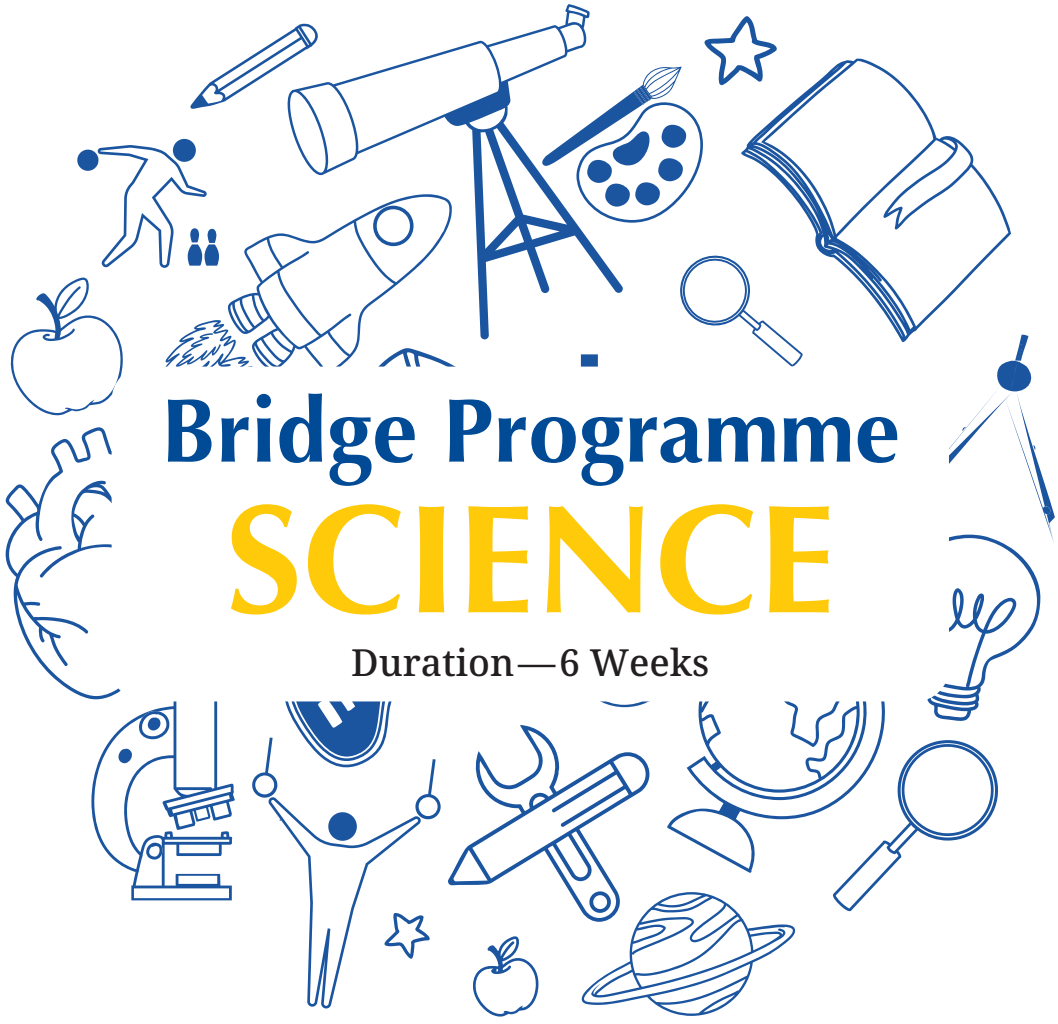
Bridge Programme

SCIENCE

FOR GRADE 8

Duration—6 Weeks



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From the Director's Desk

Dear Students and Teachers,

The National Council of Educational Research and Training (NCERT) welcomes all students stepping into Grade 8, the culminating year of the Middle Stage. This grade marks a significant transition, as we align our educational practices with the transformative vision of the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF-SE) 2023.

Our commitment is to provide a learning experience that is joyful, innovative, and deeply rooted in Indian ethos. The new syllabus and teaching-learning material are designed for experiential, discovery-based, and inquiry-driven learning, making education a truly enriching journey. However, we know that our students are transitioning from the old curriculum which differs from this new approach. To bridge this gap and ensure a smooth and effective transition, we have developed a comprehensive six-week Bridge Programme across all subject areas, including Science.

This Bridge Programme is designed to prepare students for the innovative pedagogical approaches and content that await them in Grade 8. It provides detailed guidelines for teachers and engaging activities for students, ensuring a holistic development. As Grade 8 serves as a bridge to the Secondary Stage, it is vital for laying a strong foundation for future learning.

We believe that after successfully completing this Bridge Programme, students will be well-equipped to fully appreciate and benefit from the new textbooks and other teaching-learning material. I earnestly urge all teachers to embrace the spirit of NEP 2020, fostering a culturally rooted, experiential education that resonates with the ethos of *Vasudhaiva Kutumbakam* — "The world is one family." This is the first step in our journey, and together, we can demonstrate to the entire education fraternity the power of collaboration and teamwork in delivering quality education to every student.

Let us embark on this journey with dedication and enthusiasm, ensuring that every student experiences the joy of learning and achieves their full potential.

DINESH PRASAD SAKLANI
Director
National Council of Educational Research and Training

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Contents

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.**

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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)

Science

Bridge Programme for Grade 8
Duration—6 Weeks

Context

As a follow up of National Education Policy, 2020 (NEP-2020), National Curriculum Framework for Foundational Stage (NCF-FS 2022) and National Curriculum Framework for School Education (NCF-SE 2023), NCERT is in the process of developing syllabi and textbooks for all Grades of school education in a phased manner. Up till now, NCERT has developed textbooks of Grades 1, 2, 3 and 6 in two phases. The textbooks of Grades 1 and 2 have already been introduced in the year 2023–24 and textbooks of Grade 3 and 6 have been introduced in the year 2024–25. In the third phase, NCERT is currently developing syllabi and textbooks for Grades 4 and 5, and Grades 7 and 8 to be introduced in the year 2025–26. In the academic year 2025–26, Grade 4 and 5 students will get new textbooks. The Grade 4 students will be able to link the new textbook with the Grade 3 curriculum as they have already been exposed to the new curriculum in the lower Grade. However, for Grade 5, students may need more time to understand the new pedagogical perspective and competency-based content and exercises. The Grade 5 students may experience a gap in curriculum between what they studied in Grades 3 and 4, and what they will study in Grade 5. The same will be the case for Grade 8 students, who will get new textbooks but have studied their Grades 6 and 7 with the old curriculum.

In this context, there is a need to provide learners with academic support for their smooth transition from the old curriculum to the new curriculum through a Bridge programme. The curriculum before NEP 2020 was based on a constructivist approach. Hence, competency development had not been given much importance.

However, NEP 2020 recommends competency-based education, and following this, competency-based teaching-learning materials, including textbooks that are currently being developed.

The idea of the Bridge programme is to have a fun-filled series of activities based on scientific processes that would allow the children to enjoy, interact, shed their inhibitions, speak with other students and teachers, play, engage in simple projects, etc. The purpose is to develop an interactive and playful classroom environment to set the atmosphere and prepare both teachers and students for the new syllabus, new textbooks, and new approach to learning.

Continuing this vision of the Bridge programme, a Bridge programme of six weeks has been developed for learners entering Grade 8 this year, which marks the final year of the middle stage. It is pedagogically essential that the old and new curriculum is bridged at this stage for paving the path of smooth learning in higher Grades.

Teachers' Section

"Science is the study of the natural and physical world around us through a systematic process of observing, questioning, forming hypotheses, testing hypotheses through experiment, analysing evidence and thereby, continuously revising our knowledge. The process of science is not something that only scientists do in laboratories alone. It also develops an important set of capacities (and dispositions) essential for leading rational and fulfilling lives. These capacities (and dispositions) help us make informed and good decisions that benefit us and our communities." (NCF-SE 2023, Chapter 4, Science Education, Page 294)

The National Education Policy (NEP) 2020 strongly recommends competency-based education (CBE), where the focus of science teaching and learning should be on the development of competencies among learners. In the same light, NCF-SE 2023 focuses not only on the processes of science but also on—how engaging may help develop certain competencies in learners as is evident in the above excerpt.

Thus, NCF-SE 2023 envisions that learning Science should build capacities, such as observation, analysis, inference, etc., that may help learners to evolve into rational beings in their lives beyond school. We know that science is introduced as a separate subject only

in the Middle Stage which has also been suggested by NCF-SE 2023. Although, learners may have experienced the processes of science in the previous curriculum, the focus in the new curriculum is to align the scientific processes for the development of specific competencies among learners. The text including activities and assessment in the new textbooks has been developed after identifying expected learning outcomes in the light of competencies and curricular goals given in NCF-SE 2023. Hence, the overall organisation of the new science textbooks in terms of activities based on process skills in science, including seeking evidence, experimentation, reduction in content and focus on inductive approach provides a completely new outlook towards teaching-learning science in the middle school. Hence, since the learners currently in Grade 8 have not engaged with the textbooks based on NCF-SE 2023 before, it is required that they should be oriented by taking some of the concepts that they would have learnt in the previous classes under NCF-SE 2023. This can be most appropriately done, if they are involved pedagogically during classroom teaching-learning processes before they begin studying the new textbooks and transitioning to the new curriculum. Hence, as per the vision for the Bridge programme, a programme of at least six weeks is required this year for Grade 8, which marks the final year of middle stage and also to reduce the gap in the development of competencies for at least the previous two years of middle school.

Purpose of the Bridge Course

1. Providing opportunity to learners of Grade 8 to orient themselves to competency-based approach in learning science.
2. Providing opportunity to learners of Grade 8 to revisit certain concepts in science from Grades 6 and 7 by engaging with science, process skills through an inductive approach.
3. Providing opportunity to learners of Grade 8 to experience a learning environment in science, where focus is on nurturing abilities to develop scientific ideas through questioning, observing, hypothesising and investigating.
4. Familiarising teachers with competency-based approach in science and experience of facilitating activities for learners.

Week-wise time-table for the respective subject area as per the illustrative timetable/time allocation given in NCF-SE

Time allocation for the middle stage along with an illustrative timetable is given in the NCF-SE 2023 (Page 137). As per the time allocation, the total time allotted for science per week is 4 hours 40 minutes. Therefore, an illustrative timetable for Bridge programme of science (6 weeks) is given below:

Table 1

Week	Time Available (in Hours)	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	4 hrs. 40 mins.	Science	Science	Science	Science	Science
		Science		Science		
Week 2	4 hrs. 40 mins.	Science	Science	Science	Science	Science
		Science		Science		
Week 3	4 hrs. 40 mins.	Science	Science	Science	Science	Science
		Science		Science		
Week 4	4 hrs. 40 mins.	Science	Science	Science	Science	Science
		Science		Science		
Week 5	4 hrs. 40 mins.	Science	Science	Science	Science	Science
		Science		Science		
Week 6	4 hrs. 40 mins.	Science	Science	Science	Science	Science
		Science		Science		

This timetable is suggestive in nature and the school may be adapted in different contexts without changing the total allocated time for science **Activity-wise timetable.**

An illustrative activity-wise timetable for science, based on the above timetable is given below. The details of each activity are given later in the student's section.

Table 2

Week	Competencies to be addressed	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1 (W1)	• Observing Questioning Comparison • Observes, compares, analyses and find out the relationship between the types of root, leaf venation and number of cotyledons • Compare different states of matter • Formulate possible explanation	W1.1 W1.2	W1.2	W1.3 W1.4	W1.5	W1.5	
Week 2 (W2)	• Investigate conditions that will affect how fast water will evaporate • Balanced food • Inferring case studies related to diseases caused due to deficiencies • Designing experiments to identify the essential conditions for germination of a seed	W2.1	W2.2	W2.2 W2.3	W2.4	W2.5	

Week 3 (W3)	• Natural resources • Physical properties of metals and non-metals (such as hardness, appearance, sonority, malleability, ductility, electrical and thermal conductivity) • Chemical properties of metals and non-metals (reactions with air and water only) • Exploring the rusting phenomenon through	W3.1	W3.2	W3.2 W3.3	W3.3	W3.4	
Week 4 (W4)	• Investigate the movement of hot air • Understanding adolescence	W4.1	W4.2	W4.3 W4.4	W4.5	W4.6	
Week 5 (W5)	• Night sky watching • Star, constellations, galaxy • Solar system	W5.1	W5.2	W5.3	W5.4	W5.4	
Week 6 (W6)	• Earth's Rotation and Day-Night • Solar and Lunar eclipses	W6.1 W6.2	W6.2	W6.2	Assessment	Assessment	

Pedagogy and Assessment

"Learning science enables us to gain valid knowledge about the world as well as acquire scientific values, capacities and dispositions, such as curiosity, creativity, evidence-based thinking, and sound decision making". (NCF-SE 2023, Page 294).

As quoted above, NCF-SE 2023 encourages us to envision science to play an instrumental role in developing various competencies in learners including higher order thinking skills to informed decision making. The NCF-SE 2023 has reasoned out that traditionally, science teaching and learning has been focused on facts and definitions only because of curricular load and disconnect between school curriculum and students' experiences outside school. Thus, the reduction in content in the new textbooks provides opportunity and time for teachers to engage learners in exploration, experimentation and other scientific processes. Learners should be involved in visiting their own existing ideas, testing them and bringing changes, if required to develop an understanding of the concept. They should be encouraged to nurture their curiosity by giving them opportunities to investigate. Thus, the Bridge programme should be taken up by creating a classroom environment, where students feel free to pose their own questions, and experiment with their own ideas by engaging with their peers and teachers. The activities given in the Bridge course are based on the various scientific process skills and are geared towards building certain competencies eventually in learners. Hence, each activity should be taken up pedagogically in a way that involves learners meaningfully in the scientific process and would further pave the way and prepare them for engaging with the Grade 8 textbook effectively.

Assessment is an essential part of learning and as suggested by NCF-SE 2023, it should be done through a variety of ways. It should also be integrated with learning. Learners should be assessed for asking different kind of questions or for designing experiments or as they conduct experiments. The focus should be on assessing the process skills. They can be evaluated for their ability to apply their understanding of a concept in the given real-life situation and their ability to provide relevant and appropriate reasoning for steps taken in an activity. Activities involving experiments may enable assessing

students' ability to measure, test, observe, predict, etc. Assessment should be multimodal, so that, it can be done orally or by giving them opportunities to present their experiments in terms of their observations, methodology adopted, analysis or interpretation. They should also be encouraged to write or illustrate their ideas. Curiosity and imaginative thinking should be nurtured by giving them the opportunities to express their ideas creatively through may be, posters, sketches, slogans, science fictions, presentations, videos, poems, etc.

Linkage with New Textbooks

The Learning Outcomes for new textbooks of Grades 6, 7 and 8 were developed based on the Curricular Goals (CGs) and Competencies for middle stage science given in NCF-SE 2023 (see the appendix). The LOs developed for the new textbooks for Grades 6 and 7 relate to those of Grade 8 since they are in a continuum. The student entering Grade 8 in the academic year 2025–26 have learnt the existing Grade 7 textbook might not have been exposed to some of the LOs, which are essential prerequisites for students to understand the new Grade 8 textbook. A gap analysis has been done and it was found that few LOs related to some CGs/Competencies must be bridged. Activities based on these LOs have been designed and presented here. This Bridge programme also contains different ice breaking activities, which will not only help learners to acquire the basic prerequisite competencies required to understand the concepts included in Grade 8 science, but also to create positive, vibrant and sustainable attitude among students towards learning science.

Students' Section

This programme is like a companion for you! It will take you through a fun journey in science. You will find many interesting activities here that may be based on questions that might often come to your mind. These activities will require you to actively take up various tasks and use your abilities to accomplish them. You would surely experience those activities provided you with ample opportunities

for thinking and doing it yourself. Some activities will encourage you to make your own observations and infer from them. Similarly, some activities will involve you in formulating your own hypothesis. Further, you will find activities, where you can design experiments to test your hypothesis. Your teachers will support and facilitate you in the process. The idea is to nurture the ability in you for 'learning to learn science' and help you discover/develop other competencies. We all see around us but how many of us observe? It means do we see a phenomenon and think about it in terms of what might be its cause or how it may be affecting us. Thus, observing involves pondering upon something that we might be seeing everyday but not giving adequate attention to it! Similarly, there are other competencies that are expected to be developed through learning science by the end of the middle school.

Since, you could not study through new textbooks in Grades 6 and 7, this programme will help you to get familiarised with learning science through a competency-based approach. In this process, you may revisit the topics that you might have already studied but the idea is to revisit them through a new approach and engage with certain competencies that will help you in effectively studying science through new textbooks in Grade 8.

Bridge Programme Content: Detailed Activities

Week 1
Theme: Diversity in the Living World

Activity W1.1: Nature Walk/A Field Visit to Observe Biodiversity

Plan a nature walk or a field visit with your teacher to the nearby park/garden or a sacred grove (A patch of forest, which is a treasure of biodiversity and is protected by the local community). You can also plan a visit with the members of your community/family or an elderly person, having knowledge about plants and animals. Appreciate the biodiversity around you and note down all the observations and questions that arise from this nature walk. Record your observations in Tables 3 and 4.

Table 3: Observations about plants around us

S. No.	Local name of plant	Height of Plant			Stem		Category (Herb/ Shrub/Tree)
		Small	Medium	Tall	Soft/ Hard	Thick/Thin	
1.							
2.							
3.							
4.							
5.							

Table 4: Observations about animals around us

S.No.	Local name of animal	Place where they live	Food they eat	The way they move	Body parts used for movement
1.					
2.					
3.					
4.					
5.					

Discuss your observations with your peers. Try to categorise animals in different groups on the basis of similarities and dissimilarities you can think of and write in Table 5.

Table 5: Grouping of animals based on similar and dissimilar features

S. No.	Group	Feature	Name of the animals
1.	A		
2.	B		
3.	C		
4.	D		
5.	E		
6.	F		

Have a discussion in your class and try to give a scientific explanation of each group.

Activity W1.2: Observation of Plants and Grouping them Based on Leaf Venation, Type of Roots and Type of Seeds

(a) Categorisation based on the leaf venation

Collect the different kinds of fallen leaves during the nature walk. Trace the shape of the leaves and the veins on a white paper. You can also place the leaves under a white sheet of paper and rub the pencil tip sideways on the paper to get an impression of the leaves and their veins. (Fig. 1)

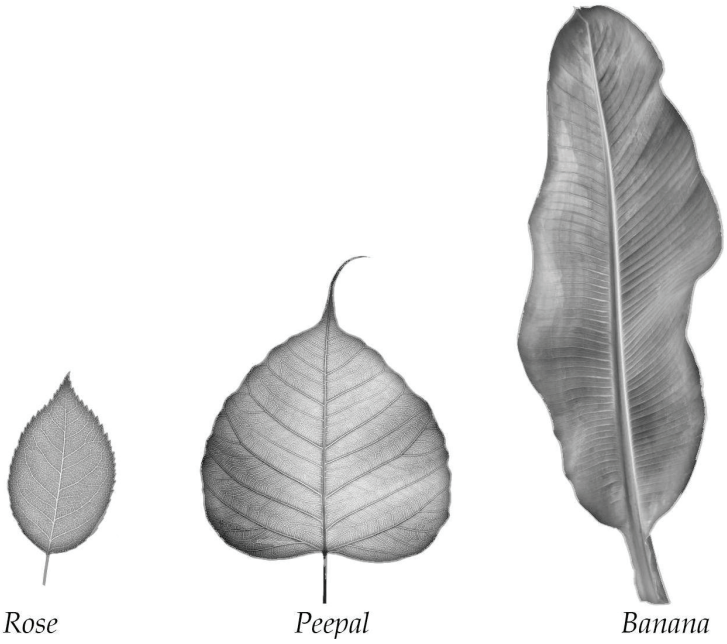
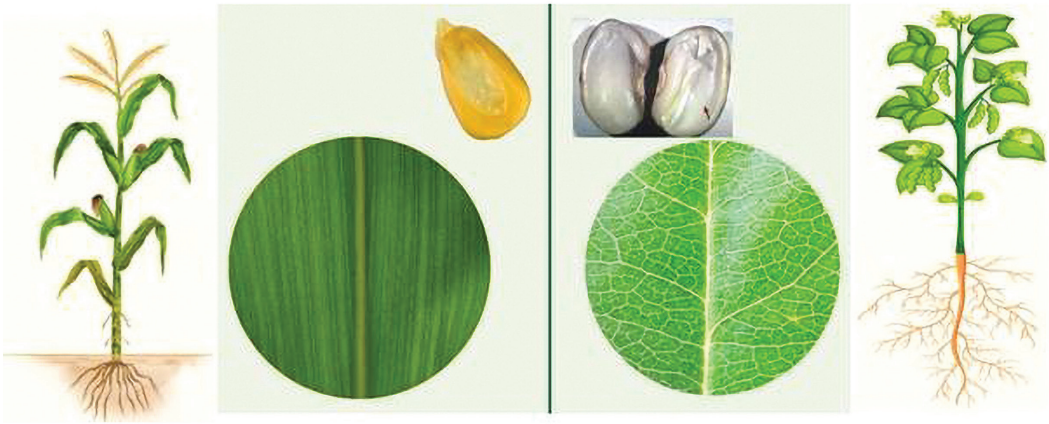


Fig. 1: Venations in different leaves

Observe the arrangement of veins on the leaves carefully and categorise them based on the reticulate and parallel venation pattern. Try to define the reticulate and parallel leaf venation in your own words.

(b) Correlation between the leaf venation, type of roots and type of seeds

Take soaked seeds of maize/wheat and beans/grams and try to split them. Based on your observations, categorise the plants bearing those seeds into **dicotyledons** (two cotyledons/dicots) and **monocotyledons** (one cotyledon/monocots). Observe the leaf venation and roots of these plants as shown in Fig. 2.



(a) Monocot plant — Maize *(b) Dicot plant — Bean*

Fig. 2: Correlation between types of roots, leaf venation and number of cotyledons in seeds

Record your observations and fill in the blanks in the Table 6. You can explore more seeds of pulses, cereal and other plants for the type of roots, leaf venation and number of cotyledons and add them to the table.

Table 6: Correlation between the type of root, leaf venation and number of cotyledons in seeds

S. No.	Name of the Plant	Type of Root	Type of Leaf Venation	Monocot/ Dicot
1.	Maize	----------	Parallel venation	----------
2.	Bean	Taproot	----------	Dicot
3.	Wheat			
4.	Rice			
5.	Mung bean			
6.	Castor			
7.				
8.				
9.				

Share your observations with your peers and discuss the correlation in the class.

Activity W1.3: Panel/Group Discussion About Loss and Conservation of Biodiversity

Have a panel discussion or group PowerPoint presentations in your class on the topics given below:

1. Loss of biodiversity and government projects/initiatives to combat with related issues.
2. Traditionally protected forests—Sacred groves
3. Success story of 'Save Silent Valley Movement'
4. Effect of changing habitats of animals on biodiversity
5. Conservation of biodiversity and associated scientists of India

Theme: Water

Activity W1.4: Change in the State of Matter

Matter generally exists in three states viz. solid, liquid and gas. Water is such a delightful substance. Have you ever run and jumped in a puddle when it rained? Did you wonder where the water disappeared after it stopped raining? Where else have you seen water disappearing? Can you think of a possible reason why this happens?

Fig. 3

Have you noticed that water freezes and becomes ice when we cool it, and boils and becomes steam when we heat it? Water is a unique substance that exists in all three states under normal conditions. You have learnt in your previous classes that water can exist in solid, liquid and gaseous states. How can you change the state of water? How can you quickly change ice to its liquid state, water?

Let us perform some activities to understand it.

Activity W1.4 (a): How Can We Change the States of Water?

Material Required

Ice cubes, hot plate, beaker and a thermometer

Procedure

- Take a few ice cubes and place them in a beaker.
- Observe the state of water and its temperature.
- Put the beaker on the hot plate and observe the change in state, if any, and record the temperature after intervals of 5 minutes in Table 7.
- Continue heating till the water starts boiling and observe the change in the state if any, and record the temperature.

Table 7: Record the Observations

Time	State of matter	Temperature
Initial		
After 5 minutes		
After 10 minutes		

Communicate your findings to your peers. Is there any relation between the change of the state and temperature? Discuss.

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

Have you ever experienced your ice cream melting away in your hands? What could be the reason? Discuss with your peers.

Fig. 4

A candle, which is made of wax, is another such example. How can we turn candle wax into a liquid state? How can we change the liquid wax back into the solid state? What are the other liquids that you have seen which get converted into solids? 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 by heating or cooling. The process of conversion of 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 by completing the given diagram.

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

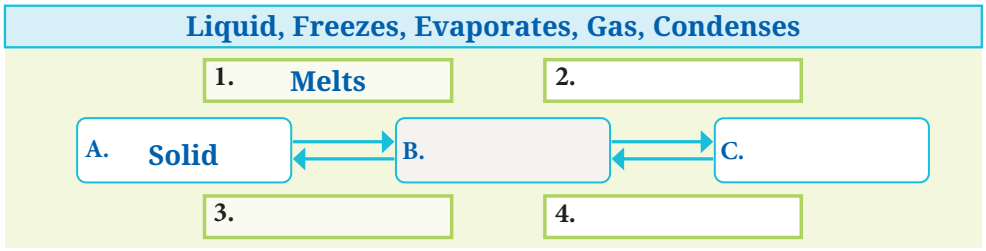


Fig 5: Conversion of different states of matter

More to know

Water may change from a liquid state to a gaseous state below 100°C and this is called evaporation, whereas at 100°C, the process is called boiling.

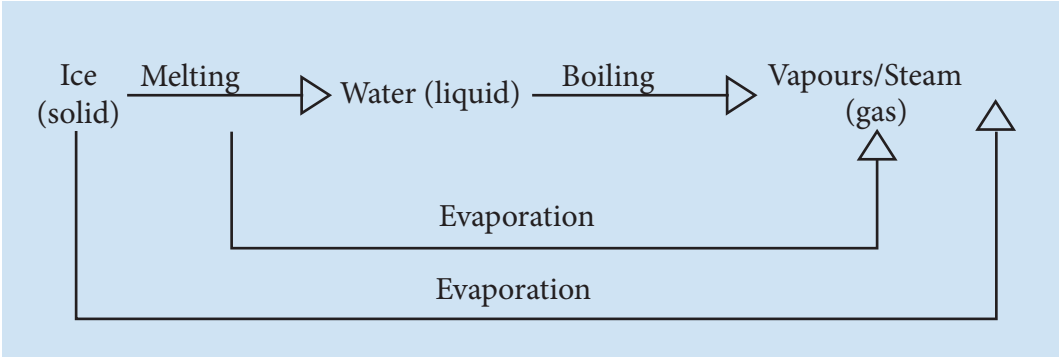


Fig. 6

Let us sum up

How would you make ice at home?

Observe your surroundings and make a list of where you see a change in the state of matter.

Activity W1.4 (b): 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 an activity to identify the properties of different states of water.

Let us identify

- Put an ice cube in one container and transfer it to another container of a different shape. What changes do you notice in the shape of the ice cube? Record your observations in Table 8.
- Pour water from one container into 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: Compare different states of water

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

Activity W1.5: Mystery of Appearing of Water Droplets

Have you tried making lemonade? During its preparation, you may take cold water in a glass tumbler and add ice cubes to it. After a few minutes, you may notice something exciting about the outer surface of the glass tumbler.

Let us find out by conducting a similar activity ourselves.

Let us experiment

- Take cold water in a glass tumbler.
- Add a few ice cubes into it as shown in Fig. 7.

Fig.7: 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 9. 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 9: Record the observations and questions

I observe	I wonder

One observation that may arise in your 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.

Discuss with your friends. Write down the possible reasons in Fig. 8.

Fig. 8: Provide 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. You may argue with your friends for a chain of reasons. What do you think about the possible reasons mentioned in Fig. 9?

Fig. 9: Chain of reasoning

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?

Fig. 10: 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 1.5. Could the water appearing on the outer surface of the glass tumbler in Activity 1.5 also be due to the condensation of water vapour present in the air?

Week 2
Theme: Water

Activity W2.1: How Can Water be Evaporated—Faster or Slower?

Children often observe the disappearance of water in their daily lives without realising that it is due to evaporation. They may notice puddles drying up after rain, water vanishing from a wet playground, or their clothes drying on a clothes line. When they leave a glass of water outside on a hot day, they might see it gradually decrease without being spilt. Similarly, after washing their hands, the water on their skin disappears as it dries. These experiences help children understand that water changes from liquid to gas and mixes with the air, even though they cannot see it happening.

In the previous activity, you 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 and rainy day. Let us perform an activity to investigate the conditions that will affect how fast water will evaporate.

Let us investigate

W2.1 (a) Effect of Temperature

Let us explore

- Take identical caps of two bottles.
- Pour equal amounts of water in each of the caps.
- Place one of the caps in the sunlight and keep the other in shade as shown in Fig. 11. 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.

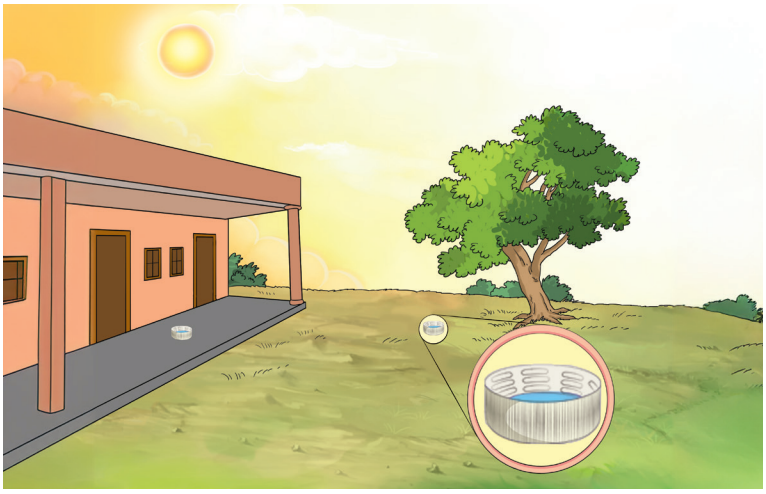


Fig. 11: Evaporation of water in sunlight and shade

Table 10: Findings of the investigations

Temperature of the water	Volume of the liquid	Time taken for the water to completely evaporate
Warm (in sunlight)		
Cold (in shade)		

What conclusions can you draw from the activity 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.

W2.1 (b) Effect of Surface Area

- Take water in a small cap of a bottle (you may use sanitiser in place of water).
- Take the same amount of water on 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 10.

Table 11: Findings of the investigations

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

Reflect on what you did really well in this activity.

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 will happen, if milk is taken instead of water in the above activity?

Fig. 12: Let us investigate

W2.1 (c): Effect of Humidity

Other conditions which affect how fast water evaporates

Design an activity similar to Activity W2.1 (c) to find out what other conditions can affect how fast water will evaporate. What will you change? What will you keep the same? Perform this activity. Use Table 12 to record the data and discuss your observations.

Table 12: Record the data of an investigation where one condition is changed and the other condition remains the same

Condition that is kept the same: _____

Condition that is changed	Time taken for complete evaporation

It is a common observation that clothes dry faster on a hot sunny day. Do clothes dry faster or slower on a windy day?

You may conclude that the speed of evaporation depends on various factors like the nature of liquid, temperature, surface area and humidity.

Have you ever felt that sweating cools the body and we also feel cold when sanitiser is applied to the skin? Discuss.

Draw a water cycle and identify the various processes involved in it, such as evaporation, condensation, etc.

Theme: Food

Activity W2.2

Good, nutritious food, along with good dietary habits, results in sound health and good mental growth. You eat a variety of food every day to keep your body healthy, obtain energy, and for growth, development and repair of body parts. It also protects the body from several diseases and keeps it fit and healthy.

Why do you need a variety of food? Try to answer the following questions.

1. What kind of nutrients does food contain?
2. Do all food items have the same nutrients?
3. Do different nutrients carry different functions in the body?

Some nutrients give us energy, while others help in the growth of the body and provide protection from diseases. Think, analyse and try to give reasons for the following situations.

1. A marathon runner drinks glucose water during and after a race.
2. In winters, we include *laddoos* in our diet.
3. Growing children need pulses, milk, eggs, etc., for a healthy body and proper growth.
4. We are advised to include fruits, vegetables and other plant-based foods in our daily diet.

We need different types of food items for performing specific body functions and daily activities. Find out about the functions and sources of different nutrients required by our body. Fill in the Table 13.

Table 13: Functions and sources of different nutrients

S. No.	Nutrients	Functions	Sources of nutrients
1.	Carbohydrates		
2.	Fats		
3.	Proteins		
4.	Vitamins		
5.	Minerals		

Is water also a nutrient? One should drink sufficient water everyday as it helps in the absorption of the nutrients from the food and also in the removal of the waste through sweat and urine. In addition, plant-based food items, rich in fibres, called roughage, are also required by our body as they help in easy defecation.

Based on the above observations, discuss the concept of a **balanced diet** in the class with scientific explanation of the need of all the nutrients. The discussion may include — what is a balanced diet and why should we take a balanced diet? What would happen if our body is deficient in any of the nutrients?

Activity W2.2 (a): Understanding of the Deficiency Diseases

Case studies

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

(b) In the 1960s, Indian scientists found that several individuals in the Himalayan region and the Northern plains of India developed swelling at the front of the neck — a symptom of goitre. The symptoms were reduced on the consumption of the iodised salt.

What do you interpret from these case studies? Which nutrient was deficient in their diets? Why did the consumption of a particular food item give them relief? Discuss with your peers.

Causes, symptoms and remedies of deficiency diseases

Have a discussion in the class regarding the importance of each nutrient in the diet. Find out about other deficiency diseases and fill the Table 14.

Table 14: Common symptoms of deficiency diseases

S. No.	Food nutrients	Deficiency diseases	Symptoms	Food items which can reduce/cure the symptoms
1.	Vitamin A	Night blindness		
2.	Vitamin C	Scurvy		
3.	Vitamin D	Rickets		
4.	Iron	Anaemia		
5.	Iodine	Goitre		
6.	.....	.....		
7.	.....	.....		
8.	.....	.....		

Have a discussion in the class on the above diseases. This will improve your understanding about the basic knowledge of these diseases, and enhance critical analysis and communicable skills.

Activity W2.2 (b)

India is an agricultural country with diverse soil and climate types, where a large number of people are involved in farming practices. We cultivate several kinds of crops—vegetables, fruits, oilseeds, fibres, etc., in different regions, depending on the climate and soil types. We obtain our daily food items from these crops, which may be grown locally or at far-off places. We are dependent on these food resources for our survival.

Think and try to answer the following questions:

1. How does food reach from an agricultural farm to the local market and then our houses?
2. What are the different steps involved in the process?
3. Can you imagine the amount of energy and effort involved in this whole process?

You eat *chapati*, rice and vegetables everyday. Do you know how much time is required to get these food items from the farm? Observe the Fig. 13 and try to understand the different steps involved to get the wheat flour once seed grains germinate in the farm and making the *chapati* that we eat.

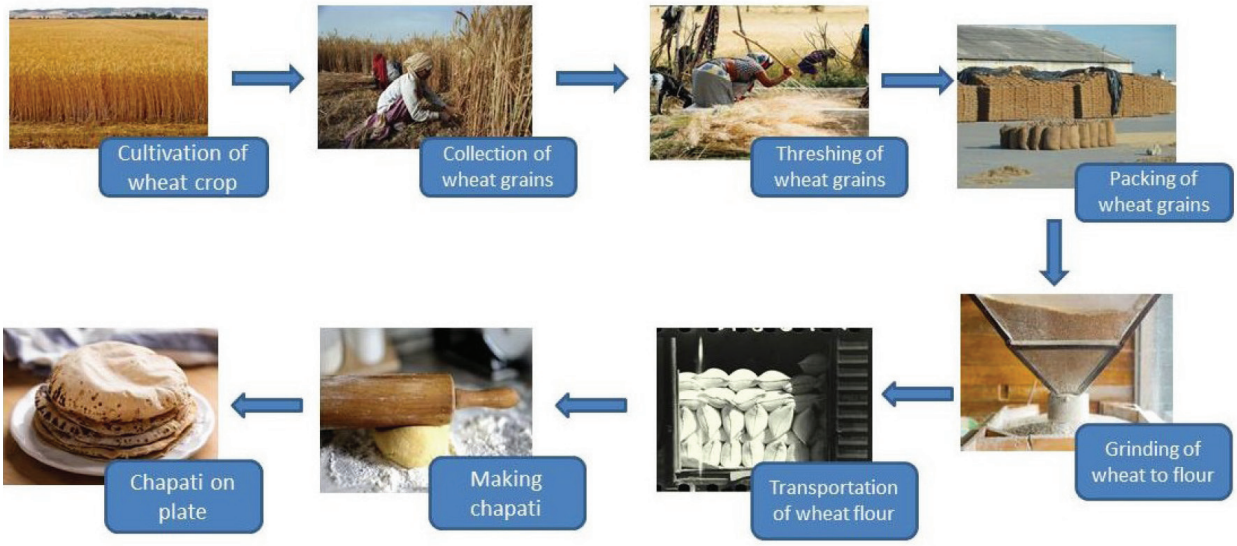


Fig. 13: Story of chapati: from farm to plate

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**. Do food miles have any effect on the cost of food items? Correlate the cost of food items with human effort, energy and the distance travelled by the food item to reach our home. If we reduce the food miles, it can help to cut down the cost as well as pollution caused by transportation.

How can we reduce the food miles? Can eating local food help our environment and farmers? Eating locally grown food reduces food miles, helps support local farmers, reduces pollution and also keeps our food fresher and healthier.

Activity W2.3: Prepare Your Own Food Miles

You must have understood the food miles of wheat grain to *chapati*. Now, make the food miles of following food items (you can select any other food item of your choice):

1. Rice/pulses
2. Any vegetable
3. Any fruit

Make a pictorial flowchart of the story of 'Farm to Plate' of each of the above food items. Try to find the timeline for the various processes involved in getting the food from farm to plate. Discuss with your peers about the energy, time and human resources involved in the process. Try to find answers of the following questions:

1. Why is food getting costlier?
2. How much cost is put in a field to make a one-time meal?

Think of the ways you can reduce the food miles, save energy and protect our planet.

Activity W2.4: Know Your Millet

What are millets? Have you ever consumed millets? Millets are small-sized grains, which have been an integral part of the Indian diet for centuries. Interact with your grandparents or other elderly persons to know about millets and their benefits.

What benefits do millets provide us? What kinds of nutrients are present in millets? The millet crop is highly productive and can be cultivated in varied climatic conditions. They are called nutri-cereals as they are rich in vitamins, minerals and dietary fibres. They help to keep us healthy, protect us from diseases and carry our body functions normally.

Try to explore the answers to the following questions:

1. Can millets help to overcome any nutritional deficiencies?
2. How is millet cultivation helpful for the farmers?
3. Can millets be grown in adverse climatic conditions, such as in arid and hot regions?

Activity W2.4 (a): Variety of Millets Around Us

Several types of millets are grown in India, which are known differently in different languages. A few are given in the Table 15. Add more kinds of millets and their local names in different languages. Find out which one of these is the most widely grown in India. You can also do mapping of different Indian varieties of millets.

Table 15: Millets and local names

Millet	Hindi	Language 1	Language 2	Language 3
Pearl Millet	*Bajra*			
Sorghum Millet	*Jowar*			
Finger Millet	*Ragi*			
Foxtail Millet	*Kakum*			
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Fig. 14: Different kinds of millets commonly grown in India

Extended activities

1. Plant millet seeds in the school garden and take care till harvesting.
2. Collate traditional millet recipes from different regions of India.
3. Create awareness about benefits of millet consumption by organising millet fair in school.
4. Plan a field trip to local farms or millet processing units to gain hands-on experience about millet cultivation.

Activity W2.5: Germination of Seeds

You may have consumed sprouted pulses. What are the small, elongated whitish processes that emerge from the seeds? Do you know why and how do these processes emerge? Sprouted pulses which we often include in our diet are examples of germinated seeds (Fig. 15). Process by which a seed develops into a seedling and eventually into a plant is referred to as seed germination.

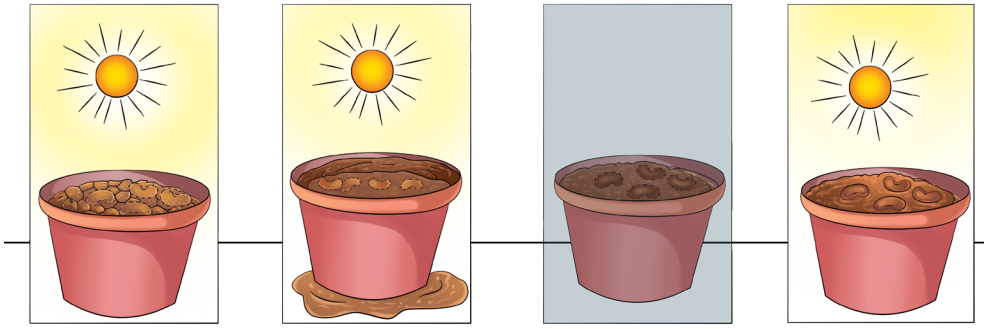
Fig. 15: Germinated seeds

How do seeds germinate? What conditions do seeds require for proper germination? Perform the following activity to understand the requirements of a seed for successful germination.

Activity 2.5 (a): To Know the Effects of Environmental Factors on Seed Germination

Take four identical pots (A–D) filled with the same garden soil. Sow 4–5 healthy bean seeds in each pot. Keep each pot in different environmental conditions for ~ 15 days.

Pot A—Direct sunlight and dry soil
Pot B—Direct sunlight and excess water to the soil
Pot C—Dark location and moist soil with moderate amount of water
Pot D—Direct sunlight and moist soil with moderate amount of water



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

Fig. 16: Exploring the germination of bean seeds under different conditions

Can you predict whether seeds will germinate in each pot? Fill Table 16 with your predictions. Observe the pots each day, taking care that the water and light conditions provided to them are maintained. Record your observations in Table 16.

Table 16: Effect of environmental conditions on seed germination

Pot with bean seeds	Availability of			Seed germination		Possible reason for your observation
	Water	Sunlight	Air	Prediction	Observation	
Pot A	No	Yes	Yes			
Pot B	Yes (Excess)	Yes	No			
Pot C	Yes	No	Yes			
Pot D	Yes	Yes	Yes			

Match your observations with the predictions. Discuss your results with your peer group. You can conduct the above activity with other seeds and find out whether the conditions needed for seed germination are the same for every type of seed. What would happen in the absence of one or more of these conditions?

Have a discussion in your class regarding the scientific explanation of seed germination in the presence/absence of

essential requirements. Try to explore the answers to the following questions:

1. Why do we soak seeds for sprouting? How does water help in seed germination?
2. Do seeds require air for germination? What will happen, if the soil in which seeds are sown, is waterlogged?
3. Is sunlight an essential requirement for a seed to germinate?
4. Is there any other factor, which can affect seed germination?

Week 3
Theme: Natural Resources

Activity W3.1: Renewable and Non-Renewable Natural Resources

Earth is the only planet where life is known to exist. This life depends on many factors. These include ambient surrounding temperature, the presence of air, water, food, etc. The resources available on the earth and the energy from the Sun are necessary to meet the basic requirements of all life forms. The resources that are available to us in abundance are natural resources. For example, sunlight, fruits, vegetables, air, water, land, rivers, coal, petroleum, etc. Humans have also created resources using the natural resources, such as electricity, buildings, furniture, etc.

1. What are Natural Resources?

Natural resources are the things that we need from the natural world for our existence. The light from the Sun, air from the atmosphere, water from the rivers and food from plants and animals, etc., are examples of natural resources. The significance of natural resources and their wise usage for mankind has been acknowledged by all ancient civilisations, including that in Bharat.

In this section, we largely discuss the resources that are naturally available to us. These may largely be classified as **depletable** or **non-depletable**. Coal, minerals, petroleum and natural gas are the natural resources that are stored in the depths of our planet,

Earth. Such resources have limited quantities and thus, every time we use them, they are depleted. Therefore, such resources are depletable sources. On the other hand, resources like light coming from the Sun, wind, tidal energy, etc., are also naturally available to us. These resources are not stored. We get light from the Sun, winds due to air currents, tides due to relative motion of the moon, etc. Such resources replenish themselves and are therefore, non-depletable. However, these are often conventionally said to be renewable. The energy available through such non-depletable resources, can be used for mankind.

Activity W3.1(a)

1. Classify the following resources as Non-depletable (Renewable) and Depletable (Non-renewable).

Table 17

S. No.	Name of Resource	Non-Depletable (Renewable) (Yes/No)	Depletable (Non-renewable) (Yes/No)
1.	Coal		
2	Solar energy		
3.	Wind energy		
4.	Oil		
5.	Water		
6.	Air		
7.	Uranium		
8.	Biomass		
9.	Natural gas		

2. The Management of Natural Resources

It is crucial to make wise usage of natural resources, so that subsequent generations can use them. Following are some of the important methods to manage the natural resources:

2.1 Soil Conservation

'Fallowing' and 'crop rotation' are the key Indian agriculture sustainable practices. Following involves leaving the field uncultivated for a few months. Crop rotation involves cultivating a variety of crops in the same location. Additionally, organic fertilisers like compost and cow dung were employed in ancient agricultural practices, these reduced the need for chemical inputs and maintained the soil's health. Modern methods, as employed in Indian agriculture, aim to increase productivity, efficiency and ensure sustainability by improving the soil fertility, using genetically modified crops, drip irrigation, sprinkler systems, pest management and organic farming. In addition tractors, combine harvesters, seed drills and plows are being used.

2.2 Water Conservation

India's traditional methods of conserving water serve as significant examples of how local customs are used to manage natural resources. Gathering and storing rainwater is known as rainwater harvesting and it is a crucial water management technique. The key technique of rainwater harvesting includes step wells, *kunds, bawadi, tanka* and *johad* systems. The step wells (*Baolis*) are the structures built to harvest and store water, especially in dry regions, while *kunds* are small circular tanks that are common in arid regions and are used to store rainwater. Tanka is an old rain water harvesting structure available in different shapes and sizes, and can be made by cement masonry or lime or stones. In many Indian states, *johads*—also called *pokhars* or percolation ponds—are traditional, community-owned wetland areas. They store rainfall water and are primarily utilised for efficient water resource management. Many of these methods show how to manage water resources efficiently and sustainably to guarantee that there is water available during dry seasons. Water bodies have long been seen as essential to the environment, and numerous methods have been employed to protect them. People, for example, offer prayers and ceremonies to the rivers (like the Ganga) in appreciation of its significance for both material and spiritual well-being.

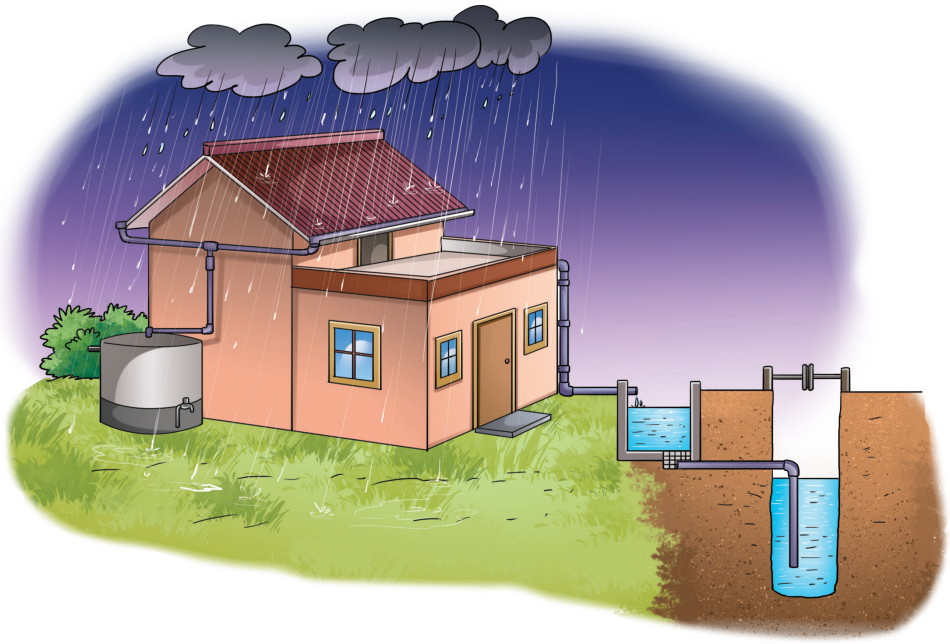


Fig. 17: Rain Water Harvesting

Fig. 18: Bawadi (Toorji ka Jhalra, Jodhpur in Rajasthan)

Do you know?
World Water Day is observed on 22nd March every year.

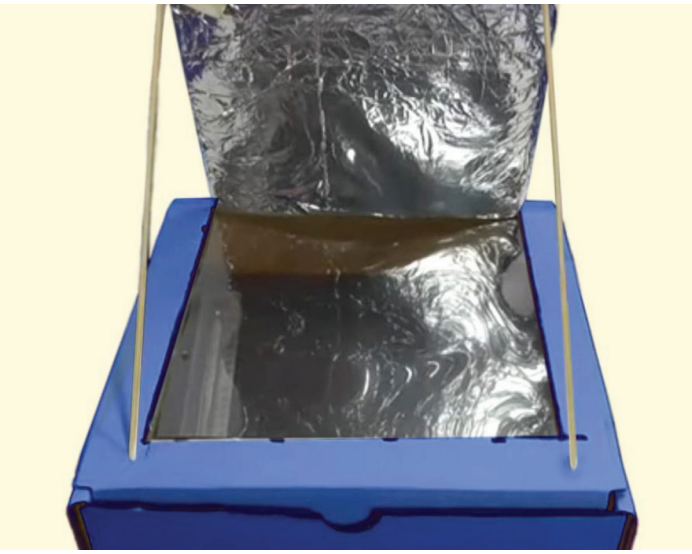


Fig. 19: A solar oven with a box and aluminium foil

Activity W3.1 (b)

A solar oven or cooker is a system that cooks food by trapping the sunlight. A typical solar oven can be prepared in-house. It consists of aluminium foil as reflectors, a cardboard box as cooking chamber, a transparent plastic foil allows sunlight to enter but prevents the heat from escaping and black paper sheet for ensuring the absorption of heat. The instructions to prepare a solar oven are as under:

Step 1 — To make a window for the solar oven to receive sunlight, cut a flap on the top of a cardboard container, leaving a few centimetres (may be two or three) around the sides.

Step 2 — In order to increase the heat absorption inside the chamber and to speed up the cooking, affix sheets of black paper inside the cardboard box.

Step 3 — Affix the aluminium foil on the interior of the lid and the edges. By doing this, the sunlight will be reflected into the cooking chamber.

Step 4 — Cover the top with a clear plastic foil. Sunlight should be able to pass through the transparent plastic foil but sufficient heat will remain trapped within the box.

Step 5 — Now, take this box for outdoor activity on a sunny midday and place a bowl (containing some water and rice in it) inside the box.

Step 6 — Ensure that the sunlight is properly entering the box. Leave the solar oven in the Sun for about 2 hours.

Step 7 — Carefully open the lid, take out rice using a spoon and check if they have cooked.

Activity W3.1 (c): List Different Methods of Conservation of Natural Resources in Your Locality.

Theme: Metals and Non-metals

Activity W3.2: Physical Properties of Metals and Non-metals

You are familiar with a number of materials like iron, aluminium, copper, etc. Some materials have been given in Table 18.

Table 18: Appearance and Hardness of Materials

Object/ Material	Appearance (Shiny/Dull)	Hardness (Very Hard/ Not Very Hard)
Iron		
Coal		
Sulphur		
Aluminium		
Copper		
.....		

Can you name the materials which are metals? The rest of the materials in Table 18 are not metals. They may be termed as non-metals. Metals can be distinguished from non-metals on the basis of their physical and chemical properties. Let us perform some activities to compare the physical properties of metals and non-metals.

Activity W3.2 (a): Metallic Lustre

Do you have copper, iron or aluminium articles at home? Have you noticed their surface?

- Take samples of iron, copper, aluminium, coal and sulphur. Note the appearance of each sample.

- Clean the surface of each sample by rubbing them with a sandpaper and note their appearance again. What do you observe? Record your observations in Table 19.

Table 19

Sample	Appearance of sample	
	Before rubbing by sandpaper	After rubbing by sandpaper
Iron nail		
Coal piece		
Aluminium wire		
Pencil lead		

Metals, in their pure state, have a shining surface. This property is called metallic lustre. You have observed that in the above activities, iron, copper and aluminium show metallic lustre. Thus, they are metals. No such shining surface is observed in coal. Thus, it is a non-metal.

From the above discussion, one should not be confused into thinking that all materials with shining surfaces are metals and others are non-metals. In fact, the present concept is only applicable to materials that are elements.

Activity W3.2 (b): Hardness

- Take small pieces of iron, copper and aluminium.
- Try to cut these samples with a sharp knife and note your observations.
- Repeat the above activity by taking coal, sulphur and iodine.
- What do you observe?

Metals are generally hard and hardness varies from metal to metal. It is due to the effective arrangement and interaction of atoms in the metals. On the other hand, non-metals are easy to cut with a knife. On the basis of the above observations, it may be concluded that iron, copper and aluminium are metals and coal, sulphur and iodine are non-metals.

Mercury is a liquid metal. Sodium and potassium metals are soft and we can cut them by a knife.

Activity W3.3 (c): Malleability

- Take a small iron nail, a coal piece, a piece of thick aluminium wire and a pencil lead.
- Beat the iron nail with a hammer. (But take care that you don't hurt yourself in the process.) Try to hit hard.
- Hit hard the aluminium wire also.
- Repeat the same kind of treatment on the piece of coal and lump of Sulphur.
- Record your observations in Table 20.

Fig. 20: Beating an iron nail with a hammer

Table 20

Object/Material	Change in Shape Material (Flattens/ Breaks into Pieces)
Iron nail	
Coal piece	
Aluminium wire	
Lump of sulphur	

You saw that the shape of the iron nail and the aluminium wire changed on beating. If metal were beaten harder, these could be changed into sheets. You might be familiar with silver foil used for decorating sweets. You must also be familiar with the aluminium foil used for wrapping food. The property of metals by which they can be beaten into thin sheets is called malleability.

As you must have noticed, materials like coal and sulphur do not show this property. Thus, they are called non-metals.

Activity W3.2 (d): Ductility

Where do you find the use of aluminium and copper wires? Have you seen the wires of coal? Definitely not! The property of metal by which it can be drawn into wires is called ductility. Gold is the most ductile

metal. You will be surprised to know that a wire of about 2 km in length can be drawn from one gram of gold.

Activity W3.2 (e): Sonorous Sound

Have you ever noticed the difference in sound when dropping an iron sheet/plate, a metal coin and a piece of coal on the floor? If not, you can try it now. Have you noted any difference in the sound produced? Can you give a reason?

The things made of metals produce a ringing sound when struck hard. Since metals produce ringing sounds, they are said to be sonorous. Non-metals like coal and sulphur are not sonorous.

Activity W3.2 (f): Thermal Conductivity

- Take an aluminium or copper wire.
- Clamp this wire on a stand, as shown in the Fig. 21.
- Fix a pin to the free end of the wire using wax.
- Heat the wire with a spirit lamp/Bunsen burner, candle near, where it is clamped. What do you observe after some time? Note your observations.

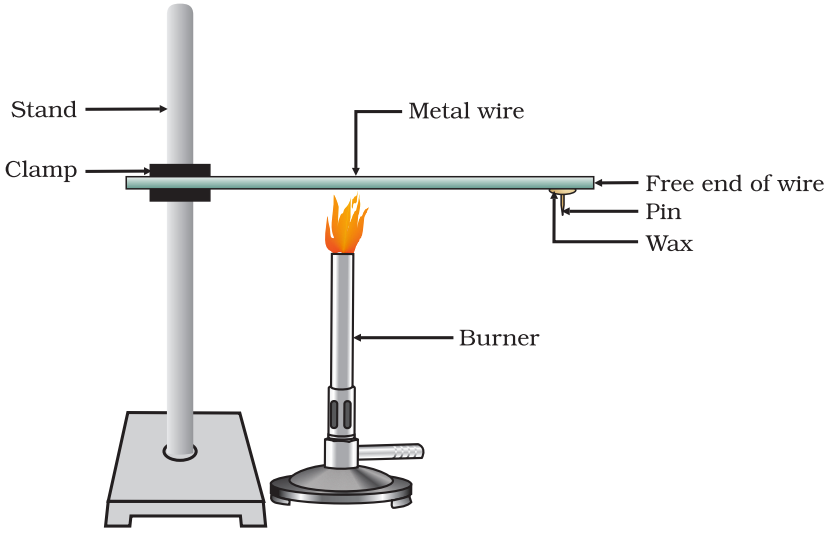


Fig. 21: Metals are good conductors of heat

Metals are good conductors of heat. Non-metals are poor conductors of heat.

Activity W3.2 (g): Electrical Conductivity

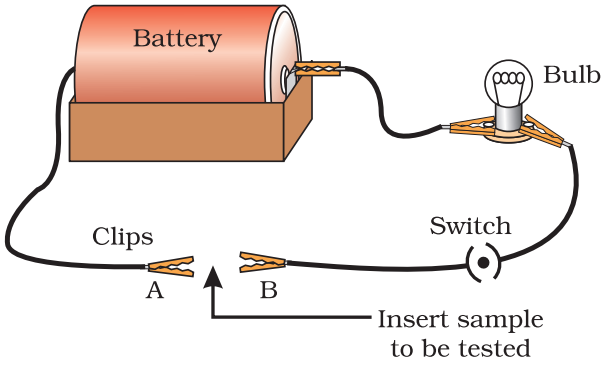


Fig. 22: Metals are good conductors of electricity

- Set up an electric circuit as shown in Fig. 22.
- Place the sample (iron nail, copper wire, aluminium foil, coal and sulphur) to be tested in the circuit between terminals A and B, as shown.
- Does the bulb glow?
- Record your observations in the Table 21.

Table 21: Observation table for electrical conductivity

Sample	Does the bulb glow? (Yes/No)
Iron nail	
Copper wire	
Aluminium foil	
Coal	
Sulphur	

What does this indicate?

You have observed that the bulb glows when iron nail, copper wire and aluminium foil is placed in the circuit between terminals A and B. A substance that allows electricity to flow through it is called an electrical conductor. Metals are good conductors of electricity, while non-metals are poor conductors of electricity. Iron, copper and aluminium are metals in the above samples, while coal and sulphur are non-metals.

After performing the above activities, we can say that some elements are hard, lustrous, malleable, ductile, sonorous and good conductors

of heat and electricity. The elements which generally possess these properties are called metals. Examples of metals are iron, copper, aluminium, calcium, magnesium, etc. In contrast, elements like coal and sulphur appear soft and dull. They break down into a powdery mass when tapping with a hammer. They are not sonorous and are poor conductors of heat and electricity. These materials are called non-metals. Examples of non-metals are sulphur, carbon, oxygen, phosphorus, etc.

Activity W3.3: Chemical Properties of Metals and Non-metals

Activity W3.3 (a): Reaction with Oxygen

You are familiar with the phenomenon of rusting of iron. Recall the reaction by which rust is formed. You had also performed it in the Grade 7 activity of burning a magnesium ribbon in air. You learnt that oxide formation takes place in both processes. Complete the following reactions of iron and magnesium with oxygen.

Iron + Oxygen + Water ⟶ ?

Magnesium + Oxygen ⟶ ?

Let us check the nature of rust formed due to the reaction between iron, oxygen and water. Collect a spoonful of rust powder and dissolve it in very little water. You will find that the rust remains suspended in water. Shake the suspension well. Test the solution with red and blue litmus papers (Fig. 23). What do you observe? Is the solution acidic or basic?

Now, recall the activity of burning a piece of magnesium ribbon. The ash obtained on burning the magnesium ribbon is dissolved in warm water and tested for its acidic/basic nature. Is the solution acidic or basic? How do you

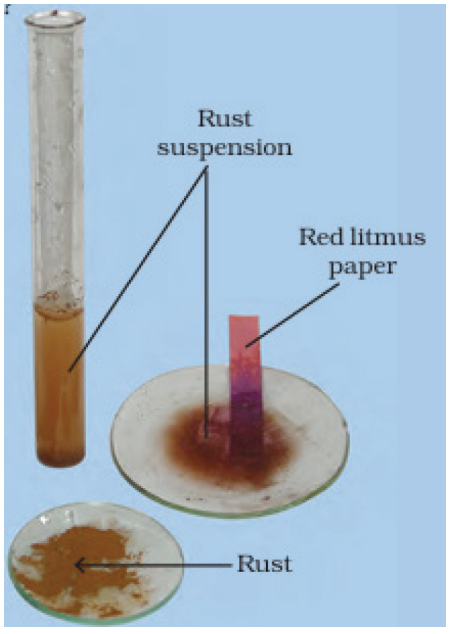


Fig. 23: Testing the nature of rust

ascertain this? You must have observed that the red litmus turns blue. So, magnesium oxide is basic in nature. In general, metallic oxides are basic in nature.

Let us now observe the reaction of non-metals with oxygen.

(To be demonstrated by the teacher in the class)

Take a small amount of powdered sulphur in a deflagrating spoon and heat it. If a deflagrating spoon is not available, you may take a metallic cap of any bottle and wrap a metallic wire around it and give it the shape shown in Fig. 24 (a). As soon as sulphur starts burning, introduce the spoon into a gas jar/glass tumbler. Cover the tumbler with a lid to ensure that the gas produced, does not escape. Remove the spoon after some time. Add a small quantity of water into the tumbler and quickly replace the lid. Shake the tumbler well. Check the solution with red and blue litmus papers. [Fig. 24 (b)]

Fig. 24 (a): Burning of sulphur powder

Fig. 24 (b): Testing of solution with litmus papers

The name of the product formed in the reaction of sulphur and oxygen is sulphur dioxide gas. When sulphur dioxide is dissolved in water, sulphurous acid is formed. The reaction can be given as follows:

Sulphur dioxide + Water ⟶ Sulphurous acid

Sulphurous acid turns blue litmus paper red. Generally, oxides of non-metals are acidic.

Activity W3.3 (b): Reaction with Water

Water reacts differently with different metals depending on their reactivity. Highly reactive metals like sodium and potassium react violently with water resulting into explosion.

Activity W3.4: Rusting of Iron

Rusting is a slow chemical change that takes place when iron reacts with water and oxygen from the air, forming a reddish-brown substance called iron oxide. This process is called oxidation and it occurs when iron is exposed to moisture for a long time. Scientists use experiments to understand rusting by placing iron nails in different conditions—in dry air, in water and in salty water. They observe that rust forms faster in water and even quicker in salty water, proving that both oxygen and water are needed for rusting. By using scientific methods like observation, experimentation and analysis, they conclude that preventing rust requires keeping iron dry or using coatings like paint or oil.

Let's perform the following activity.

Material Required

- 3 new iron nails (If new iron nails are not available, take old nails and rub them with sandpaper.)
- 2 plastic bags
- Grease or oil
- A piece of cotton cloth
- Water

Procedure

1. Take an iron nail and apply grease or oil to its surface.
2. Place the second iron nail inside a sealed plastic bag.
3. Wrap the third iron nail in a wet cotton cloth and place it in a sealed plastic bag.
4. Observe all the nails after 2–3 days.

Observations

- **Iron nail with grease/oil**: The nail will remain shiny and unaffected, as rusting requires both water and oxygen to react.

- **Iron nail in a sealed plastic bag**: The nail won't rust since there's no water present.
- **Iron nail in a wet cotton cloth**: Over time, the nail will change colour, turning brown or reddish-brown as iron oxide forms on its surface.

Chemical Reaction: The rusting of iron can be represented by the following equation:

Iron + Oxygen + Water ⟶ Iron Oxide (Rust)

Week 4
Theme: Heat and Air

Pema and Palden reside in Gangtok. On a freezing winter evening, they are sitting around the burning firewood. Feeling the warmth of the burning firewood, Pema says, "Winters are freezing here. I am thankful to sit near fire. It feels warm."

Fig. 25

Why is the smoke going up?

Palden draws Pema's attention to the rising smoke from the burning firewood around which they are sitting.

To understand why the smoke rises, let us perform the following activity.

Activity W4.1: Let Us Investigate

- Take two paper cups of equal size.
- Hang them using threads of equal length in an inverted position on the two ends of a wooden stick, as shown in the Fig. 26 (a).
- Now hold the thread, such that the wooden stick is horizontal.

Fig a *Fig b*

Fig. 26 (a, b): Hot air rising up

- Place a burning candle below one of the cups (Fig. 26 (b)).
- **Observe** what happens to the cup.
- **Record** your observations and the probable reasons for these observations in Table 22.

Table 22: Recording observations and probable reasons

Observation of the cups	Probable reasons for the observation

You observed that the cup under which the candle was placed, rises up. Why does the cup rise up?

The air surrounding the candle flame heats up. As the air in the cup gets heated, it expands, becomes less dense and rises up. The smoke is warm air and hence, it rises up. Can you recall some more situations where the warm air rises up? You must have observed that when incense sticks (*Agarbatti*) are burnt, the smoke rises up. Similarly, when we burn firewood, we can observe the smoke rising up.

Try this

1. When air _____ up, it expands and _____.
2. An incense stick is fixed pointing downward. In which direction will the smoke from the incense stick move? Show the movement of smoke by a diagram.

When water in the oceans, rivers, lakes and other water bodies get heated due to the heat of the Sun, it is transformed into water vapour. Plants and vegetation also release water in the form of vapour by a process called transpiration. The air laden with water vapour, the moist air, is warm and light. We have learnt in Activity W4.1 that the warm air expands, becomes lighter and rises up. At higher altitudes, the moist air cools down and condenses into tiny water droplets. The droplets merge, become heavy and fall down on the earth as rain, snow or hail (the phenomenon is called precipitation). The rain water and the snow, when it melts due to the heat of the sun, flows back into the rivers and eventually into the oceans and other water bodies. A small part of this water also seeps into the ground, where it gets stored as groundwater, the process is called infiltration. We dig wells into the groundwater and draw water for our use. Note that whatever water was lost as vapour, comes back in the form of rain, snow or hail. This is called the water cycle. Two important points must be noted.

- The total water content of the planet earth is conserved in this process.
- By redistributing water over different regions, it helps in maintaining the life on the earth.

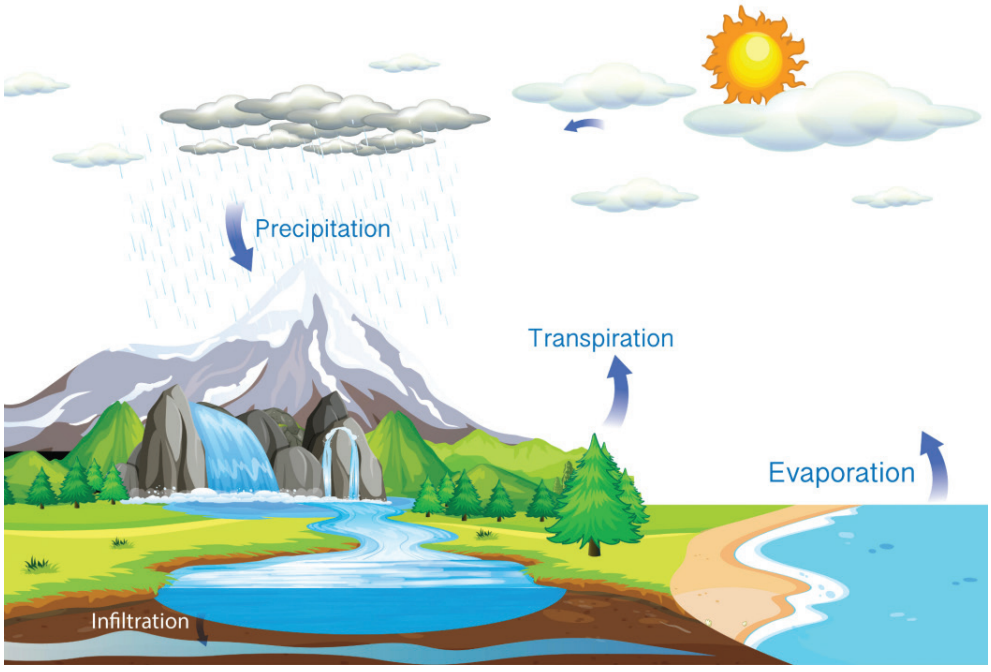


Fig. 27: Water Cycle

Theme: Understanding Adolescence

Activity W4.2: Adolescence

A human being is born as a child, grows gradually and becomes an adult. During growth, the human body undergoes various changes. This entire transition phase or period between childhood and adulthood is called **adolescence**. The growing children or **adolescents** are also called **teenagers** because of the teen years.

Activity W4.3: Understanding Puberty

Puberty can be defined as the beginning of the changes that lead to sexual maturity of a child. The physical changes associated with puberty include—increase in height, breast development and menstruation in girls, deeper voice in boys, appearance of pimples on face, etc.

Divide the class into groups of 5–6 students each. Let each group write down the prominent changes in their body which they have experienced recently and discuss in the group. Summarise the points raised in the Table 23.

Table 23: Changes that appear during adolescence

S. No.	Group Number	Change No. 1	Change No. 2	Change No. 3	Change No. 4

Categorise the observations which occur only in males, only in females and those which are common for both girls and boys. Write down these changes in the Table 24.

Table 24: Pubertal changes that are specific and common in males and females

S. No.	Common changes	Changes specific for boys	Changes specific for girls

Now, measure the height of each student in the group with the help of a measuring tape or scale. Note down your observations in Table 25 and share them with other groups.

Table 25: Height measurement and analysis in a group of students

S. No.	Name of the students	Age (in years)	Gender	Height (in centimetres)	Fill the details (in centimetres)
					Maximum height: _____
					Minimum height: _____
					Average height: _____
					Difference between the average height of boys and girls: _____

Analyse the data and make a graph between age (x-axis) and height (y-axis) of the students. Try to explain the scientific phenomenon behind the common and distinct gender changes.

4.4 Behavioural Changes in Adolescents

Adolescents not only undergo physical changes, but also emotional, attitudinal and behavioural changes. You should not feel insecure and upset since these changes are a part of growing up. If needed, do not hesitate to seek help from elders.

Activity W4.4 (a): Understanding the Behavioural Changes in Adolescents

Read the following questionnaire, fill the responses (Tick Mark) and analyse the findings.

Table 26

S. No.	Parameters	Strongly Agree	Agree	Disagree	No Such Observation
1.	Do you feel more emotional and often have mood swings?				
2.	Do you become easily upset?				
3.	Do you think that you are now a grown up and want to make your own decisions?				
4.	Are you concerned about the changes in your body appearance?				
5.	Do you feel distracted and easily influenced by peers?				
6.	Have you become more confident and aware?				
7.	Have you developed any changes in your likings?				
8.	Do you feel that your attitude has changed towards yourself and also towards the opposite sex?				

- Calculate the percentage of students opting for each of these parameters.
- Which parameter is maximally selected for the option 'Strongly Agree'?

Discuss your findings with your peers. Think, reflect and make a list of more such changes in your behaviour, thinking and attitude. You can also discuss it with your parents, siblings and friends. Try to find the scientific basis for such changes. Read about the hormones, chemicals secreted in our body, which influence our physical changes as well as behaviour, mood, attitude, etc.

4.5 Reproductive Health

Reproductive health includes physical, mental and social well-being of an individual in relation to their reproductive system. You should build positive and strong relationships with family and friends, and be able to communicate freely with them. Sharing emotions helps in handling anxiety and confusion. A healthy mind helps in realising one's worth and coping up with stressful situations.

4.6 Taking Care of Health During Adolescence

Make a list of the things you need to be healthy and live a happy and stress-free life during adolescence. Discuss the following with your classmates, teachers and elders at home.

1. What is the ideal diet for the healthy growth of adolescents? Which nutrients should be included in their diet to meet their nutritional needs?
2. Why is it important to take care of personal hygiene during puberty?
3. How do physical activities help in the healthy growth of adolescents?
4. What is menstruation in girls and why is it of utmost importance for girls to understand the phenomenon?
5. How can boys support female peers during periods, become empathetic and break the stigma associated with it?

You can also have a debate on the above topics in the class. You can share thoughts with each other, and take the help of the teacher to know the scientific concepts through videos, illustrations, or animations about the importance of hygiene during menstruation, common challenges and ways to manage them, use of reusable and disposable menstrual products, etc.

The myths and taboos in our society associated with menstruation can be discussed and justified by scientific explanation. For example, during menstruation, girls:

1. Should not be allowed to work in the kitchen.
2. Should stay in a separate room during her menstrual cycle.
3. Should not touch and eat pickles.
4. Should not wash hair during menstruation, etc.

Work in pairs or small groups and create posters with the aim of spreading awareness among the common people. The posters could have the following contents—

- Slogans and visuals promoting menstrual hygiene and breaking stigma.
- Menstrual cycle education for everyone.
- Myths and facts about menstruation.

Week 5
Theme: Sky

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 as seen from the earth appear to form patterns which are like shapes of familiar things. Long ago, when watching stars in the night sky was a necessity 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 people 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, these patterns helped people, particularly sailors and travellers, in finding directions at sea and 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 the 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 commonly used for these groups of stars.

Let us do an activity

Activity W5.1: Night Sky Watching and Stargazing

If it is a clear cloudless night, a large number of stars may be visible in the sky.

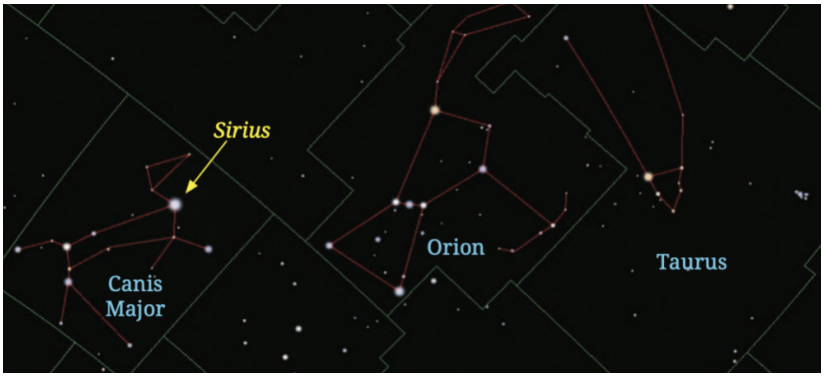


Fig. 28: Some constellations and stars

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.

Preparation for night sky watching

- Under the guidance of adults, identify a dark open area for watching the night sky. 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 (*Amavasya*) 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 day and time selected, go to the identified place with an adult, where you planned for watching the night sky.
- 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.
- Observe and identify the pattern formed by the stars at night using the chart. Gather information about the constellation as listed in the Table 27.
- Compare the data with others in the following class.

Table 27

S. No.	Name of the Constellation	Any Other Name of the Constellation	Shape of the Constellation	Brightest Star	Faintest Star

Activity W5.1 (a): Try to Locate Orion, Big Dipper in the Night Sky

1. Look for Big Dipper during summer time in the early part of the night, say, around 9 pm. View the sky above the horizon towards the northern part of the sky and identify the Big Dipper.
2. 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 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.
3. In India, Orion is best viewed during the months of December to April after sunset. So, look for it during that period.
4. 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.
5. Once you identify Orion, it is easy to locate the very bright star Sirius (Fig. 28), 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.

Activity W5.2: Virtual Navigation with Stellarium App

Material Required: Stellarium app

Steps

1. Guide students to use Stellarium to locate the Big Dipper and trace its path to the Pole Star.
2. Explore how the visibility and position of the Pole Star change based on the geographical location (for example, equator vs. northern hemisphere).
3. Students interactively explore surrounding constellations, identifying their patterns.
4. Students experiment with Stellarium's time settings to observe seasonal changes of stars in the sky.

Pole Star

Two distinct patterns of stars, the Big Dipper and the Little Dipper, are shown in Fig. 29. The Pole Star or Polaris, which is a part of the Little Dipper is also shown. The Pole Star appears stationary in the North direction, which helps to define the North direction in the Northern hemisphere.

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*.

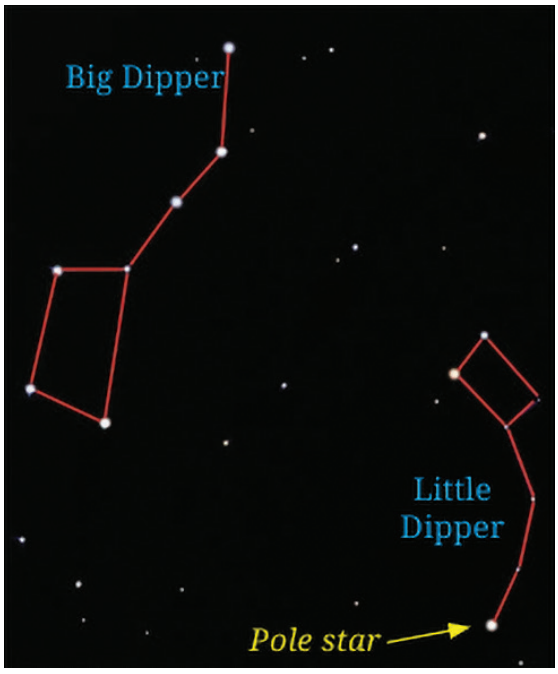


Fig. 29: Big Dipper, Little Dipper and Pole Star (The lines are not seen in the sky and have been drawn only for easy identification.)

Theme: Galaxy

A galaxy is a collection of interstellar gas, dust, dark matter, stars and stellar remains. The Milky Way Galaxy (*Ākāśha Gangā*) is the galaxy that includes the Solar System. It has billions of stars.

Fig. 30: Milky Way Galaxy as seen from a very dark location in Ladakh, India

Think: How are these stars bound in the galaxy?

It's due to gravity. In the absence of gravity, everything in our whirling galaxy would shoot off into space.

Activity W5.3: The Solar System

Key Concepts

- The Sun is the closest star to us and is the centre of the Solar System. It provides energy to all lives on Earth.
- The eight Planets — Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune revolve around the Sun.
- Natural satellites orbit planets. The moon is the natural satellite of the Earth.

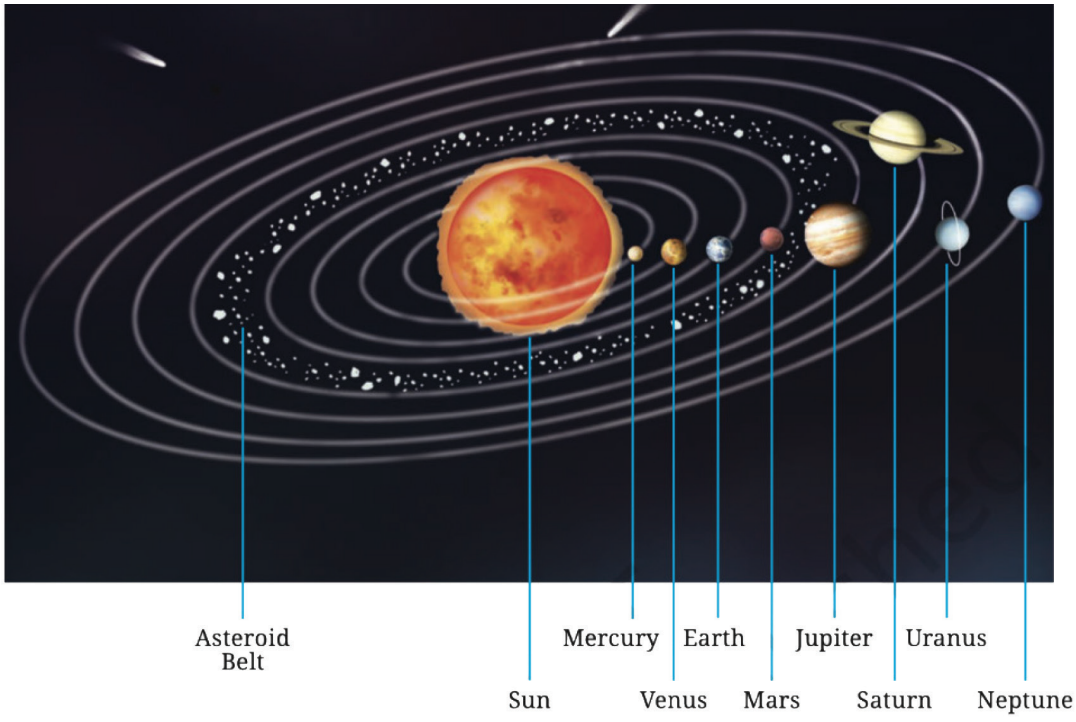
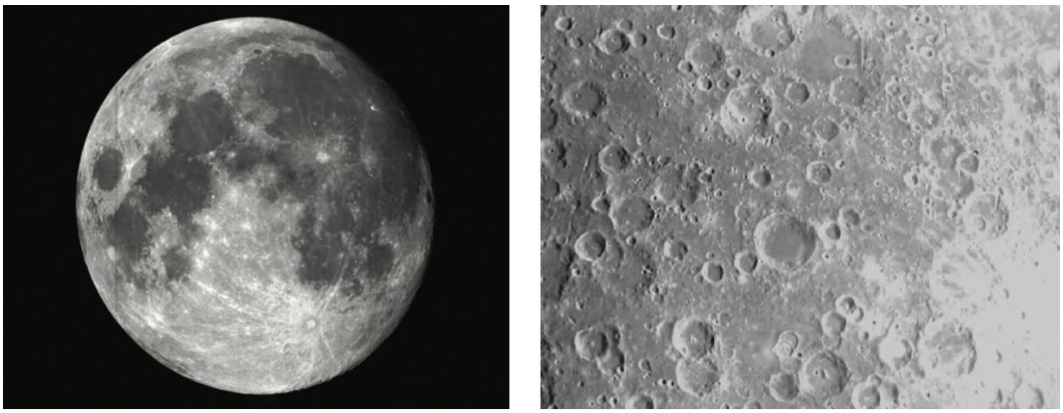


Fig. 31: An artist's representation of the Solar System

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 each have a large number of moons.



(a) *(b)*

Fig. 32: The Moon (a) Image taken by Cartosat, ISRO
(b) Close up image of the moon by Chandrayaan-3, ISRO

Activity W5.4: Build a Model of the Solar System

Material Required: Balls of varying sizes, string, paint and cardboard

Steps

1. Divide students into groups, assigning each group a planet or celestial body to research and model.
2. Students create labelled models of their assigned planets, moons, or other celestial objects, ensuring relative sizes and distances.
3. Assemble the Solar System in the classroom or outdoors, using string to represent orbits.
4. Each group presents the features of the object they have been asked to model, sharing interesting facts about their object (for example, surface features, atmosphere and rotation).

Week 6
Theme: Motion of the Earth

The earth has two types of motions, namely revolution and rotation.

1. **Revolution**: The Earth revolves around the Sun in an orbit. This motion takes about 365.25 days to complete, which defines a year.
2. **Rotation**: The Earth also rotates around its own axis, an imaginary line that runs from the North Pole to the South Pole. This rotation causes day and night. One full rotation takes approximately 24 hours.

The earth receives light from the sun. Due to the spherical shape of the earth, only half of it gets light from the sun at any time. The portion facing the sun experiences day, while the other half away from the Sun experiences night.

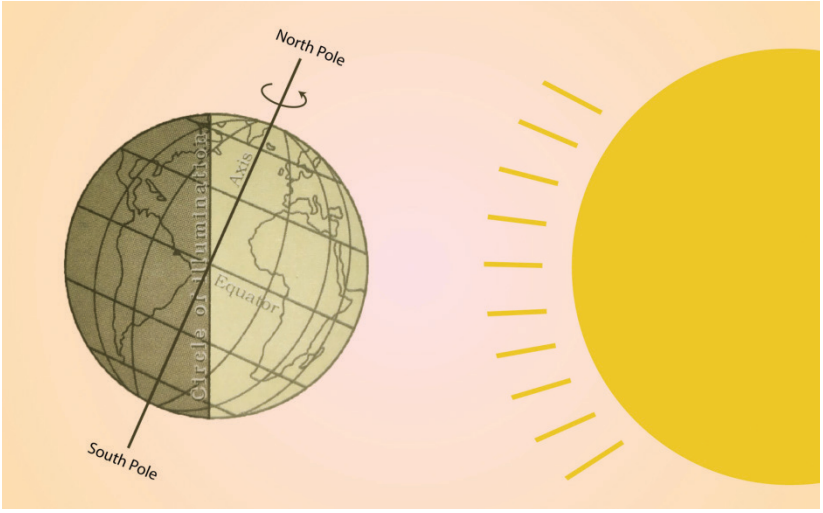


Fig. 33: Day and night on the Earth due to rotation

Activity W6.1: Earth's Rotation and Day-Night Simulation

Objective

To help students understand the rotation of the Earth and occurrence of day and night due to it.

Material Required: A globe or a large ball (such as basketball, football) representing the earth, a torch or a table lamp (to represent the Sun), a room/hall with dim light, small sticky notes or markers.

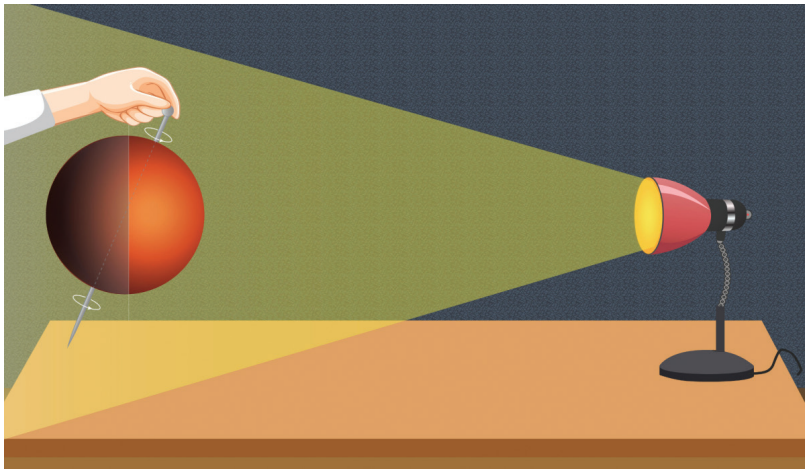


Fig. 34: Arrangement for showing the occurrence of day and night

Procedure

1. **Set Up the Model**:
   - Mark two diagonally opposite points on the big ball representing the poles of the earth. Insert a knitting needle through these points. This will represent the axis of the earth.
   - Place the torch or lamp in the centre of the room. This will represent the Sun.
   - Position the big ball a few metres away from the lamp. The ball will represent the Earth. Ensure that the ball's axis is tilted by about 23.5° to mimic the Earth's tilt.
2. **Mark a Location**:
   - Stick a small note or put a mark using a marker on the ball to represent your location on the Earth (for example, India).
3. **Simulating Day and Night**:
   - Turn off the room lights, leaving only the flashlight or lamp on.
   - Slowly rotate the ball counter-clockwise (when viewed from above the North Pole) to simulate the Earth's rotation. Remember that the Earth rotates from west to east.
   - Observe how the mark moves into the lighted area (day) and then into the dark area (night). Note the direction from which the light appears falling on the mark.
4. **Observation and Discussion**:
   - Have students observe how only half of the ball is illuminated at any time, while the other half remains dark. (Fig. 34)
   - Ask them to notice how the marker moves between the light and dark areas, creating the day-night cycle.

Questions

1. Why does the Sun seem to rise in the east and set in the west?
2. If the Earth's rotation were faster, how would the length of a day change?
3. What might happen if the Earth did not rotate at all?

Activity W6.2: Solar and Lunar Eclipses

An eclipse of the Sun, or solar eclipse, is said to occur when the shadow of the Moon falls on the Earth. See Fig. 35, An eclipse of the Moon, or the lunar eclipse, occurs when the Sun, the Earth and the Moon are in line so that the shadow of the Earth falls upon the Moon, see Fig. 35.

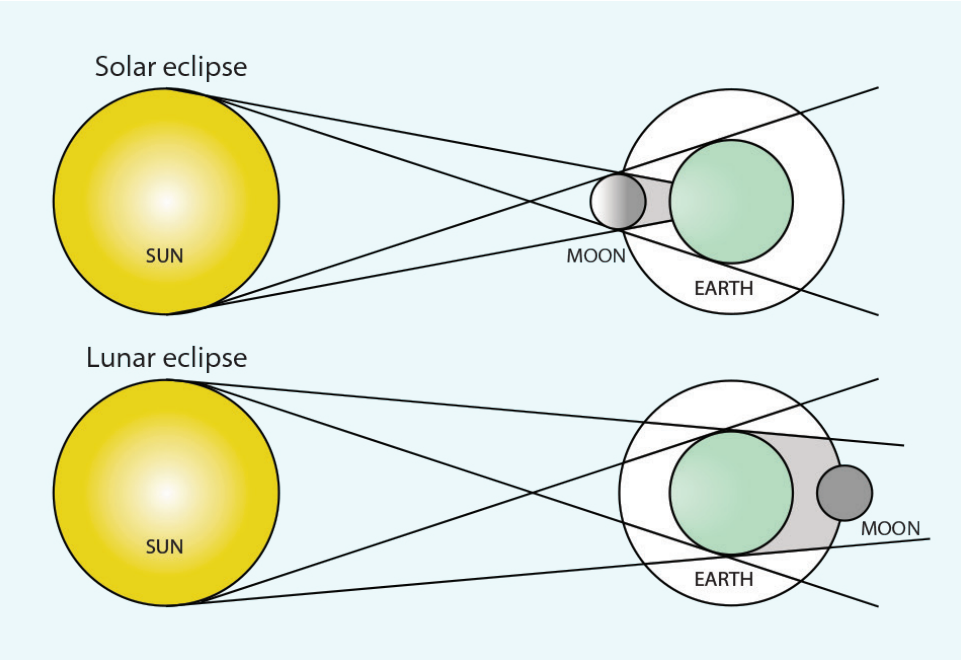


Fig. 35: Solar eclipse and Lunar eclipse

Through the following activity, we can understand the phenomenon of eclipse.

Solar and Lunar Eclipses

Material Required: Torch (to represent the Sun), 2 plastic balls one smaller than the other, 2 tea paper cups and dark room or dim lighting for better visibility of the effects.

For Solar Eclipse

1. Set up the torch: Position the torch on one side of the setup to act as the Sun. Make sure the torch is steady and positioned, so that it casts light in the direction of the plastic balls.
2. Position the Earth: Place the larger plastic ball in the middle to represent Earth. You can mount it using a tea paper cup to keep it stable. The Earth should be fixed in place, as it will not move during the demonstration.
3. Position the Moon: Mount the smaller plastic ball on a separate tea paper cup, and place it between the Earth and the Sun. Move the Moon ball closer to the Earth, directly in line with the Sun and the Earth.
4. Create the Eclipse Effect: Slowly move the small ball (the Moon) directly in front of the Earth, blocking the light from the torch

(the Sun). This will simulate the solar eclipse. The area on the Earth, that is directly behind the Moon will be in shadow, just like during a real solar eclipse.

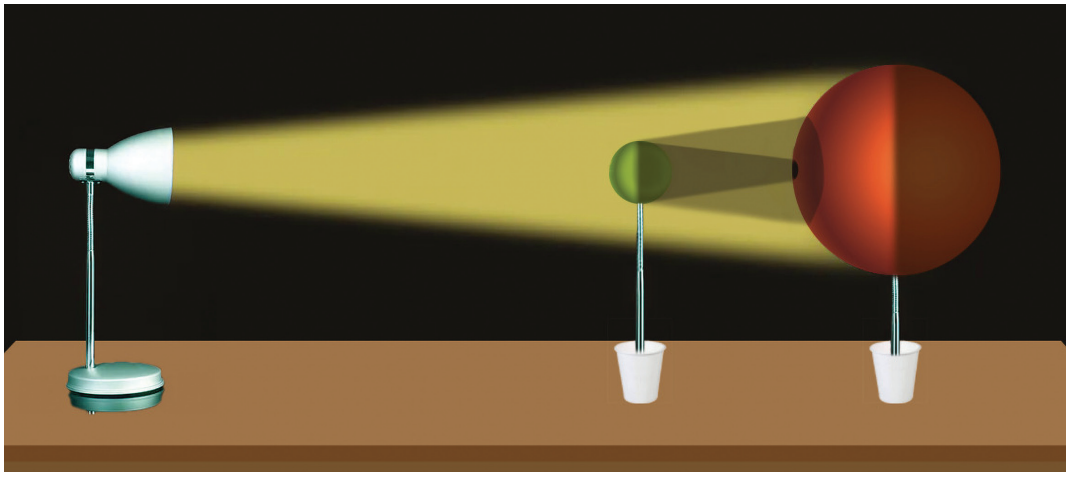


Fig. 36: Setup for demonstrating Solar and Lunar eclipses

For Lunar Eclipse

1. Position the torch: Keep the torch in the same position to represent the Sun.
2. Position the Earth: Keep the larger plastic ball (the Earth) in the same place as in the solar eclipse.
3. Position the Moon: Move the smaller plastic ball (the Moon) behind the Earth, so that it is in the Earth's shadow. The Earth will block the light from the torch and the Moon will be in the shadow, simulating a lunar eclipse.
4. Observe the effect: As the Moon passes through the Earth's shadow, it should gradually darken, just like during a lunar eclipse.

Assessment and Reflection

Assessment Rubric

- **Observation:** Can the student identify stars, constellations, or Solar System components?
- **Pattern Recognition:** Does the student connect stars into recognisable constellations and explain their significance?
- **Inquiry:** Does the student ask relevant and thought-provoking questions?

Reflection Activity

- Students may write a poem, story, or reflective essay about the night sky, solar system, or universe, integrating scientific knowledge with personal impressions.

Extensions

- Organise a field trip to a planetarium or an observatory, incorporating a guided tour and telescope viewing.
- Host a night sky observation session using telescopes, binoculars, or apps.
- Include discussions on space exploration missions, such as Chandrayaan–3 or the James Webb Space Telescope, linking historical and modern discoveries.

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING