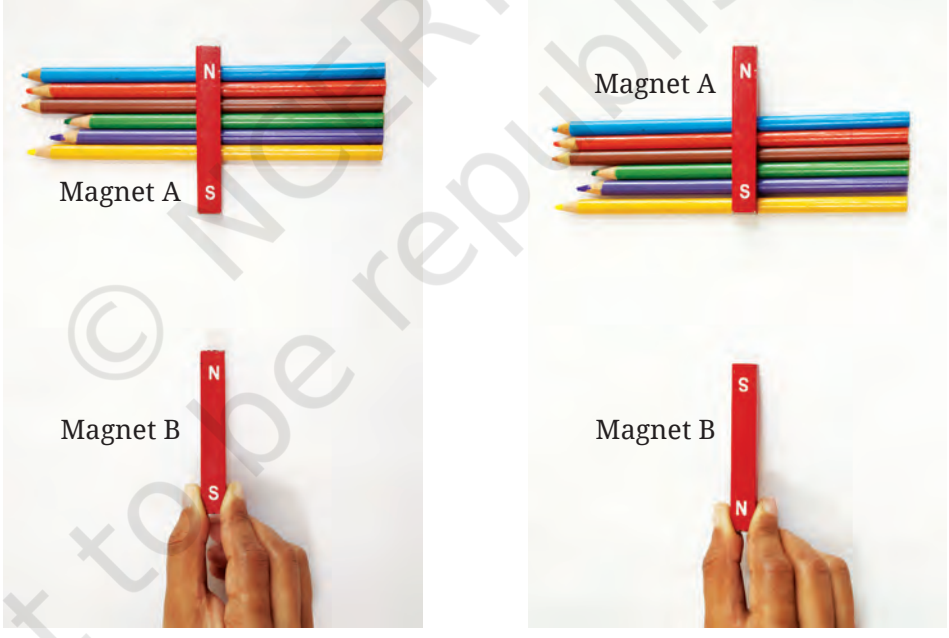
4.4 Attraction and Repulsion between Magnets

Activity 4.5: Let us experiment

- Take a pair of bar magnets on which North and South poles have been marked. Mark the two bar magnets as A and B.
- Place the longer side of magnet A over 5–6 round shaped pencils as shown in Fig. 4.8a.
- Now bring one end of magnet B near the end of magnet A placed on the pencils. Make sure that the two magnets do not touch each other. Observe what happens.
- Next, bring the other end of magnet B near the same end of magnet A (Fig. 4.8b). Does the magnet A on the pencils begin to move? Does it always move in the direction of the approaching magnet? What do these observations suggest?



(a) *(b)*

Fig. 4.8: Interaction between two bar magnets

You will see that unlike poles of two magnets, that is, the North pole of one magnet and the South pole of another magnet, attract each other. The like poles, that is, either the North poles or the South poles of both magnets, repel each other.

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- Repeat the activity by using an iron bar in place of one of the magnets. What do you observe this time?

  You will find that both the ends of the iron bar will be attracted by both the North and South poles of the magnet.

  From this activity, we find that a magnet can be identified by its property of repulsion.

Activity 4.6: Let us experiment

- Take a magnetic compass and a bar magnet.
- Place the magnetic compass over a horizontal surface and wait for its needle to come to rest.
- Now slowly bring North pole of the bar magnet close to the North pole of the compass needle as shown in Fig. 4.9a. Observe the compass needle carefully. What do you observe? Does the needle deflect? If yes, in which direction?
- Now repeat the above step with the South pole of the bar magnet. Do you observe any difference this time?

Fig. 4.9: A compass needle and a magnet

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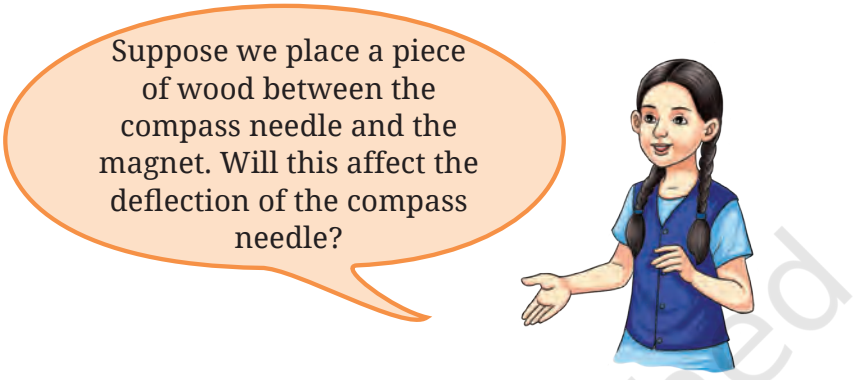
When the North pole of a magnet is brought closer to the North pole of the compass needle, it moves away as shown in Fig. 4.9a. When the South pole of the magnet is brought closer to the North pole of the compass needle, it moves closer (Fig. 4.9b).



Activity 4.7: Let us investigate

Fig. 4.10: Compass needle and a magnet with a piece of wood in between

- Repeat the first or second part of Activity 4.6.
- Without disturbing the bar magnet and magnetic compass, place a piece of wood between them, perpendicular to the table as shown in Fig. 4.10. Observe the compass needle carefully.
- Is there any effect on the deflection of compass needle due to the piece of wood? Record your observation in Table 4.2.
- Repeat the process by replacing the piece of wood with a cardboard sheet, thin plastic sheet, and a thin glass sheet.

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Table 4.2: Observing the effect of magnet through non-magnetic materials

S. no.	Material placed between the magnet and the compass needle	Observations
1.	Wood	
2.	Cardboard	
3.	Plastic	
4.	Glass	

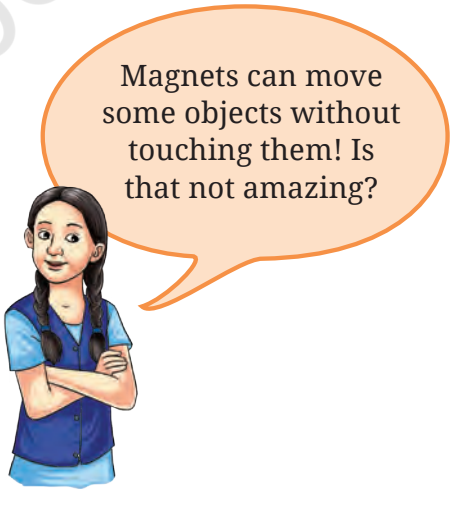
You would observe that there is no appreciable change in the deflection of the needle when a sheet of any of the above material is placed between the magnet and the compass needle. Therefore, we can **conclude** that the magnetic effect can act through non-magnetic materials.

4.5 Fun with Magnets

After learning about magnets, Reshma was excited and decided to set up some fun activities using magnets at her school fair. You may try making these yourself and may also think of some more fun ideas.

Can we make a garland? (Fig. 4.11)

Fig. 4.11: Magnetic garland



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Can we take the steel balls out of the maze by moving a magnet below the cardboard tray? (Fig. 4.12)

Can we pick out a steel paper clip fallen in water using a magnet, without getting our fingers or the magnet wet? (Fig. 4.13)

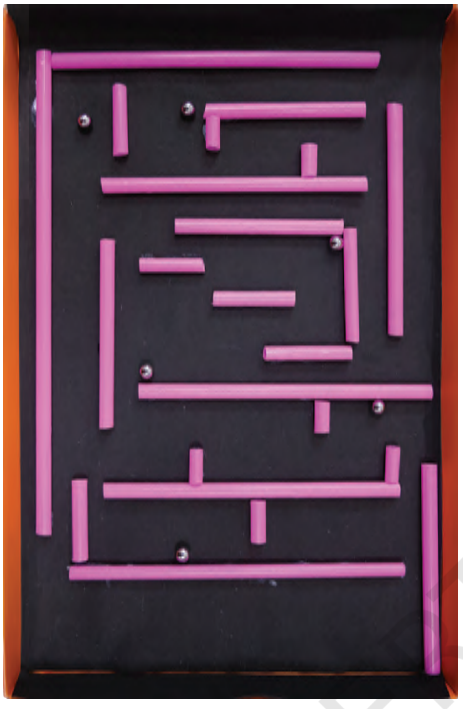

Fig. 4.12: Steel balls in a maze

Fig. 4.13: Steel paperclip in water

Will the two cars speed towards each other or run away from each other when brought closer? (Fig. 4.14)

Fig. 4.14: Two matchbox-magnet cars with like poles of the magnets facing each other

More to know!

In some magnets, the North and South poles are marked as N and S. In some other magnets, the North pole is indicated by a white dot. Sometimes, the North pole of a magnet is painted red and South pole is painted blue.

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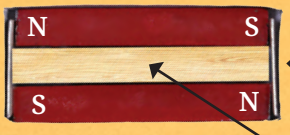
How to keep the magnets safe?

Magnet says,

"Store me properly. Keep me in pairs with unlike poles on the same side. Keep a piece of wood in between. Place two pieces of soft iron across the ends."



"Do not heat me or drop me or hammer me.

Do not keep me near mobile phones or remote controls."

More to know!

Caution
Have fun, but treat magnets with care.

Keywords

- Attraction
- Bar magnet
- Magnetic compass
- Magnetic materials
- Non-magnetic materials
- North pole of a magnet
- Repulsion
- Ring magnet
- South pole of a magnet
- U-shaped magnet
- Conclude
- Construct
- Experiment
- Explore
- Investigate
- Observe
- Predict
- Record

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Summary

Key Points

- A magnet has two poles—the North pole and the South pole.
- The poles of a magnet always exist in pairs. A single North pole or a single South pole cannot exist.
- Magnetic materials are the materials that are attracted towards a magnet.
- Non-magnetic materials are the materials that are not attracted towards a magnet.
- A freely suspended magnet rests along the north-south direction.
- The needle of a magnetic compass indicates the north-south direction.
- When two magnets are brought close to each other, like poles (North-North, South-South) repel each other while unlike poles (North-South) attract each other.

Let us enhance our learning

1. Fill in the blanks
   (i) Unlike poles of two magnets _____ each other, whereas like poles _____ each other.
   (ii) The materials that are attracted towards a magnet are called _____.
   (iii) The needle of a magnetic compass rests along the _____ direction.
   (iv) A magnet always has _____ poles.
2. State whether the following statements are True (T) or False (F).
   (i) A magnet can be broken into pieces to obtain a single pole. [ ]
   (ii) Similar poles of a magnet repel each other. [ ]
   (iii) Iron filings mostly stick in the middle of a bar magnet when it is brought near them. [ ]
   (iv) A freely suspended bar magnet always aligns with the north-south direction. [ ]

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3. Column I shows different positions in which one pole of a magnet is placed near that of the other. Column II indicates the resulting interaction between them for different situations. Fill in the blanks.

Column I	Column II
N – N	----------
N – ----------	Attraction
S – N	----------
---------- – S	Repulsion

4. Atharv performed an experiment in which he took a bar magnet and rolled it over a heap of steel U-clips (Fig. 4.15).

Fig. 4.15: Bar magnet and heap of steel U-clips

According to you, which of the options given in Table 4.3 is likely to be his observation?

Table 4.3: Number of pins attracted by the magnet at its various positions

	Position A	Position B	Position C
(i)	10	2	10
(ii)	10	10	2
(iii)	2	10	10
(iv)	10	10	10

5. Reshma bought three identical metal bars from the market. Out of these bars, two were magnets and one was just a piece of iron. How will she identify which two amongst the three could be magnets (without using any other material)?

6. You are given a magnet which does not have the poles marked. How can you find its poles with the help of another magnet which has its poles marked?

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7. A bar magnet has no markings to indicate its poles. How would you find out near which end its North pole is located without using another magnet?

8. If the earth is itself a magnet, can you guess the poles of earth's magnet by looking at the direction of the magnetic compass?

9. While a mechanic was repairing a gadget using a screw driver, the steel screws kept falling down. Suggest a way to solve the problem of the mechanic on the basis of what you have learnt in this chapter.

10. Two ring magnets X and Y are arranged as shown in Fig. 4.16. It is observed that the magnet X does not move down further. What could be the possible reason? Suggest a way to bring the magnet X in contact with magnet Y, without pushing either of the magnets.

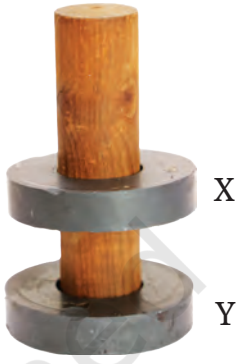

Fig. 4.16: Two ring magnets

11. Three magnets are arranged on a table in the form of the shape shown in Fig. 4.17. What is the polarity, N or S, at the ends 1, 2, 3, 4 and 6 of the magnets? Polarity of one end (5) is given for you.

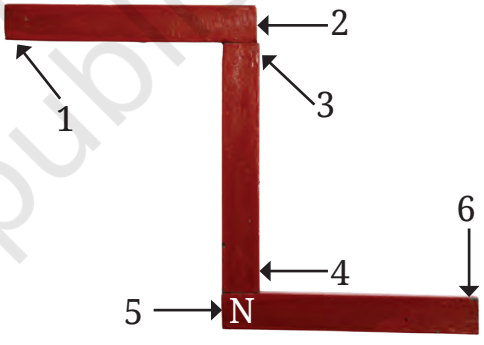

Fig. 4.17: Three bar magnets

Learning further

- Using 3–4 different magnets, try to lift steel pins or U-clips and check which magnet picks up the largest number of pins. Discuss with your friends why different magnets might have picked up different numbers of pins.
- Make a toy 'Hopping Frog' as a combined class activity with the help of your teacher. For constructing the toy, fix ring magnets in an alternate North-South fashion along the

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length of a scale using glue (Fig. 4.18a). Paint a frog on paper, cut along the outline and glue a ring magnet at its base. Take a transparent, flexible plastic strip (Fig. 4.18a) of a smaller size and glue it to the ring magnet which is attached to the frog.

(a) *(b)*

Fig. 4.18: My hopping frog

When you slide the plastic strip (with frog) over the scale (Fig. 4.18b), you can observe the frog hopping.

- Find out about the Maglev Train and try to make its model.
- Try to find out why there is a need to make magnets of different shapes.
- Collect information related to the use of magnets in the field of medicine.

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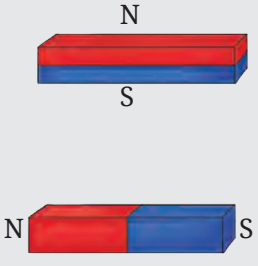
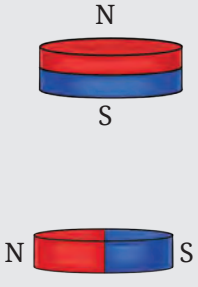
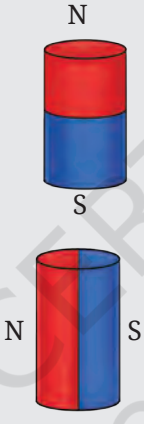
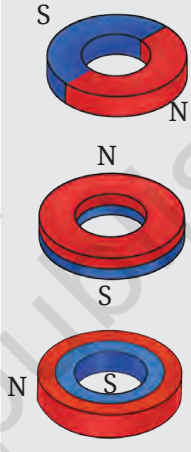
More to know!

Magnet says "Humans have made me in different shapes and sizes as per their requirements. However, my poles always occur in pairs, no matter my shape".

Bar Magnet	Disc Magnet	Cylindrical Magnet	Ring Magnet	Spherical Magnet
				

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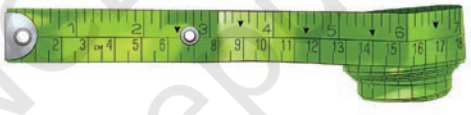
Chapter 5

Measurement of Length and Motion

Deepa, a curious eleven-year old girl, lives in a town in the state of Haryana. The new school year has started. Deepa needs a new uniform since she has grown taller. Her mother takes her to a cloth shop. She asks for a two-metre cloth piece. The shopkeeper measures the cloth using a metal measuring rod.

Then, the tailor takes her measurements using a flexible measuring tape. Her mother instructs the tailor to increase the length of her uniform by *char angula* (four fingers width).



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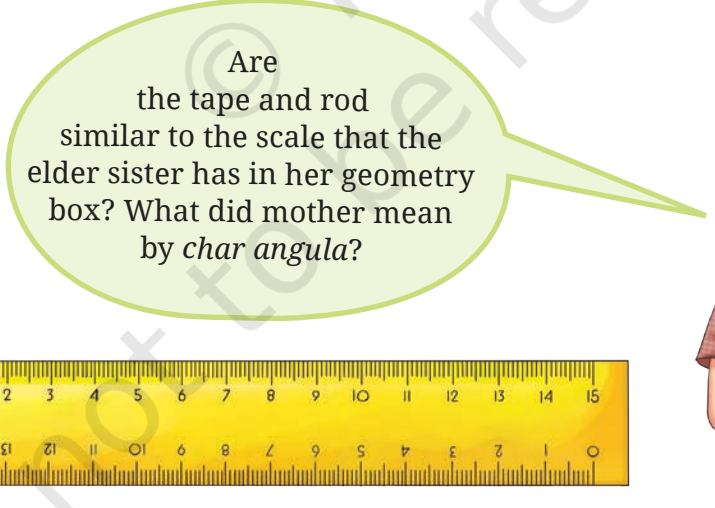

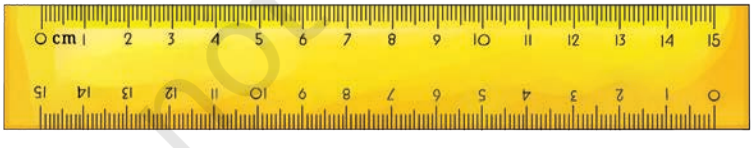

Deepa shares her experience with her school friends Anish, Hardeep, Padma, Tasneem and this leads to a discussion amongst them.

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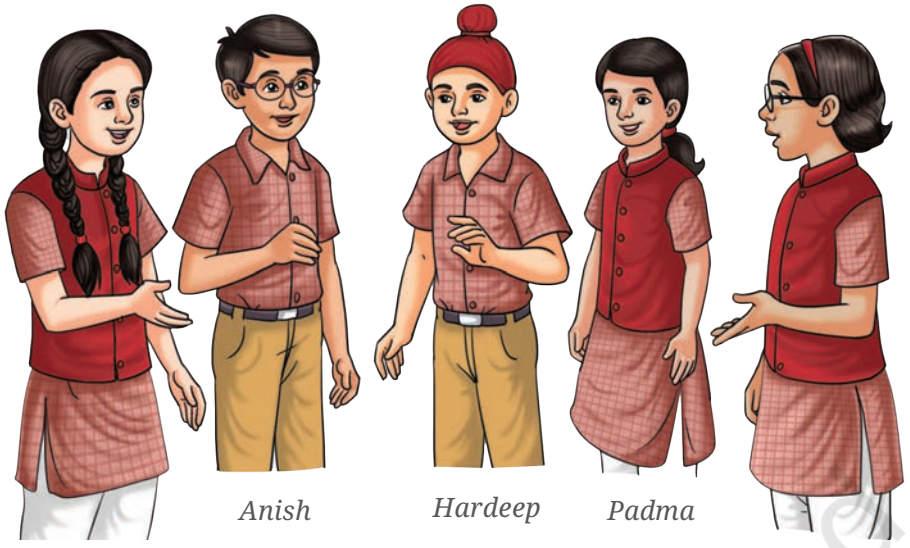

5.1 How do we Measure?

Hardeep says, “I have seen my grandmother measuring cloth by the length of her arm.”

“Have you ever seen how a farmer measures length to divide his field into beds? He walks and counts the number of his strides,” says Padma.

“Oh, not just the length of the strides—sometimes they also use the length of their feet to measure,” adds Anish.

Deepa says excitedly, “Measuring length using body parts must be so much fun! Let us also measure something using a body part.”

“What should we measure? Okay, let us measure the length of the table in our classroom,” says Tasneem.

Padma adds, “And which body part should we use to measure it?”

Deepa says, “Let us use our handspan. I will show you how to use it. I have seen my mother using it. She calls it *balisht*.”

Hardeep adds, “Okay. Let us also note down our measurements.”

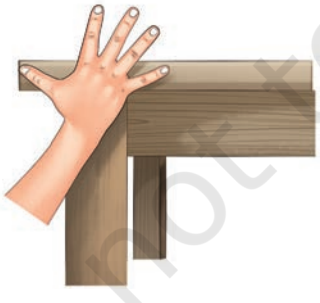

Fig. 5.1: Use of handspan for measuring

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Table 5.1: Measuring the length of the table

Name of the Student	Number of Handspans
Anish	Slightly more than 13
Padma	13
Tasneem	Slightly less than 13
Deepa	Between 13 and 14
Hardeep	14

Padma says, "Oh, the number of handspans is different for all of us. So, what can we say about the length of the table?"

"But why should the number be different?" Hardeep asked thoughtfully.

Tasneem says, "I can guess. Our handspans are of different sizes."

Anish gives an idea, "Let us check this."

So, all five of them put their handspans along each other and arrive at the conclusion that the lengths of their handspans are different.

Deepa says thoughtfully, "No wonder people use scales and measuring tapes."

Deepa and her friends compare the length of the table with the length of their handspans. The length of the table is expressed in terms of their handspans. Here, the handspan used for measurement is an example of a unit. And the length is expressed in two parts, a number and a unit. For example, if the length of the table is found to be 13 handspans, then 13 is the number and 'handspan' is the unit selected for the measurement.

However, handspans and other similar units, such as length of hand, foot, fist or fingers, differ from person to person. Thus, there is a need for such a unit for which measurements of the same length made by different people do not differ.

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More to know!

India has a rich history of measurement systems dating back to ancient times. *Angula* (finger width), multiples of *angula*, *dhanusa,* and *yojana* are some of the units mentioned in ancient Indian literature, and used in measuring artefacts, architecture, and town planning. The *angula* is still used by traditional craftspeople like carpenters and tailors. Several objects with ruled markings which could be scales have been excavated from sites of the Harappan Civilisation.

5.2 Standard Units

Several systems of units evolved with time in different parts of the world. However, when people started travelling from one place to another, it created a lot of confusion. This led to the different countries coming together and adopting a set of standard units of measurement. The system of units now used is known as the 'International System of Units' or SI units.

The **SI unit of length** is **metre**. Its symbol is **m**. A metre scale is shown in Fig. 5.2. One metre (m) is divided into 100 equal divisions. Each division is called a **centimetre** (**cm**). You may be familiar with a smaller part of the metre scale, typically 15 cm long, shown in Fig. 5.3.

Look carefully at the 15-cm scale. It has markings (in cm) from 0 to 15. The length of any section between two consecutive big marks, such as between 1 and 2 or between 5 and 6, is 1 cm. Observe that these sections

Fig. 5.2: A metre scale

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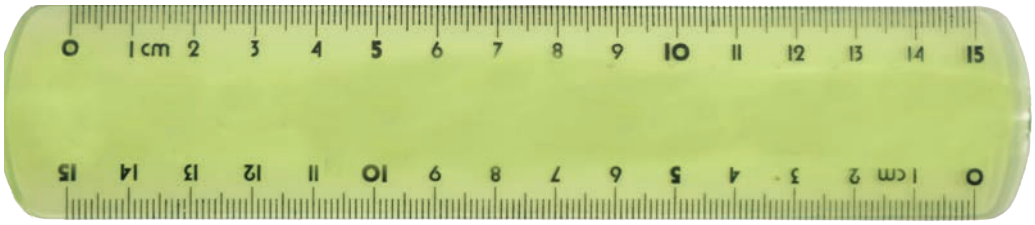

Fig. 5.3: A 15-cm scale

of 1 cm length are further divided into 10 equal parts. The length of one of these smaller parts is called a **millimetre** (**mm**). 1 mm is the smallest value of length that you can measure using this scale. 1 mm is equal to one-tenth of a centimeter (1 mm = 0.1 cm).

For measuring larger lengths, we use a larger unit called a **kilometre** (**km**) which is equal to 1000 metres. And for measuring smaller lengths, we use units such as centimetre or millimetre.

Would it be convenient to use the unit metre to measure larger lengths, such as the length of a railway track between two cities, or to measure smaller lengths, such as the thickness of a page of a book?

1 km = 1000 m	1 m = 100 cm	1 cm = 10 mm

In some scales, you might have noticed another scale marking. This scale marking is in inches, where 1 inch = 2.54 cm. In earlier days, units, such as inch and foot, were used to measure length. These units are still used by some people.

Do you know?

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5.3 Correct Way of Measuring Length

For measuring any length, we need an appropriate scale. For example, if you want to measure the length of your pencil, you may use a 15-cm scale. Similarly, if the height of a room is to be measured, you may need a metre scale or a measuring tape. You cannot directly measure the girth of a tree or the size of your chest using a metre scale. For such measurements, flexible measuring tape, such as a tailor's tape is more suitable.

While measuring lengths, we need to take care of some points.

What is the correct way to place the scale?

Place the scale in contact with the object along its length as shown in Fig. 5.4.

(a) Correct *(b) Incorrect*

Fig. 5.4: Method of placing the scale

What is the correct position of the eye while reading the scale?

For example, if you are trying to measure the length of a pencil by aligning it with a scale, the position of your eye should be directly above the tip of the pencil (Fig. 5.5).

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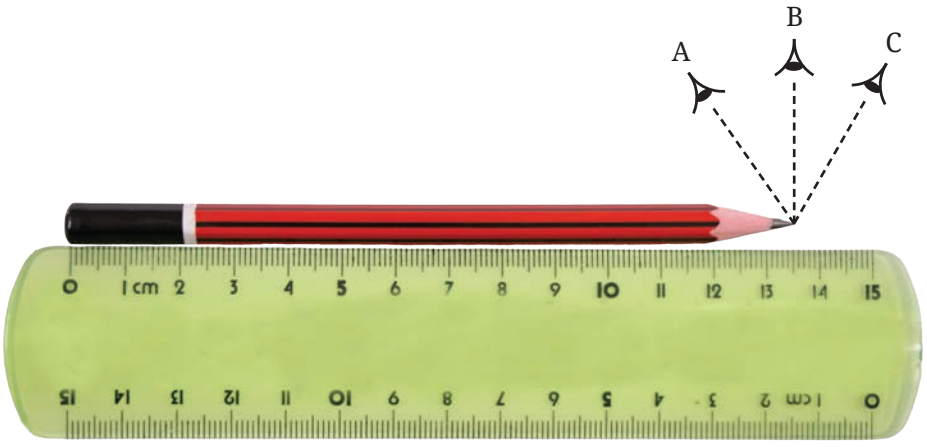

Fig. 5.5: Correct position of the eye is 'B'

How to measure the length if the ends of the scale are broken?

If the ends of the scale are broken or the zero marking is not clear, it can still be used for measurement. With such a scale, use any other full mark of the scale, say, 1.0 cm (Fig. 5.6). Then you must subtract the reading of this mark from the reading at the other end. For example, in Fig. 5.6, the reading at one end is 1.0 cm and at the other end, it is 10.4 cm. Therefore, the length of the object is 10.4 cm–1.0 cm = 9.4 cm.

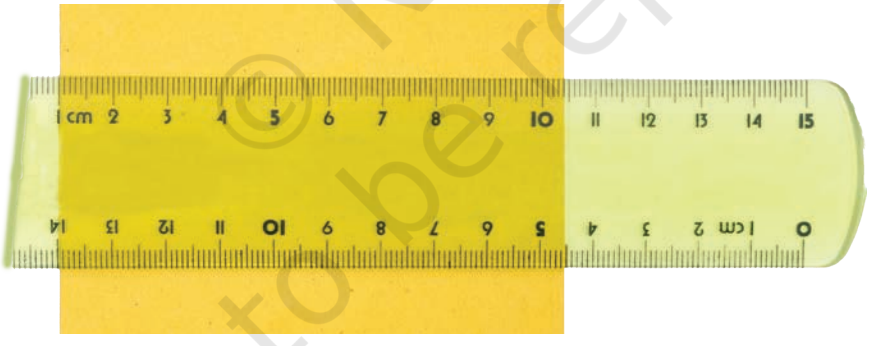

Fig. 5.6: Correct method of placing the scale with broken end

How do visually challenged students measure lengths? They use scales with raised markings that can be felt by touching them.

Do you know?

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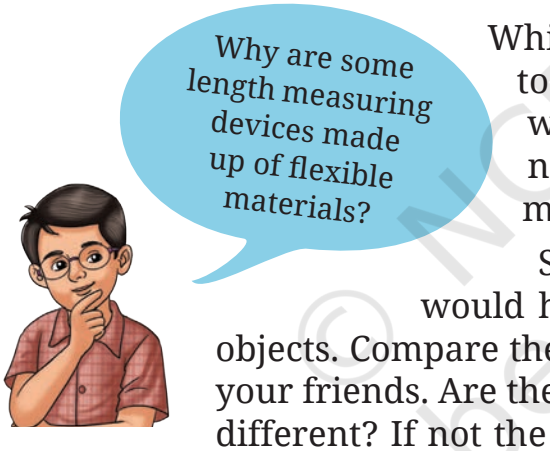
Activity 5.1: Let us measure

- Select some objects around you, such as a comb, a pen, a pencil, and an eraser to measure their lengths.
- Measure their lengths one by one using a metre scale and note down the measurements in Table 5.2.

Table 5.2: Measuring lengths

Object	Length of the object



While writing the length, do not forget to write the unit also. Thus, your result will consist of two parts—one part is a number and the other part is the unit of measurement.

Some of your friends in the class would have measured the length of the same objects. Compare the lengths measured by you with that of your friends. Are the measured lengths the same or slightly different? If not the same, discuss the possible reasons for the differences.

Do you know?

Units of length, such as kilometre, metre, centimetre and millimetre, begin with a lowercase letter, except at the beginning of a sentence. Their symbols km, m, cm and mm are also written in lowercase letters, and are never followed by 's' for the plural. Note that a full stop is not written after the symbol, except at the end of a sentence. While writing the length, always leave a space between the number and the unit.

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5.4 Measuring the Length of a Curved Line

Anish and his parents fixed electric string lights on the arches of the verandah of their house, as shown in Fig. 5.7, for a celebration at home. How would they have measured the required length of string lights?

In the case of a curved line, measurements can be made with the help of a flexible measuring tape or by using a thread as shown in Fig. 5.8.

Fig. 5.7: House decorated with string lights

Fig. 5.8: Measuring the length of a curved line

The thread can then be straightened and its length can be measured using a metre scale.

5.5 Describing Position

One day the teacher informs her students that she has planned an educational visit to a nearby garden. She asks the students to reach there directly in the morning. Deepa and her friends start discussing whether the garden would be closer than their school or farther. Tasneem and Padma say that the garden would be closer, while Deepa and Anish feel that the school would be closer, Hardeep thinks that both would be almost at an equal **distance** (Fig. 5.9).

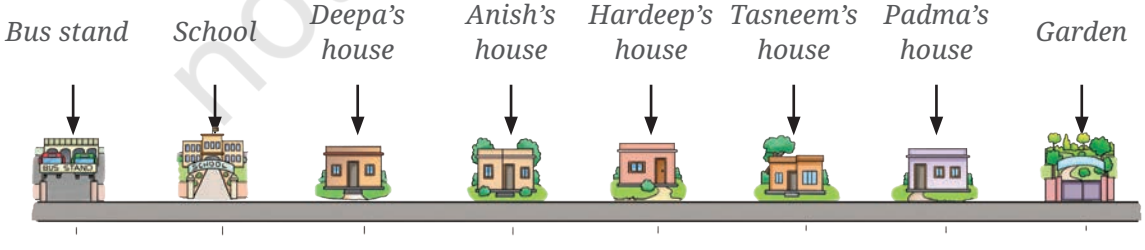

Fig. 5.9: Location of bus stand, school, garden and houses of Deepa and her friends

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Who do you think is correct? All of them are correct (Fig. 5.9). Then, why are their observations different? They are locating the distances of the school and garden from their houses. If, instead, each of them had thought of distances from a same object or point, say, the bus stand, then their observations would have been the same.

When distance is stated with respect to a fixed object or point, then this point is called a **reference point.**

A few days later, Hardeep tells his friends excitedly, "Let us all go to the playground. The sports teacher wants us to help her to draw lines with *chuna* powder (limestone powder) for making the Kabaddi court for the sports day."

Fig. 5.10: A measuring tape

Padma: "We will need a longer measuring tape. Let us take it from the sports room." (Fig. 5.10)

Deepa: "Let us first decide the point on the ground from which we will measure the distances to start drawing the lines. Let us call this our reference point." (Fig. 5.11)

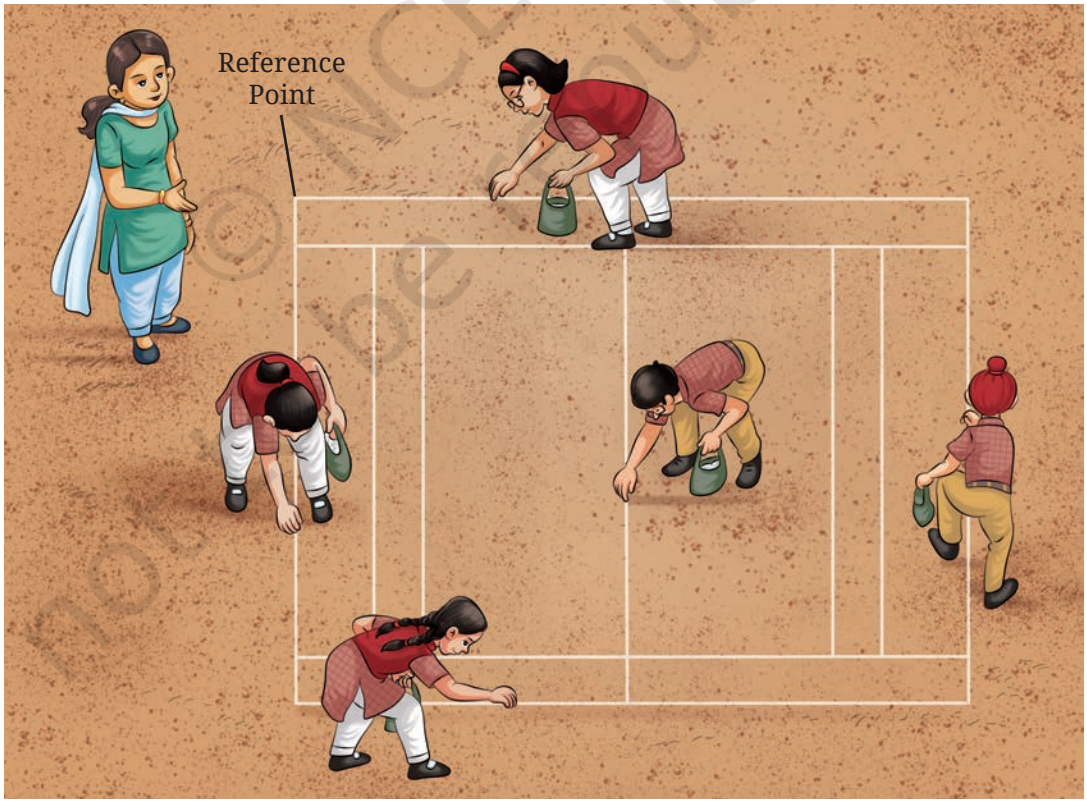

Fig. 5.11: Drawing lines for Kabaddi court

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Fig. 5.12: A kilometre stone

After a few days, Padma was travelling by bus to visit her grandparents in Delhi. She was eager to reach Delhi and was reading the kilometre stones on the side of the road. On one of the kilometre stones, it was written 'Delhi 70 km' (Fig. 5.12).

Further on, the next kilometre stone read 'Delhi 60 km'. Each kilometre stone indicated that she was getting closer to her grandparents' house.

These kilometre stones indicated her distance from Delhi. So, Delhi is the reference point in this situation.

What do such kilometre stones indicate? How could Padma conclude that she was getting closer to her destination?

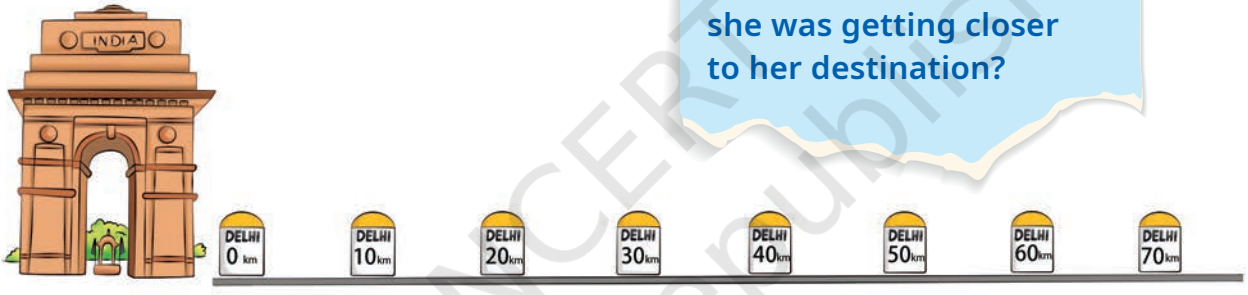

Fig. 5.13: Positions of kilometre stones with respect to Delhi as a reference point

If the kilometre stone reads 'Delhi 70 km' as shown in Fig. 5.13, we can say that the position of Padma is 70 km from Delhi. When the kilometre stone reads 'Delhi 60 km', the position of Padma is 60 km from Delhi.

Does this mean that the position of Padma, with respect to the reference point, is changing with time? When does the position of an object change with respect to a reference point? Does it change when an object is moving?

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5.6 Moving Things

Activity 5.2: Let us explore

- Look around and prepare a list of five objects that are in motion and five objects that are at rest.
- Record your observations in Table 5.3.
- Think about how you decided whether an object was in motion or at rest. Write your explanation (**justification**) in Table 5.3.

Table 5.3: Observing things around you

Objects in motion	Justification	Objects at rest	Justification
Cow grazing in the field		Tree	

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Compare and analyse your justifications. How can one decide if an object is in motion or at rest?

An object is said to be in **motion** if its position changes with respect to the reference point with time. If an object is not changing its position with respect to the reference point with time, it is said to be at rest.

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Deepa looked around her in the bus and noticed that all the passengers were seated. She looked around again after a minute and found them still occupying their seats. She wondered, 'Are they moving?' She concluded that the position of the passengers was not changing with time. Therefore, they were certainly at rest. However, when she looked outside, she felt they were in motion as their positions were changing with respect to things outside.

The reference point is important in deciding whether an object is at rest or in motion. If Deepa considered herself (or the bus) as the reference point, then the passengers were at rest. However, if she considered any object outside the bus (say a building) as the reference point, then the passengers (and the bus) were in motion.

More to know!

Think it over!

Suppose you are travelling on a ship which is moving at a constant speed along a straight line on a calm sea. Suppose there is no window on the ship. Is there any way that you can determine whether the ship is moving or is stationary?

5.7 Types of Motion

Activity 5.3: Let us explore

- Take an eraser and drop it from a certain height.
- Observe its motion.

Does it move along a straight line? When an orange drops from the tree, does it move in a straight line? Have you seen the Republic Day parade? Recall the march-past of students during the parade. Do they move on a straight-line path? When a heavy box is pushed, it may also move along a straight line (Fig. 5.14).

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When an object moves along a straight line, its motion is called **linear motion**. **Identify** such linear motion in your surroundings.

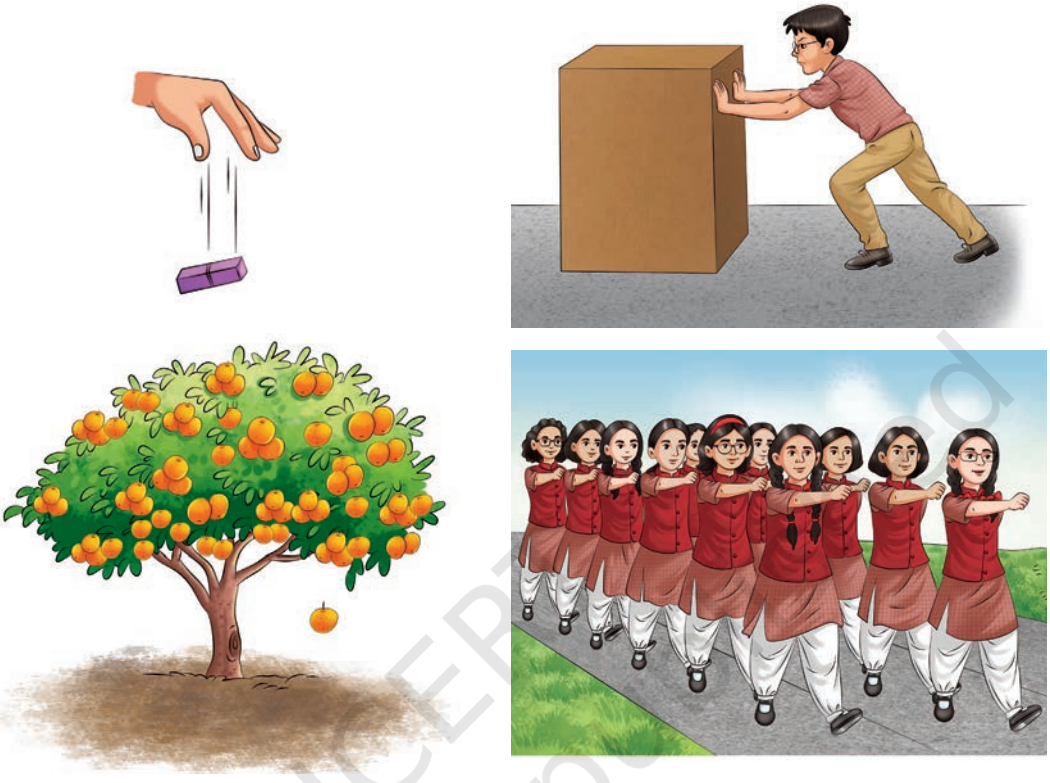

Fig. 5.14: Linear motion

But do things always move along a straight line? You might have enjoyed playing on swings and merry-go-rounds. Are these types of motion also linear motion?

Activity 5.4: Let us investigate

- Tie an eraser (or a potato) to one end of a thread.
- Hold the other end of the thread with your hand and whirl it (Fig. 5.15).
- Observe its motion.

Is the motion of the eraser the same as that of a merry-go-round?

When an object moves along a circular path, its motion is called **circular motion.**

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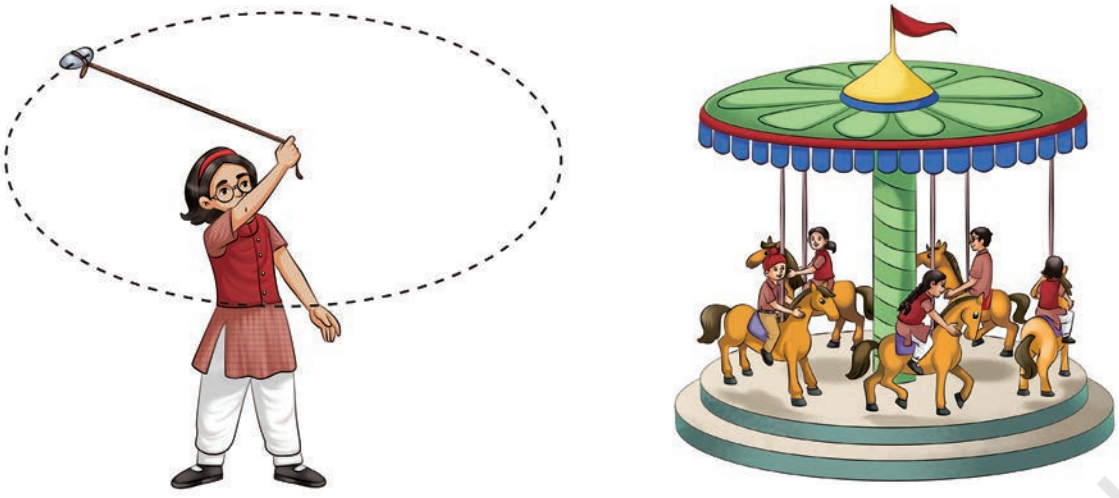

Fig. 5.15: Circular motion

Activity 5.5: Let us investigate

- Tie an eraser (or a potato) to one end of a thread.
- Hang the eraser by holding the other end of the thread (Fig. 5.16). Keep your hand steady.
- Using the other hand, take the eraser slightly to one side and then release (Fig. 5.16).

Does it start moving to and fro? Is its motion similar to the motion of a swing?

When an object moves to and fro about some fixed position, its motion is called **oscillatory motion.**

Fig. 5.16: Oscillatory motion

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Activity 5.6: Let us investigate

- Take a thin metal strip of about 50 cm long.
- Hold its one end pressed to a table. You may use a few books or a brick to hold it (Fig. 5.17).
- Press the free end of the strip slightly and let it go.
- Observe the motion of this end of the strip.

Does it move up and down? This is also an example of oscillatory motion.

Fig. 5.17: Oscillatory motion of a metal strip

More to know!

If an object repeats its path after a fixed interval of time, its motion is said to be periodic. When an object is in circular motion, it moves along the circular path again and again. An object in oscillatory motion also repeats its motion while moving to and fro. Both circular and oscillatory motion are periodic in nature.

Activity 5.7: Let us identify

- Look at the picture of a children's park (Fig. 5.18) or visit a children's park.
- Observe different kinds of motions. **Classify** them as linear, circular or oscillatory motion.

List them in Table 5.4. Give your justification for why you put each in a certain category.

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Fig. 5.18: Types of motion observed in a children's park

Table 5.4: Types of Motion

Object	Linear motion	Circular motion	Oscillatory motion
Swing			Moving to and fro

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Keywords

centimetre	Measurement	Classify
Circular motion	metre	Explore
Distance	millimetre	Identify
kilometre	Motion	Investigate
Length	Oscillatory motion	Justification
Linear motion	Reference point	Observe
	SI Unit of Length	

Summary

Key Points

- The International System of Units (SI units) has been adopted by countries as standard units of measurement.
- The SI unit of length is metre. Its symbol is m.
- 1 km = 1000 m, 1 m = 100 cm, 1 cm = 10 mm.
- When distance is stated with respect to a fixed object or point, then this point is called a reference point.
- An object is said to be in motion if its position changes with respect to a reference point with time.
- When an object moves along a straight line, its motion is called linear motion.
- When an object moves along a circular path, its motion is called circular motion.
- When any object moves to and fro about any fixed position, its motion is called oscillatory motion.

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Let us enhance our learning

1. Some lengths are given in Column I of Table 5.5. Some units are given in Column II. Match the lengths with the units suitable for measuring those lengths.

Table 5.5

Column I	Column II
Distance between Delhi and Lucknow	centimetre
Thickness of a coin	kilometre
Length of an eraser	metre
Length of school ground	millimetre

2. Read the following statements and mark True (T) or False (F) against each.
   (i) The motion of a car moving on a straight road is an example of linear motion. [ ]
   (ii) Any object which is changing its position with respect to a reference point with time is said to be in motion. [ ]
   (iii) 1 km = 100 cm [ ]
3. Which of the following is not a standard unit of measuring length?
   (i) millimetre (ii) centimetre (iii) kilometre (iv) handspan
4. Search for the different scales or measuring tapes at your home and school. Find out the smallest value that can be measured using each of these scales. Record your observations in a tabular form.
5. Suppose the distance between your school and home is 1.5 km. Express it in metres.

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6. Take a tumbler or a bottle. Measure the length of the curved part of the base of glass or bottle and record it.

7. Measure the height of your friend and express it in (i) metres (ii) centimetres and (iii) millimetres.

8. You are given a coin. Estimate how many coins are required to be placed one after the other lengthwise, without leaving any gap between them, to cover the whole length of the chosen side of a notebook. Verify your estimate by measuring the same side of the notebook and the size of the coin using a 15-cm scale.

9. Give two examples each for linear, circular and oscillatory motion.

10. Observe different objects around you. It is easier to express the lengths of some objects in mm, some in cm and some in m. Make a list of three objects in each category and enter them in the Table 5.6.

Table 5.6: Sizes of objects around us

Size	Objects
mm	
cm	
m	

11. A rollercoaster track is made in the shape shown in Fig. 5.19. A ball starts from point A and escapes through point F. Identify the types of motion of the ball on the rollercoaster and corresponding portions of the track.

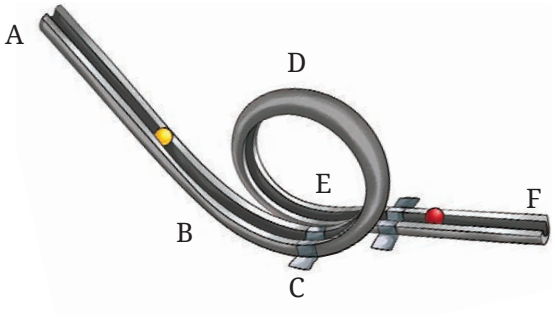

Fig. 5.19: Rollercoaster track

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12. Tasneem wants to make a metre scale by herself. She considers the following materials for it—plywood, paper, cloth, stretchable rubber and steel. Which of these should she not use and why?

13. Think, design and develop a card game on conversion of units of length to play with your friends.

Learning further

- Can you find the thickness of a single page of your notebook or textbook using a scale? Think of a way and write it. Carry out the activity and report your result.
- Collect fallen leaves from the same tree. Identify the name of the tree whose leaves you have taken. Measure length and breadth of all these leaves using a 15-cm scale, as shown in Fig. 5.20. Record your observations in the Table 5.7.

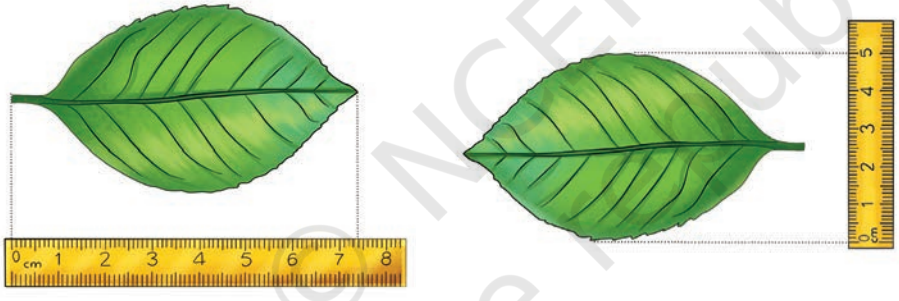

Fig. 5.20: Measuring a leaf

Table 5.7: Length and breadth of leaves

S. no.	Name of tree	Length of leaf	Breadth of leaf
1.			

Discuss why the leaves of the same tree vary in length and breadth.

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- Discuss with elders in your community what units were used for measurement of length in the olden days. Also, using the internet, try to find out about the length scales found in excavations of archaeological sites in India.

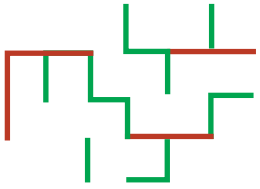

Fig. 5.21: A maze

- Create a maze using lines of 1 cm, 2 cm and their combination. Part of it has been made for you in Fig. 5.21. Now use your imagination and expand it to a size as big as you want.
- How tall am I? Stand along a wall and with the help of an adult, mark your height (Fig. 5.22). Repeat it every three months to maintain a height record for yourself and your siblings.

Fig. 5.22: Measuring height

- Let us design a fun method for measuring the distance between two places by using a bicycle. Attach a flexible metal strip to the spoke of the front wheel in such a manner that it hits the frame of the bicycle holding the wheel, every time it crosses it and produces a sound (Fig. 5.23).

Now ride the bicycle slowly and count the number of times in which sound occurred. The number will give you the number of turns of your wheel made. Now measure the length of the outer boundary of the wheel using a string as done in Fig. 5.8. Multiply this length by the number of turns of the wheel. This is the distance you travelled.

Fig. 5.23: Measuring distance

Such methods are actually used to measure the distance for road-running races. Try to find out about a 'Jones Counter' which is attached to a bicycle wheel and is used for measuring distances.

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Chapter 6

Materials Around Us

> उपादानं भवेत्तस्या (मूषाया:) मृत्तिका लोहमेव च।
>
> (रसरत्नसमुच्चय–१०.३)
>
> The materials used to make the crucible
> (a vessel used to melt substances) are clay and iron.
>
> (*Rasaratnasamuchchaya*–10.3)

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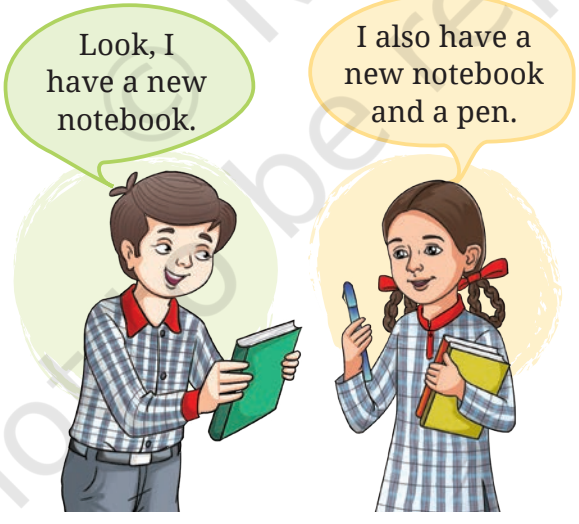
6.1 Observing Objects Around Us

Ghulan and Sheeta are thrilled to go to their new class after the summer break. They enter their classroom and start talking. "What have you brought to school today?" asks Sheeta.



After some time, Madam Vidya, their science teacher, enters the class and starts interacting with the students to draw their attention to many things they use in their daily life. She asks, "How are they similar to or different from each other? What are their shapes and colours? How does it feel when you touch them? Are some of them heavier than

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others?" All things are made up of some materials like paper, wood, cloth, glass, metal, plastic, clay, and so on.
Any substance that is used to create an object is referred to as **material**.

Activity 6.1: Let us identify

Make a list of objects you see around and also write the names of the materials they are made up of in Table 6.1.

Table 6.1: Identify materials

I observe	Materials they are made up of

Based on everyday observations, one can conclude that objects are made up of various materials.

The earliest pottery found in the Indian subcontinent dates back to 7,000 to 8,000 years in the Ganga plains (Lahuradewa) and in Baluchistan (Mehrgarh). About 4000 BCE onwards, Sindhu-Saraswatī developed techniques of wheel-turned pottery production, pigmentation, application of protective or decorative coats (called 'slips') of multiple colours, decorative painting, etc. These techniques became further sophisticated during the Sindhu-Saraswatī (also known as 'Harappan') Civilisation (2600–1900 BCE), with a bright red surface painted with black-coloured designs displaying geometric patterns, and aquatic and terrestrial animals. The clay used for making pots, dishes, bowls and other items was carefully selected and cleaned, sieved, kneaded, turned over a wheel and finally baked in kilns (baked clay is called 'terracotta'). Pots were used for various purposes, from cooking to storage of food grains, oil, ghee, and so on. Some very large storage jars and other pottery items are exhibited at the National Museum, New Delhi.

Do you know?

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Let us explore materials further.

6.2 How to Group Materials?

Activity 6.2: Let us group

- Group the objects shown in Fig. 6.1 based on any common property, such as shape, colour, hardness, softness, shine, dullness or materials they are made up of.

Fig. 6.1: Objects around us

- Which property did you use to group the objects in Activity 6.2?
- Did your friends group objects based on similar properties?
- What did you learn from this activity?

You must have noticed that an object can be made from different materials and some materials can be used to make more than one object.

The method of arranging the objects into groups is called **classification**. Objects can be classified on the basis of a common property that they have.

Similarly, we can classify materials based on certain properties.

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Activity 6.3: Let us think

Let us think what materials we can use to make a tumbler. Fill in the names of the materials in the spaces provided in Fig. 6.2.

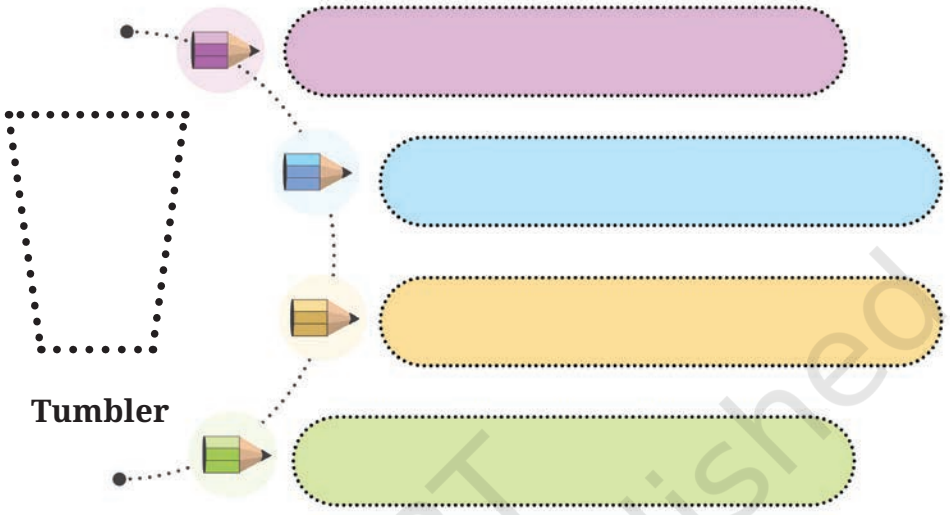

Fig. 6.2: Materials used to make a tumbler

Would it be a good idea to use paper-like materials for making cooking utensils?

Why cannot a tumbler made of cloth be used for storing water?

The materials that are required to make a tumbler should be capable of holding water.

What decides which material should be used for making an object? We choose a material to make an object depending on its properties and the purpose for which the object is to be used.

We may use different materials for making different parts of an object. For example, a pen may be made up of different materials like plastic, metal and ink.

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Activity 6.4: Let us explore

Fig. 6.3 illustrates a variety of balls that are of the same size but made up of different materials.

- Take each ball and drop it from a fixed height.
- Note the height to which the ball bounces and **record** it in Table 6.2.
- Identify the ball that achieves the highest bounce.

Tennis ball *Cricket ball* *Hand exercise ball*

Fig. 6.3: Different types of balls used for various purposes

Table 6.2: Bouncing level of the balls

Ball	Bounce (high, medium or low)
Tennis ball	
Cricket ball	
Hand exercise ball	
Any other	

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Discuss in class other properties of sports balls, such as size, colour, texture and how high they bounce and understand why balls are made up of specific materials for specific sports. Observe Fig. 6.4 and group the objects in as many different ways as possible.

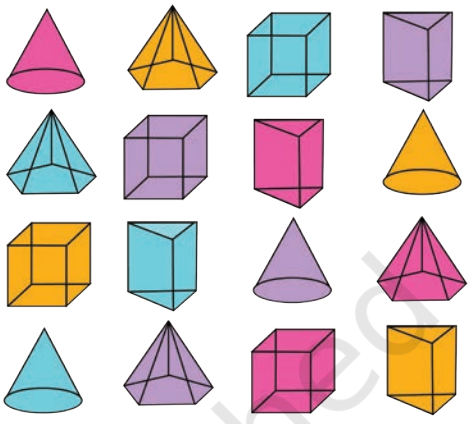

Fig. 6.4: Grouping of objects

You might have grouped these objects according to their shapes or by their colour or materials they are made up of.

We have learnt that materials may be classified on the basis of their properties.

For example, in the kitchen, we usually store things in such a manner where similar utensils are placed together. Similarly, a grocer usually keeps all types of spices in one corner, pulses and grains in another corner and so on. You may also visit any chemist shop and enquire about how medicines are arranged.

6.3 What are the Different Properties of Materials?

Let us learn some more properties of materials.

6.3.1 Observe and identify appearance of materials

Materials often look different from each other. Freshly cut wood, which is unpolished, has a distinct appearance, quite different from that of iron. Similarly, iron looks different from copper or aluminium. However, there might be some similarities among iron, copper and aluminium that make them different from wood.

Let us do a sorting challenge! Collect small pieces of paper, cardboard, wood, chalk, copper wire, aluminium foil and any article made up of brass, bronze, steel, etc. Take a look at the pieces you have collected. Do any of these materials shine when light falls on them? Observe their texture (whether

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rough or smooth), colour and other noticeable features, and record your observations in the notebook. Group the collected pieces based on their appearance.

Materials that typically have shiny surfaces are said to have a **lustrous** appearance. Such materials with lustre are usually metals. Examples of metals include iron, copper, zinc, aluminium, gold, etc. However, some metals may lose their lustre and start to look dull or non-lustrous due to the effect of air and moisture on them. As a result, we often notice the lustre only on their freshly cut surfaces. **Non-lustrous** materials are those that do not have a shiny surface. Some examples of non-lustrous materials are paper, wood, rubber, jute, etc.

"All that glitters is not gold" goes an old saying! Not all the materials that shine are metals. Surfaces of some materials are made shiny by polishing or coating them with thin layers of plastic, wax or any other material which makes them look shiny. These materials may not be metals.

6.3.2 Which materials are hard?

When you press different objects or materials with your hands, some of them like stones, may be hard to compress, while others, like an eraser, can be easily compressed. Take a metal key and use it to scratch the surface of a piece of wood, aluminium, stone, iron, candle, chalk and any other material or object. Can some materials be scratched more easily than others? Materials which can be compressed or scratched easily are **soft**, while other materials which are difficult to compress or scratch are **hard**. However, these properties are relative in nature. For example, rubber is harder than sponge but softer than iron.

Activity 6.5: Let us observe

- Hold the objects given in Table 6.3 with your hands. Feel whether the objects are hard or soft. Find out the materials they are made up of. Enter your observations in Table 6.3.

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Table 6.3: Hard or soft objects and the materials they are made up of

Object	Hard/Soft	Material(s)
Brick	Hard	Baked clay
Water bottle		
Pillow		
Tumbler		
Table		
Sweater		
Any other		

- Compare your observations with the observations of your friends and discuss.

You have learnt that materials can have different properties, like lustre, hardness, softness and colour. Can you think of any other properties that are shown by materials? Let us explore it further.

6.3.3 Explore materials through which one can see or cannot see

Ghulan, Sheeta and Sara are playing hide and seek with their friends. Ghulan hides behind a wall, Sheeta hides behind a big tree in the garden while Sara hides behind the frosted glass door (which has a hazy surface). Sheeta's younger brother can see all of this happening through a glass window of his house.

The materials, through which things can be seen clearly, are called **transparent**. Glass, water, air, cellophane paper, etc., are some examples of transparent materials.

Why did Ghulan, Sheeta and Sara choose these places to hide?

Do you think it would be possible for Sheeta's brother to see her and her friends through a closed wooden window of the house?

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There are many materials through which you are not able to see at all. These materials are called **opaque**. Wood, cardboard and metals are examples of opaque materials.

The materials through which objects can be seen, but not clearly, are known as **translucent**. Butter paper and frosted glass are examples of translucent materials.

Look at Fig. 6.5. Identify and label the nature of materials used by Ghulan (A), Sheeta (B), Sara (C) and Sheeta's brother (D).

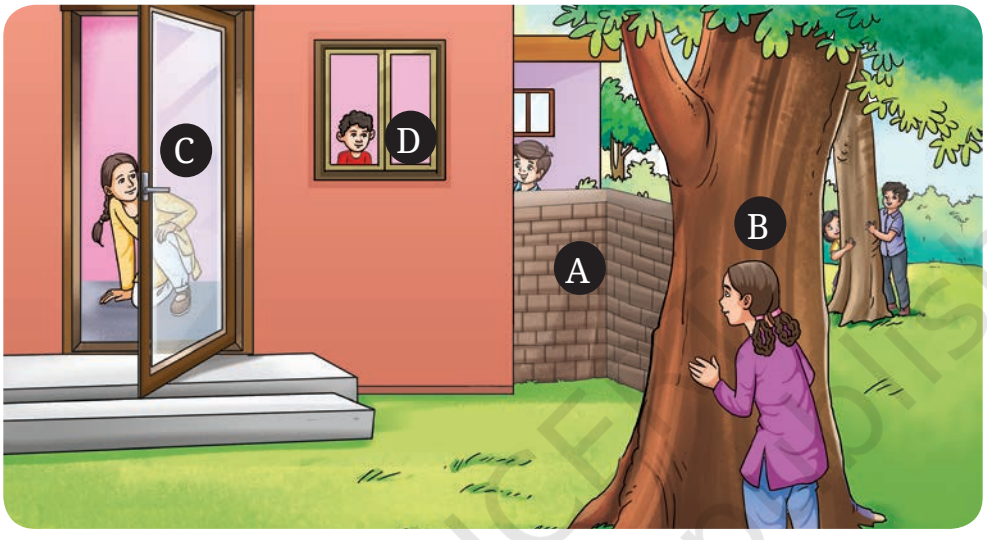


Fig. 6.5: Identify the nature of different materials

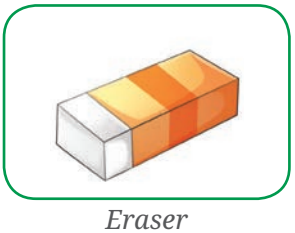
(A) _____ (B)_____ (C) _____ (D) _____.

Activity 6.6: Let us classify

Classify the following objects as transparent, translucent or opaque in Table 6.4.

Glass tumbler

Butter paper



Eraser

Frosted glass

Wooden board

Window glass

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Is water transparent? Can it be made opaque? ?

Table 6.4: Classification of objects

Transparent	Translucent	Opaque

6.3.4 What is soluble in water; what is not?

Ghulan was sweating when he came home after playing in the evening. He was feeling tired and thirsty. Ghulan's mother mixed a spoonful of sugar, a pinch of salt and some lemon juice in a glass tumbler of water and offered him this *shikanji* (lemonade) to drink.

Ghulan noticed that while his mother was mixing sugar and salt in water, the salt and the sugar disappeared after a while.

Let us try a simple activity to explore how different materials behave when we mix them in water!

Activity 6.7: Let us explore

- Collect small amounts of sugar, salt, chalk powder, sand and sawdust.
- Take five glass tumblers and fill them about two-third with water.
- Put a teaspoonful of sugar in the first glass tumbler, salt in the second one, chalk powder in the third, sand in the fourth and sawdust in the fifth glass tumbler.
- On stirring, **predict** what will happen in each case.
- Use a spoon to stir well the contents of each glass tumbler.
- Wait for a few minutes and watch what happens.
- Write down your observations in Table 6.5.

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Table 6.5: Mixing different materials in water

Material	Prediction	Observation
	Will disappear in water/will not disappear in water	Disappears in water/ does not disappear in water
Sugar		
Salt		
Chalk powder		
Sand		
Sawdust		
Any other		

Does everything you put in water disappear?

You might have noticed that some materials completely disappear when mixed in water. We say that these materials dissolve in water or, in other words, they are **soluble** in water (Fig. 6.6a). Some materials do not mix with water and do not disappear even after we stir them for a long time. These materials are **insoluble** in water (Fig. 6.6b). Water plays an important role in the functioning of our body because it can dissolve a large number of materials.

(a) Soluble material in water *(b) Insoluble material in water*

Fig. 6.6: What disappears, what does not?

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Make your own ORS!

ORS—Oral Rehydration Solution— is used to treat dehydration due to diarrhoea or other illnesses. These ready-made ORS packets are available in primary health centres and also in the market. Each packet is dissolved in a litre of water before use. If these are not available, ORS can be prepared at home by mixing six teaspoons of sugar and half a teaspoon of common salt in one litre of boiled and cooled water.

Some liquids get completely mixed with water. Some do not mix with water and form a separate layer when left undisturbed for some time. Similarly, some gases are soluble in water whereas others are not. For example, oxygen gas dissolves in water. It is very important for the survival of animals and plants that live in water.

6.3.5 How heavy or light?

Activity 6.8: Let us measure

- Let us take three identical paper cups (or bowls). Fill each cup half with the provided materials.
- Fill one with water and mark it as 'A', second with sand and mark it as 'B', and the third with pebbles and mark it as 'C'.
- Predict which one would be heavier and which one would be lighter?

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- Weigh each cup using a balance (Fig. 6.7) and record the readings in your notebook.
- Compare the data and infer which is heavier or lighter.

From Activity 6.8, we can say that any object which is heavier or lighter can be measured in terms of a property called **mass**.

The one which is heavier has more mass and the one which is lighter has less mass.

Fig. 6.7: Weighing a paper cup containing water

Weight is sometimes used in common language for mass as it is determined by weighing. You will learn more about mass and weight and their relation in higher classes.

6.3.6 Space and volume

Next day, Madam Vidya enters the class. All the students stand up to greet her. She reciprocates and deliberately says, "Please keep your bags on your seats and sit down." Students are not able to sit because bags are kept on their seats. Madam Vidya asks, "Why are you not sitting?" The students reply that there is no place to sit because the bags have occupied that space.

Continuing the conversation, she provides two identical glass tumblers to two students and encourages them to pour the remaining water from their drinking water bottles into the respective glass tumblers. On pouring water in the glass tumblers, the students observe that one glass tumbler gets half-filled with water (Fig. 6.8a) while the other is almost completely filled with water (Fig. 6.8b).

(a) Half-filled *(b) Fully-filled*

Fig. 6.8: Glass tumblers with varying levels of water

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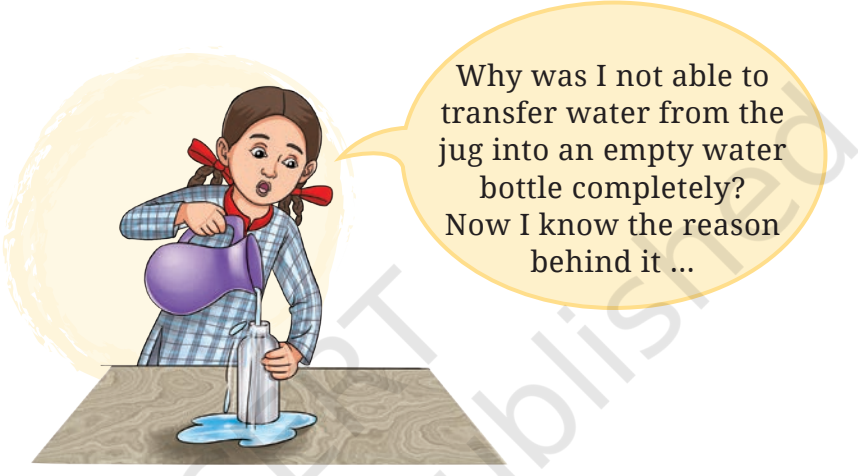
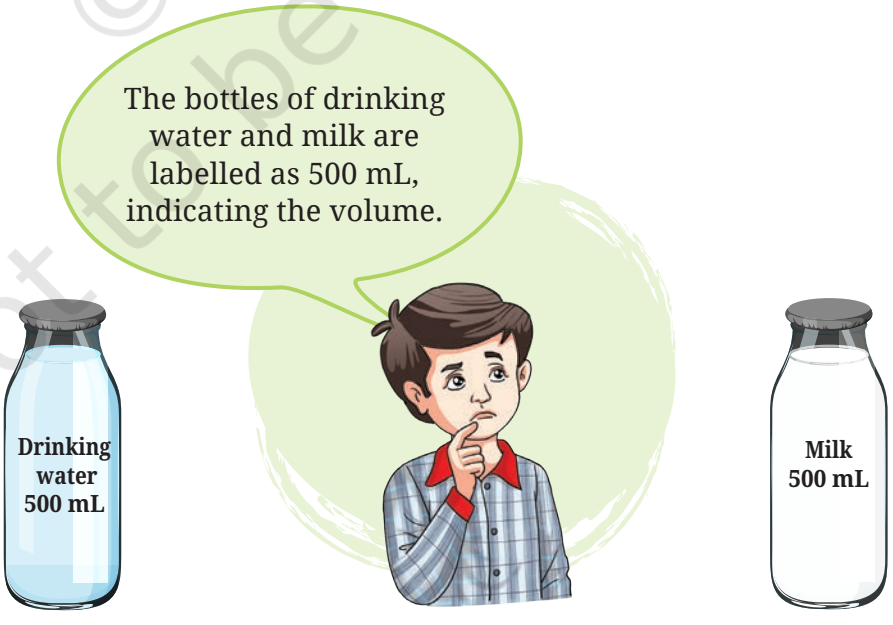
Why is the level of water different in the two tumblers?

Madam Vidya elaborates that both tumblers have the same capacity. The water levels differ in each case, which indicates that the amount of water in each tumbler is different.

The water in the first tumbler occupies less space, indicating that the volume of water in this tumbler is less than the water in the other tumbler. The space occupied by water represents its **volume**.



You may have noticed drinking water bottles of different sizes being sold in the market. Have you noticed 1 L, 500 mL, 200 mL, etc., written as net quantity on the bottles? These indicate the volume of water in the bottles.



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Now you have become familiar with many properties of materials. However, all materials do not possess all these properties.

Are there any properties which can be shown by all materials? If yes, what are those?

6.4 What is Matter?

Mass and volume are the two properties that are possessed by all materials. Can we give a general name to anything that possesses these two properties?

Anything that occupies space and has mass is called **matter**. The mass gives the quantity of matter, and the units to measure it are gram (g) and kilogram (kg). The space occupied by matter is its volume. The units to measure the volume are litre (L) and millilitre (mL).

Kilogram is the unit of mass in the International System of Units (SI). Kilogram is abbreviated in lower case as kg. There is no space between 'k' and 'g' in kg, and no full stop after the symbol, except at the end of a sentence. While writing the mass, always leave a space between the number (numerical value) and the unit. For example, if we have mass of 7 kilograms, it would be written as 7 kg and not as 7 kgs.

Similarly, litre is abbreviated as capital L and millilitre as mL. There is no space between 'm' and 'L' in mL. For example, if you have 500 millilitres of water, it would be written as 500 mL, m will be in lower case and L will be in upper case. The SI unit for volume is cubic metre, abbreviated as m^3. The abbreviation is written with a superscript 3 to denote cubic metre. For example, if you have volume of 2 cubic metres, it would be written as 2 m^3. Always leave a space between number (numerical value) and the unit. 1 m^3 =1000 L.

Do you know?

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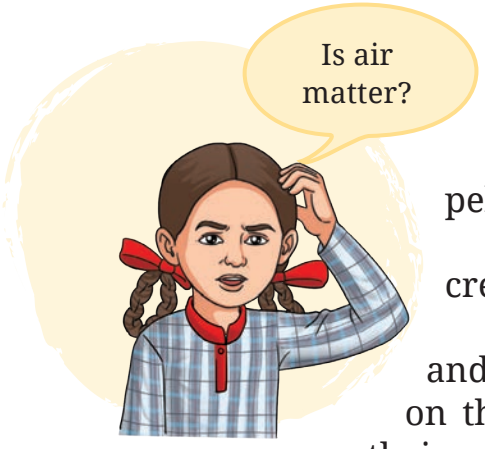


Can all the materials around us be considered as different examples of matter? Discuss with your friends.

For example, water is matter, sand and pebbles are matter and so is the cup.

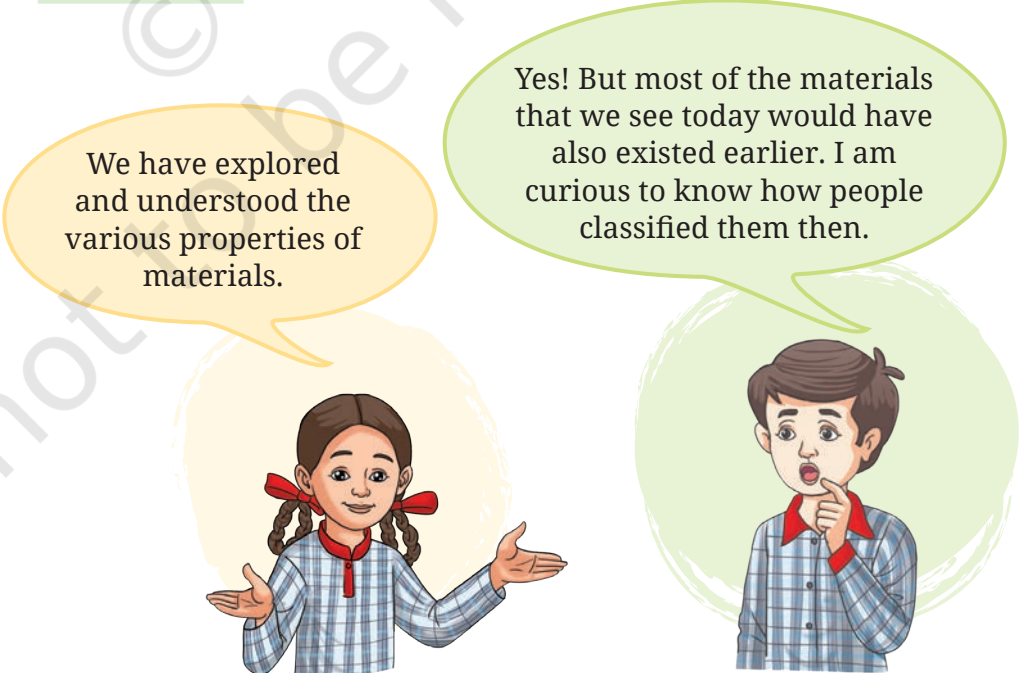
Materials are types of matter used in the creation or making of objects.

We learnt that materials look different and behave differently. We grouped materials on the basis of similarities or differences in their properties.

We find grouping useful as it helps us study and observe patterns in the properties of things. Humans have been classifying not only things, but also rocks, plants and animals. We have learnt about the classification of the living world in the chapter 'Diversity in the Living World'. Just like in the living world, classification of the non-living world is also done on the basis of their properties.

Think it over!

Can you think about what changes the invention of plastic brought to humans? Is it a boon or a bane?



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A similar classification system existed in ancient India. Ayurveda, one of the Indian medical systems, too has a system of grouping things.

गुरु मन्द हिम स्निग्ध श्लक्ष्ण सान्द्र मृदु स्थिराः|
गुणाः ससूक्ष्म विशदाः विंशतिः स विपर्ययाः||

(*Aṣhtanga hṛidaya Sūtra sthāna 1.18*)

The shloka precisely talks about the 20 properties (*guṇa*—ten pairs of opposite properties), which are used to describe all physical matter in Ayurveda. These properties can also be used to describe all living systems (plants, animals and humans), the environment and also food.

These properties are:

(i)	*guru* (heavy)	×	*laghu* (light in weight)
(ii)	*manda* (slow)	×	*tīkṣhṇa* (quick, fast)
(iii)	*hima* (cold)	×	*uṣhṇa* (hot)
(iv)	*snigdha* (unctous)	×	*rukṣha* (dry)
(v)	*śhlakṣhaṇa* (smooth)	×	*khara* (rough)
(vi)	*sāndra* (solid)	×	*drava* (liquid)
(vii)	*mṛidu* (soft)	×	*kaṭhina* (hard)
(viii)	*sthira* (stable)	×	*khāla* (moving, unstable)
(ix)	*sūkṣhma* (subtle, small)	×	*sthūla* (big, gross)
(x)	*viśhada* (non slimy)	×	*picchhila* (slimy)

Do you know?

Keywords

Classification
Hard
Insoluble
Lustrous
Mass
Material
Matter
Non-lustrous
Opaque
Soft
Soluble
Translucent
Transparent
Volume
Classify
Explore
Identify
Observe
Predict
Record

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Summary

Key Points

- Objects are made from a large variety of materials. An object can be made up of a single material or a combination of different materials.
- We can use different materials to make objects with similar functions.
- The method of arranging objects into groups is called classification.
- Materials possess different properties which determine their use.
- Materials are grouped or classified based on their similarities or differences in their properties.
- Materials can be grouped based on appearance, such as lustrous or non-lustrous and based on the feel, such as hard or soft.
- Materials are grouped as transparent, translucent or opaque depending on how much we can see through them.
- Some materials are soluble in water, while others remain insoluble.
- Anything that occupies space and has mass is called matter.
- The space occupied by matter is its volume.
- Mass quantifies the amount of matter present in an object.

Let us play

1. Find the companion.

   Link the following words by putting arrows between words that have a connection.

	Iron	
Transparent		Copper
Solid		Bottle
Plastic	Lustrous	
Wood		Opaque
	Glass	

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2. Win the 'Word-hub'

The following words from the chapter like lustrous, non-lustrous, soluble, insoluble, hard, soft, matter, mass, transparent, opaque, volume and translucent are picked up.

Grid

- Students should randomly choose nine words from the given list and write them in the grid.
- Then, the facilitator either reads the definition of a word or the word itself (randomly) from the given list.
- The learners have to tick if the particular word is there in the grid.
- Whoever finishes ticking off all nine words first will shout out 'Hurray!' That person will be the winner if his/her words are marked correctly.

Let us enhance our learning

1. Visit your kitchen and observe how your parents have organised various edibles. Can you suggest a better sorting method? Write it in your notebook.

2. Unscramble the letters (Column I) and match with their properties (Column II).

Column I	Column II
(i) T R E M A T	(a) Objects can be seen clearly through it
(ii) U L S B E L O	(b) Occupies space and has mass
(iii) T N E R P A S N A R T	(c) Shiny surface
(iv) E R U S T L	(d) Mixes completely in water

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3. The containers which are used to store materials in shops and at home are usually transparent. Give your reasons for this.

4. State whether the statements given below are True [T] or False [F]. Correct the False statement(s).

   (i) Wood is translucent while glass is opaque. [ ]

   (ii) Aluminium foil has lustre while an eraser does not. [ ]

   (iii) Sugar dissolves in water whereas sawdust does not. [ ]

   (iv) An apple is a matter because it occupies no space and has mass. [ ]

5. We see chairs made up of various materials, such as wood, iron, plastic, bamboo, cement and stones. Following are some desirable properties of materials which can be used to make chairs. Which materials used to make chairs fulfil these properties the most?

   (i) Hardness (does not bend or shake on sitting even after long use).

   (ii) Lightweight (easy to lift or to take from one place to another).

   (iii) Does not feel very cold when sitting during winters.

   (iv) Can be cleaned regularly and made to look new even after long use.

6. You need to have containers for collection of: (i) food waste, (ii) broken glass and (iii) wastepaper. Which materials will you choose for containers of these types of waste? What properties of materials do you need to think of?

7. Air is all around us but does not hinder us from seeing each other. Whereas, if a wooden door comes in between, we cannot see each other. It is because air is ---------- and the wooden door is ---------- . Choose the most appropriate option:

   (i) transparent, opaque

   (ii) translucent, transparent

   (iii) opaque, translucent

   (iv) transparent, translucent

8. Imagine you have two mysterious materials, X and Y. When you try to press material X, it feels rigid and does not change its shape easily. On the other hand, material Y easily changes its shape when you press it. Now, when you mix both materials in water, only material X dissolves completely,

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while material Y remains unchanged. What can materials X and Y be? Can you identify whether material X is hard or soft? What about material Y? Justify your answer.

9. (i) Who am I? Identify me on the basis of the given properties.

   (a) I have lustre. ----------

   (b) I can be easily compressed. ----------

   (c) I am hard and soluble in water. ----------

   (d) You cannot see clearly through me. ----------

   (e) I have mass and volume but you cannot see me. ----------

   (ii) Make your own 'Who am I?'

10. You are provided with the following materials—vinegar, honey, mustard oil, water, glucose and wheat flour.

    Make any two pairs of materials where one material is soluble in the other. Now, make two pairs of materials where one material remains insoluble in the other material.

Learning further

- Gather information on different materials which can be recycled. You can take help from various sources, such as newspapers, magazines, elders in your community, and the internet.
- Recyclers buy old objects based on properties of the materials and do not bother even if an object is broken. Conduct a survey with recyclers near you and find out what properties of materials do they check before buying objects from households. Which materials do they not buy and why?
- Collect 20–30 objects from your household and classify them based on the properties of the materials they are made up of. Were you able to put them in separate groups? What relationship do you see between the properties of the materials and the use of the objects?
- Create and decorate a useful object of your choice using discarded materials and bring it to the class. Discuss with your friends what they have made and the materials they have used. Additionally, provide constructive feedback on areas for improvement, considering functionality and any other points.

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Notes

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Chapter 7

Temperature and its Measurement

> "Wrong measurements are worse than no measurements at all."
>
> — Anna Mani

0677CH07

Lambok and his elder sister Phiban live in Shillong. One day they came home from school. Their parents were away at work and Lambok complained that he was feeling feverish. Phiban touched his forehead and felt that he might be having a fever. To confirm this, she took out the thermometer kept in the almirah. She washed its tip with soap and water, and measured Lambok's temperature. To her relief, she found that his temperature was normal. She washed the thermometer tip again, dried it and put it back. She then asked Lambok to change his school uniform, eat his lunch, and rest for some time.

Can it always be correctly judged, that a person has fever, only by touching the person? ?

7.1 Hot or Cold?

We know from experience that some bodies are hotter than others. For example, during summers, the tap water may be hotter than the cold water from a *matka* (earthen pot) or a

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refrigerator. We can realise this by merely touching the two samples of water. But can we always rely upon our sense of touch? Let us find out.

Activity 7.1: Let us investigate

- Take three large containers and label them A, B and C, as shown in Fig. 7.1.
- Pour warm water in container A, tap water in B and ice-cold water in C.
- We will conduct this activity in two parts — prediction and observation.
- Firstly, **predict** what will you feel if you
  - dip your right hand in A and left hand in C and keep them there for 1–2 minutes.
  - take out your hands from containers A and C, and place both hands simultaneously in B.

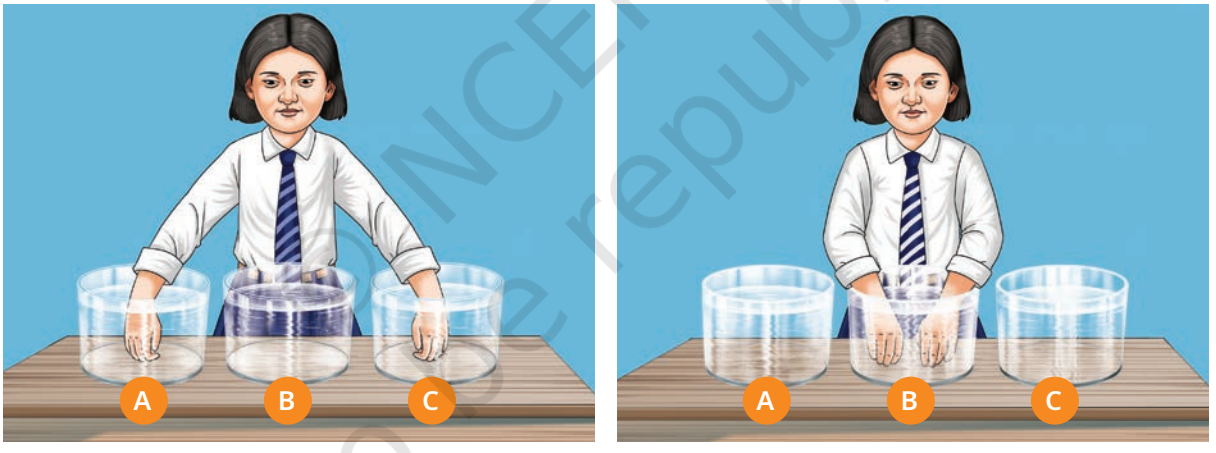

Fig. 7.1: Feeling hotness or coldness of water by dipping hands

- Write down your predictions.
  - What will my right hand feel on dipping it in B?

  - What will my left hand feel on dipping it in B?

- Now, conduct the activity and write your observations.

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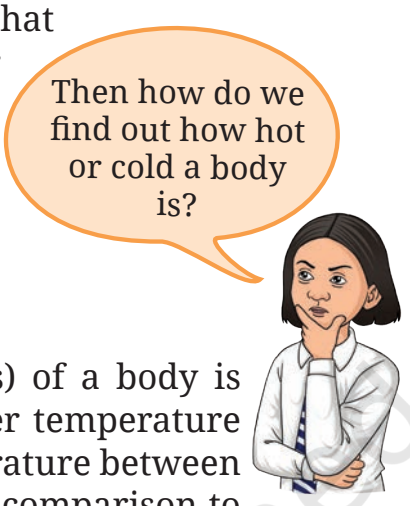
Compare whether your observations match with your predictions. Did your right hand feel that the water in container B is cool, while your left hand felt that the same water is warm? What do you **infer** from these observations?

We cannot always rely upon our sense of touch to decide correctly whether a body is hot or cold.



7.2 Temperature

A reliable measure of hotness (or coldness) of a body is its **temperature**. A hotter body has a higher temperature than a colder body. The difference in temperature between the two bodies tells us how hot a body is in comparison to another body. A device that measures temperature is called a **thermometer**.

There are two kinds of thermometers that you are likely to come across—clinical thermometers and laboratory thermometers. Clinical thermometers are used to measure human body temperatures whereas laboratory thermometers are used for many other purposes. Let us now learn more about thermometers and how to use them to measure temperature.

7.3 Measuring Temperature

7.3.1 Clinical thermometer

You might be familiar with a thermometer, like that shown in Fig. 7.2, which is used for measuring our body temperature. It is called a clinical thermometer. Such thermometers show temperatures digitally. These are also known as digital clinical thermometers and run on batteries. These measure

Fig.7.2: A digital clinical thermometer

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temperature when the thermometer is placed in contact with a person's body.

For measuring temperature, the clinical thermometers generally use a scale called the **Celsius scale**. On this scale, the unit of temperature is **degree Celsius** and is denoted by °C.

Earlier, mercury thermometers were used for measuring the body temperature. But mercury is an extremely toxic substance and is difficult to dispose of if the thermometer breaks accidently.

Digital thermometers pose no such risk and also the numbers in its display are easier to read. Therefore, mercury thermometers are being replaced by digital thermometers. Temperature in a digital thermometer is determined with the help of heat sensors.

Do you know?

They are non-contact thermometers, also called infrared thermometers. Such thermometers can measure temperature without touching a person's body and thus reduce the risk of spreading disease.

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Activity 7.2: Let us measure

Let us now use a digital clinical thermometer to measure body temperature. You may measure your own temperature as well as the temperature of some of your friends. Talk to your friends to find out who would be willing to get their body temperatures measured by you.

- Wash your hands and the tip of the digital thermometer with soap and water.
- Reset the thermometer by pressing the reset button.
- Place the thermometer under the tongue and close your mouth.
- Wait till the thermometer makes a beeping sound or flashes a light.
- Take it out from the mouth and read the temperature on the digital display.
- **Record** the temperature in Table 7.1.
- Clean the tip of the thermometer with soap and water, and dry it.
- Repeat the above steps for measuring the temperatures of your friends.

Precautions
to be taken while using a digital clinical thermometer

- To be used after reading the instruction manual of the thermometer.
- Tip of the thermometer to be washed with soap and water before and after use.
- While washing, care to be taken to keep the digital portion such as the display out of water.
- Do not hold the thermometer by the tip.

Table 7.1: Body temperatures of 10 persons

S. no.	Name	Temperature (°C)
1.		
.		
.		
.		
.		
10.		

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The normal temperature of a healthy human body is taken to be 37.0 °C. But in this activity, did you find that the normal temperature of every person was 37.0 °C? Or did you find the temperature slightly higher or lower for some people?

Do small children generally have slightly higher body temperatures as compared to adults? ?

Do old people, even when healthy, generally have lower body temperatures than young adults? ?

The temperature of every person may not be 37.0 °C. What we call normal temperature is the average body temperature of a large number of healthy people. A perfectly healthy person may, therefore, have a normal temperature slightly different from 37.0 °C. The body temperature is influenced by several factors, such as age, time of the day and activity level.

You may try measuring your own temperature at different times of the day and on different days. Record the thermometer readings in your notebook. After a month, analyse your temperature record and see if there are any variations. If yes, try to think what might be the reasons for that.

The temperature of human beings does not normally go below 35 °C or above 42 °C.

For measuring the body temperature of small children or old people, the digital thermometer can also be placed in the armpit. The temperature measured this way is about 0.5 °C to 1 °C lower than the actual body temperature.

There is another scale of temperature known as **Fahrenheit scale**. On this scale, the unit of temperature is **degree Fahrenheit** and is denoted by °F. A temperature measured as 37.0 °C on Celsius scale is equivalent to 98.6 °F on Fahrenheit scale. The Fahrenheit scale is not used in most scientific studies anymore. In scientific work, there is another scale of temperature known as **Kelvin scale**. On this scale, the unit for temperature is **kelvin** and is denoted by **K**. The **SI unit of temperature** is kelvin.

I have seen a friend of mine using a digital thermometer that reads temperature on a different scale. It shows the normal temperature of a healthy human body as 98.6 °F. What is the reason for this difference?

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All three temperature scales, Celsius, Fahrenheit and Kelvin are named in honour of the scientists who developed these scales.

We can easily convert the temperature from Celsius scale to Kelvin scale by using:

Temperature in Kelvin scale = Temperature in Celsius scale + 273.15

More to know!

The names of temperature scales—Celsius scale, Fahrenheit scale and Kelvin scale—start with a capital letter. For the units for temperature, degree Celsius and degree Fahrenheit, the word degree starts with a lower-case letter while Celsius and Fahrenheit start with a capital letter. The unit kelvin starts with a lower-case letter. The symbols of all units (°C, °F, K) are capital letters. Note that degree sign (°) is not written with K. A full stop is not written after the symbol, except at the end of a sentence. While writing the temperature, a space is left between the number and the unit. For temperatures more than one degree, use the plural of 'degree', that is, 'degrees', while writing the full form of the unit.

Can a clinical thermometer be used for measuring the temperature of boiling water? Or for measuring the temperature of ice?

No, the temperatures of boiling water and ice are outside the range of a clinical thermometer.

Do you know?

How was fever detected before thermometers were developed? Fever affects the pulse rate of a person. This was known even in olden days in India. However, apart from fever, some other situations also affect the pulse rate. Hence, pulse rate alone is not a reliable indicator of fever.

How can we measure temperatures beyond the range of a clinical thermometer?

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7.3.2 Laboratory thermometer

There are many types of laboratory thermometers but the one that might be available in your school laboratory may look like the one shown in Fig. 7.3a. It consists of a long, narrow, uniform glass tube which is sealed. At one end of the tube is a bulb which contains a liquid. Outside the bulb, in the tube, a narrow column of liquid can be seen. There is a Celsius scale marked along the tube. The liquid column rises or falls with change in temperature. The mark of the Celsius scale with which the top level of the liquid column coincides is the temperature reading.

Fig.7.3(a): A laboratory thermometer

Do you know?

The liquid used in the laboratory thermometer is generally alcohol (coloured red to make it easily seen) or mercury.

Activity 7.3: Let us observe

Let us try to find the temperature range of a given laboratory thermometer.

- Take a laboratory thermometer and observe it carefully.
- Note down the following:
  - What is the lowest temperature it can measure?

  - What is the highest temperature it can measure?

  - So, the range of this thermometer is ---

Precautions
to be taken while using a laboratory thermometer

- Handle with care. If it hits against some hard object, it can break.
- Do not hold it by the bulb.

Now look at the thermometer shown in Fig. 7.3a carefully. Can you tell its range? Its range is from –10 °C to 110 °C.

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Activity 7.4: Let us observe and calculate

Let us now try to find the smallest value that a given laboratory thermometer can read.

- Again, take the same laboratory thermometer which you used in Activity 7.3 and observe it carefully.
- Note down the following:
  - How much is the temperature difference indicated between the two bigger marks? ----------
  - How many divisions (shown by smaller marks) are there between these two bigger marks? ----------
  - How much temperature does one small division indicate? ----------
  - So, the smallest value that the thermometer can read is ----------

Fig. 7.3b shows a closeup of a part of the thermometer shown in Fig. 7.3a. Can you now find the smallest value that this thermometer can read?

Fig. 7.3(b): Closeup of a part of the thermometer shown in Fig. 7.3a.

For the thermometer shown in Fig. 7.3b, the temperature difference indicated between 0 °C and 10 °C or between 10 °C and 20 °C is 10 °C. And the number of divisions between these marks are 10 divisions. So, one small division can read 10/10 = 1 °C.

That is, the smallest value that this thermometer can read is 1 °C.

Your school laboratory may have thermometers for which the range and the value of the smallest division may be different. It is, therefore, always necessary to look carefully at the thermometer you are about to use.

You have learnt how to find the temperature range of a given laboratory thermometer. You have also learnt how to find the smallest value that a given laboratory thermometer can read. We will now learn how to measure temperature using a laboratory thermometer. But, let us first learn how to use a laboratory thermometer correctly.

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Correct way of measuring temperature using a laboratory thermometer

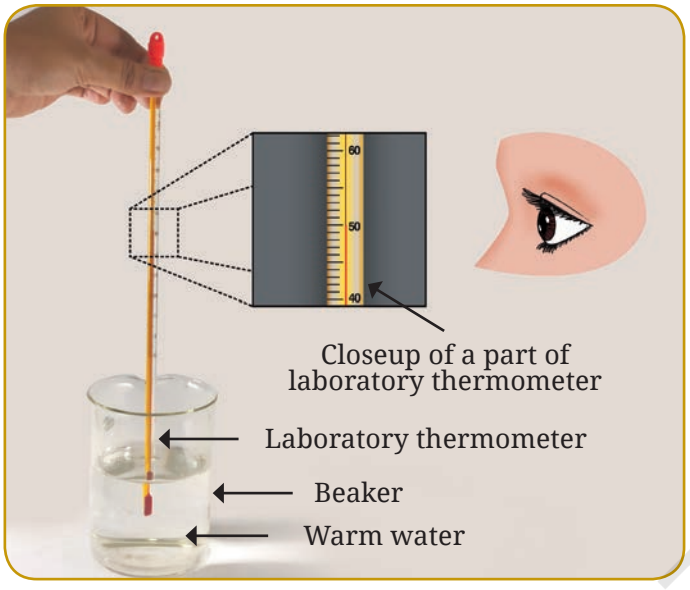
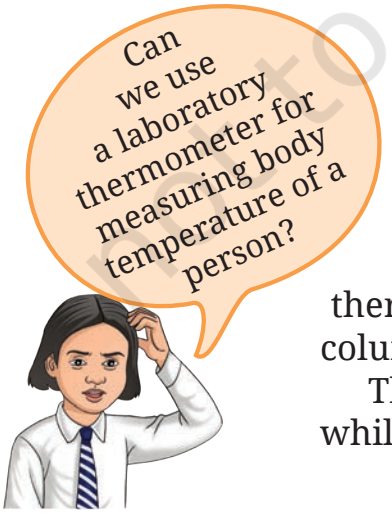


Fig.7.4: Measuring temperature of warm water

- When the thermometer is immersed in water, its bulb should not touch the bottom or the sides of the beaker.
- The thermometer should be held vertically (Fig. 7.4). It should not be tilted.
- The temperature must be read while the thermometer is immersed in water.
- While reading the thermometer, the eye should be directly in line with the level of the liquid column to be read (Fig. 7.4).

Activity 7.5: Let us measure

- Take some warm water in a beaker.
- Dip the thermometer in water so that the bulb is immersed in water (Fig. 7.4).
- Observe the rise of liquid column in the thermometer.



Wait till the column stops rising and note the temperature (do not wait too long; otherwise, the water itself will start to cool).

What is the temperature of water measured by you? Compare it with the readings of your friends.

Do you notice that, as soon as you take the thermometer out of the water, the level of liquid column begins to fall?

This means that the temperature must be read while the thermometer is immersed in water.

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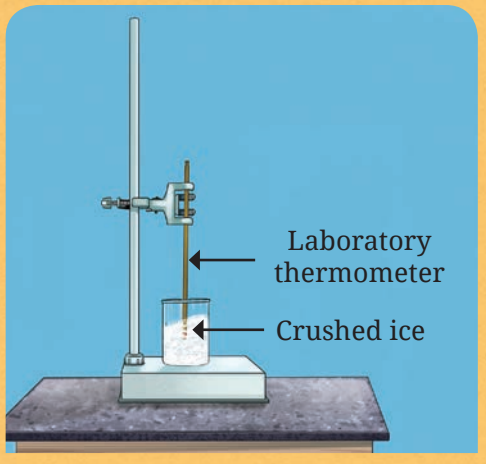
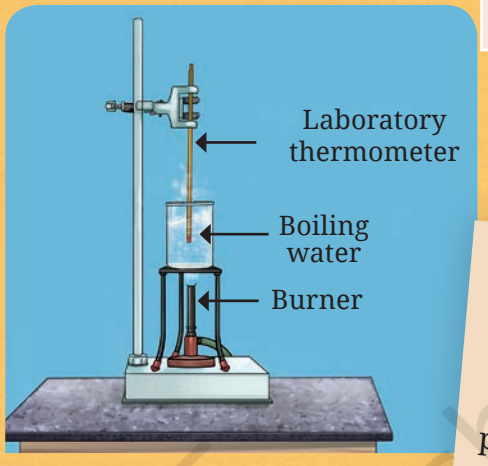
More to do!

Following two experimental setups are to be arranged by your teacher. One by one, as per your turn, go closer to the setups and observe the readings of both the thermometers. What are the temperatures of ice and boiling water?





Read the temperatures of ice and boiling water again after some time. Are the temperatures same or have changed? You may have noticed that the temperature of water remains constant while it is boiling. Also, the temperature of ice remains constant while it is melting.

Caution
This activity should be performed strictly only under supervision of the teacher. Do not touch the experimental setups.

Activity 7.6: Let us compare

- Phiban's Science teacher arranged the experimental setup for measuring temperature of boiling water. The temperature readings of the boiling water taken by Phiban and her classmates in Shillong are given in Table 7.2.

Table 7.2: Temperature of boiling water

Name	Temperature of boiling water (in °C)
Phiban	97.8
Shemphang	98.0
Onestar	97.9
Kloi	98.0
Bandarisha	98.1

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- Compare the temperatures of boiling water recorded by different students.

Why are there differences in their readings? **Discuss** the possible reasons amongst yourselves. Maybe, the correct way of reading temperature was not followed by all the students.

7.3.3 Air temperature

You might have seen thermometers, such as the one shown in Fig. 7.5, hung on walls of your school laboratory, doctor's clinic, and hospitals. These give an approximate idea of the room temperature.

Have you seen weather reports in newspapers, TV news or internet? These reports also mention the maximum and minimum air temperature of the day.

Fig.7.5: Room thermometer

Activity 7.7: Let us analyse

- Read or listen to the weather reports for a place for 10 successive days.
- Record the maximum and minimum air temperature for each day in Table 7.3.
- Analyse the data in Table 7.3.

Table 7.3: Maximum and minimum air temperature

S.no.	Date	Maximum air temperature	Minimum air temperature
1.			
.			
.			
10.			

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Does the maximum and minimum temperature stay at the same level during these days?

Because weather depends on several factors, these temperatures usually vary every day. Generally, as we approach the summer season, the temperature rises and during the winter season it falls.

More to know!

There are many techniques for measuring air temperature. Air temperature is an important weather parameter and is monitored at weather stations all over the world. The data gathered on air temperature along with various other parameters are used for making weather forecasts.

Know a scientist

Anna Mani (1918–2001) was an Indian scientist, also known as the 'Weather Woman of India'. She invented and built a large number of weather measurement instruments. This reduced the reliance of India on other nations for such instruments. She also explored the possibilities of using wind and solar energy in India. Her work helped India to become one of the global leaders in renewable energy.

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Keywords

Air Temperature	Analyse
Celsius Scale	Calculate
Clinical thermometer	Compare
degree Celsius	Discuss
degree Fahrenheit	Infer
Fahrenheit scale	Investigate
kelvin	Measure
Kelvin scale	Observe
Laboratory thermometer	Precaution
SI unit of temperature	Predict
Temperature	Record

Summary

Key Points

- The temperature of a body tells us how hot or cold it is.
- The three most-used scales of temperature are: (a) the Celsius scale, (b) the Fahrenheit scale, and (c) the Kelvin scale. The units of temperature in these scales are (a) degree Celsius, denoted by °C, (b) degree Fahrenheit, denoted by °F, and (c) kelvin, denoted by K.
- The SI unit for temperature is kelvin.
- A clinical thermometer is used for measuring body temperature.
- Normal temperature of a healthy human adult is taken to be 37.0 °C or 98.6 °F.
- Laboratory thermometers typically have a temperature range from –10 °C to 110 °C.

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Let us enhance our learning

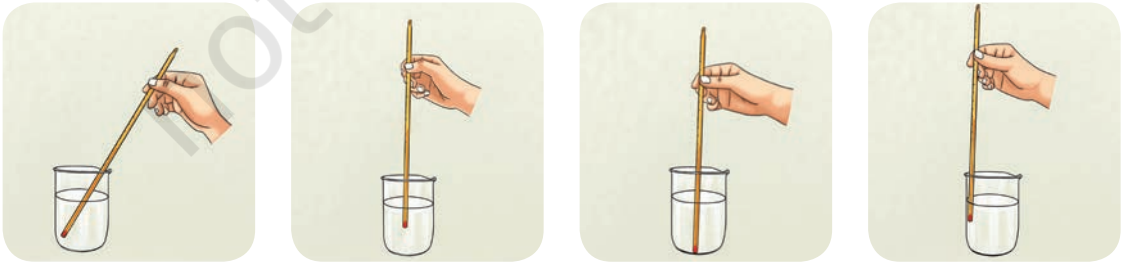
1. The normal temperature of a healthy human being is close to ---------- .
   (i) 98.6 °C
   (ii) 37.0 °C
   (iii) 32.0 °C
   (iv) 27.0 °C

2. 37 °C is the same temperature as ---------- .
   (i) 97.4 °F
   (ii) 97.6 °F
   (iii) 98.4 °F
   (iv) 98.6 °F

3. Fill in the blanks:
   (i) The hotness or coldness of a system is determined by its ---------- .
   (ii) The temperature of ice-cold water cannot be measured by a ---------- thermometer.
   (iii) The unit of temperature is degree ---------- .

4. The range of a laboratory thermometer is usually ---------- .
   (i) 10 °C to 100 °C
   (ii) –10 °C to 110 °C
   (iii) 32 °C to 45 °C
   (iv) 35 °C to 42 °C

5. Four students used a laboratory thermometer to measure the temperature of water as shown in Fig. 7.6:



Student 1 Student 2 Student 3 Student 4

Fig. 7.6

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Who do you think followed the correct way for measuring temperature?

(i) Student 1

(ii) Student 2

(iii) Student 3

(iv) Student 4

6. Colour to show the red column on the drawings of thermometers (Fig. 7.7) as per the temperatures written below:

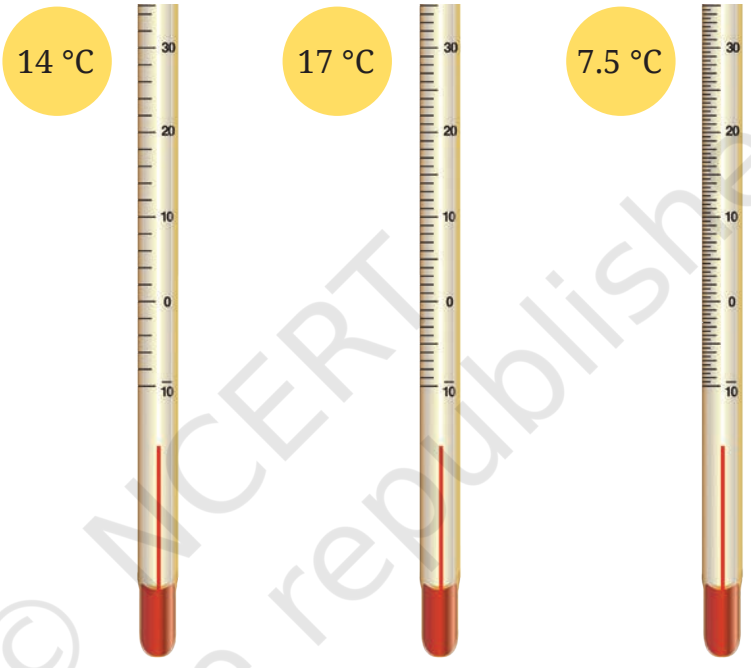

Fig. 7.7

7. Observe the part of thermometer shown in Fig. 7.8 and answer the following questions:

Fig. 7.8

(i) What type of thermometer is it?

(ii) What is the reading of the thermometer?

(iii) What is the smallest value that this thermometer can measure?

8. A laboratory thermometer is not used to measure our body temperature. Give a reason.

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9. Vaishnavi has not gone to school as she is ill. Her mother has kept a record of her body temperature for three days as shown in Table 7.4.

Table 7.4: Body temperature record of Vaishnavi

DAY	Temperature at					
	7am	10am	1pm	4pm	7pm	10pm
One	38.0 °C	37.8 °C	38.0 °C	38.0 °C	40.0 °C	39.0 °C
Two	38.6 °C	38.8 °C	39.0 °C	39.0 °C	39.0 °C	38.0 °C
Three	37.6 °C	37.4 °C	37.2 °C	37.0 °C	36.8 °C	36.6 °C

(i) What was Vaishnavi's highest recorded temperature?

(ii) On which day and at what time was Vaishnavi's highest temperature recorded?

(iii) On which day did Vaishnavi's temperature return to normal?

10. If you have to measure the temperature 22.5 °C, which of the following three thermometers will you use (Fig. 7.9)? Explain.

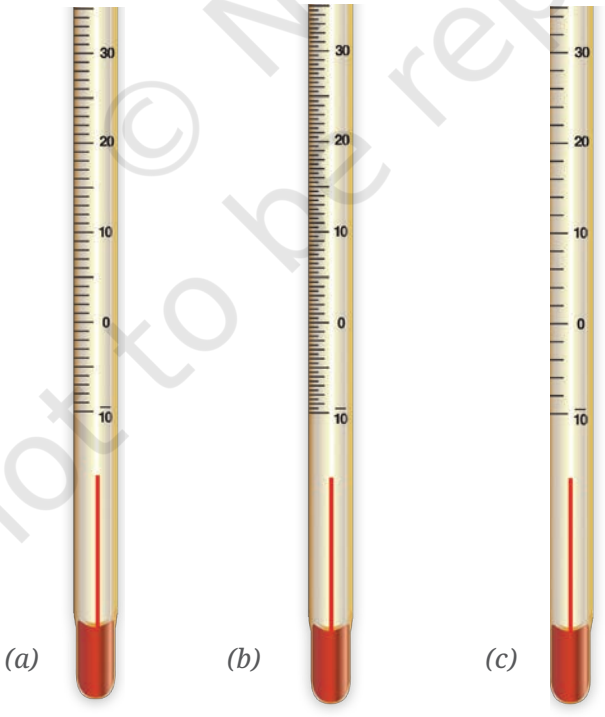

Fig. 7.9: Three thermometers

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11. The temperature shown by the thermometer in Fig. 7.10 is

(i) 28.0 °C
(ii) 27.5 °C
(iii) 26.5 °C
(iv) 25.3 °C

Fig. 7.10

12. A laboratory thermometer has 50 divisions between 0 °C and 100 °C. What does each division of this thermometer measure?

13. Draw the scale of a thermometer in which the smallest division reads 0.5 °C. You may draw only the portion between 10 °C and 20 °C.

14. Komal tells you that she has a fever of 101 degrees. Does she mean it on the Celsius scale or Fahrenheit scale?

Learning further

- Gather information from the Internet and find out how the body temperature of animals, such as a cat, dog, horse, camel, cow and buffalo, is measured. If there is any veterinary hospital in your vicinity, you may visit to see the body temperature of animals being measured.
- Find out which places in India are usually regarded to be the coldest and hottest. Also, find out the minimum and the maximum temperatures recorded for these places.
- Various planets in our Solar System are at different distances from the Sun. Search the Internet and make a table with the planets, their distances from the Sun (in increasing order) and their temperatures written. Does the average temperature of planets decrease as their distance from the Sun increases? If it is not true for any planet, find out for which planet and why.
- Hang a room thermometer in your classroom. Set up the apparatus, as shown in Fig. 7.11, near the thermometer hung on the wall.

  Take the readings of thermometers 1 and 2 three times during the day, say, first period, lunch break, and last period.

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Record your readings. Compare the readings and draw your conclusions. Repeat this for two weeks.

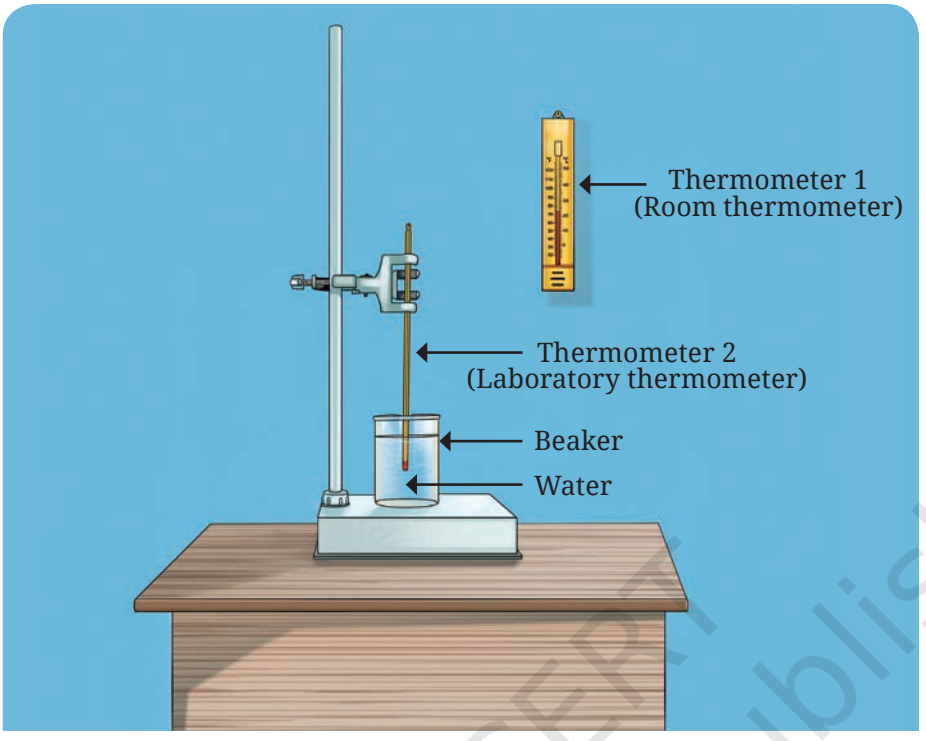

Fig. 7.11: Set up to measure temperature of water and room temperature

More to know!

The temperature at the core of the Sun reaches as high as 15 million degrees Celsius. Are there objects in the sky that have even higher temperatures? There is no limit on the highest temperature that can exist. However, as per scientific understanding, there is a limit to the lowest temperature that can be achieved. It is close to –273.15 °C (0 kelvin) and is called absolute zero.

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Notes

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