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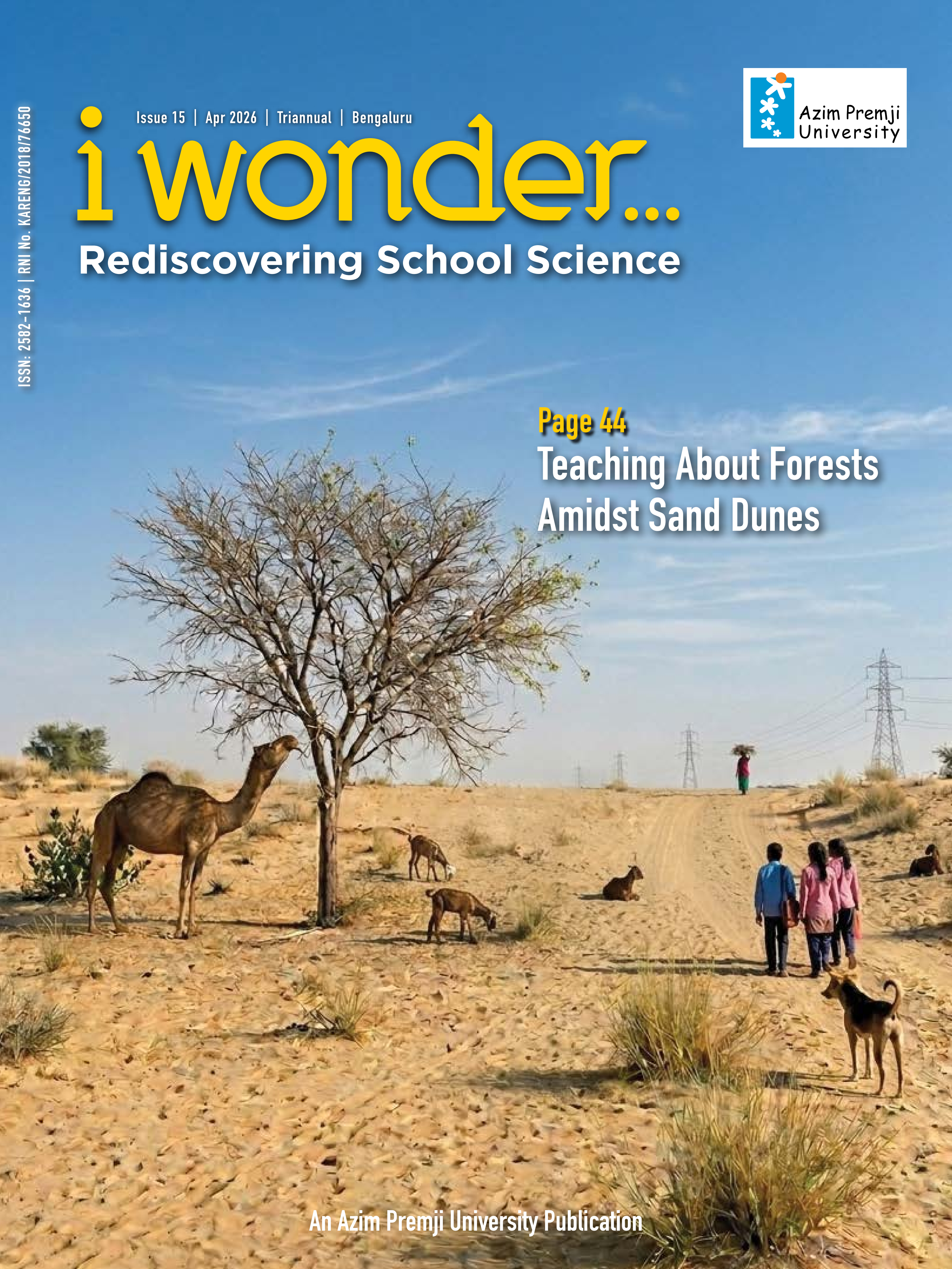
Azim Premji University

i wonder...

Rediscovering School Science



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Teaching About Forests Amidst Sand Dunes

An Azim Premji University Publication

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About us: i wonder... is an Azim Premji University publication focused on preparatory-stage (Grades III–V) EVS and middle-stage (Grades VI–VIII) science teaching. Our aim is to publish articles and resources (such as activity sheets, teacher's guides, posters, and field guides) that support classroom instruction in government schools. We present critical perspectives and pedagogical approaches aligned with the broader curricular goals and competencies recommended by the National Curriculum Framework for School Education (NCF-SE) 2023.

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i wonder...
REDISCOVERING SCHOOL SCIENCE

Editorial

Welcome to the April 2026 issue of i wonder… In this issue, we focus on the relationship between the teacher and the textbook. Why does this matter? As NCF 2005 recognises, *"for a great majority of school-going children… [the textbook] is the only accessible and affordable resource for education."* Based on this, the Framework stresses that textbooks be designed to promote equity, include diverse experiences, and value local knowledge. As teachers, we recognise that textbooks can play an important role in linking students across contexts and geographies through a shared national curriculum. At the same time, we know from experience that a book—no matter how relevant and well-designed—is static. While it provides the foundation for classroom instruction, words on a printed page only come alive in teaching-learning experiences that bridge the gap between abstract concepts and tangible, real-world experience. The student needs to be able to see themselves in what they learn, and see what they learn in how they make meaning of the world they are part of. When this begins to happen in the classroom, learning moves naturally and spontaneously from memorisation to understanding. It is this tacit knowledge that grounds most of our teaching practice and is acknowledged in NCF 2005: *"Good science education is true to the child, true to life, and true to science."* Seen from this perspective, the teacher's role becomes central to learning. In mapping a topic, they interpret the textbook through the national curriculum. As NCF-SE 2023 emphasises, 'curriculum' is more than subject content—it includes the *"…overall goals, plans, arrangements, and practices that shape the experiences of students,"* as well as *"aspects such as school environment and culture."* In planning their approach, the teacher adapts questions, examples, and activities to the local geography and social context of the children who are at the heart of it. In translating a lesson, they acknowledge, listen to, and develop a personal and supportive relationship with each child. In this way, classroom instruction becomes a reflective practice of bringing these different forms of understanding together.

This issue presents three examples of such practice around 'Teaching about Forests'. Each recognises that students can fully grasp a forest's complex web of relationships only by direct observation. Rich textbook descriptions provide detail, but experiencing a forest—or any local ecosystem—engages students' senses, invites curiosity, and allows them to notice patterns and interactions that words alone cannot convey. **Lokesh Dasila** invites us to examine **what we teach** by using curricular criteria from NCF 2005 to assess the national scope of an EVS chapter. By identifying how it can be grounded in Uttarakhand's long cultural history of struggle for forest rights, he shows how curricular aims can help students develop a broader sense of belonging. **Nachiket Sandeep Shirude** encourages us to explore **how we teach** by expanding what students recognise as forests. By drawing attention to the ecological richness of community-managed orans of Rajasthan, he underlines the need to help students appreciate the vital 'lifelines' that exist in landscapes in their own backyard. **Priti David** urges us to consider **why we teach** by looking at the human and social consequences of iconic conservation models. By revealing their competing needs and uneven consequences, she highlights the importance of helping children navigate real-world complexities while learning to think and feel for others. Taken together, these stories remind us that teaching about the environment is rarely just about facts. By connecting our teaching to the histories, landscapes, and people around us, we help our students move beyond the pages of a textbook and into a deeper, more empathetic relationship with the world they inherit. How do you bring the textbook to life in your classroom? Do share your stories, reflections, and examples with us.

Chitra Ravi
Chief Editor

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INTRODUCING THE HUMAN HEART: FROM DIAGRAM TO EXPERIENCE

VISHWANATH GURUBHIM KULKARNI

The textbook introduces the human heart and its role in circulation through a diagram. How might structured play help students connect what they read to their own bodies?

Students are introduced to the role of the heart in circulation in Chapter 9 ('Life Processes in Animals') of the Grade VII science textbook (NCERT, Reprint 2026-2027): "*Our body has a unique system for the transport of nutrients, oxygen, and other substances. This system is called the circulatory system. It includes the heart, blood, and blood vessels. The heart pumps blood through blood vessels, ensuring the transport of nutrients, oxygen, and other substances to all parts of the body, while waste products are carried away.*"[1] Chapter 7 ('Transportation in Animals and Plants') of the Grade VII science textbook (NCERT, Reprint 2024-2025) elaborates on this role through a labelled diagram of the human heart. Students are asked to trace the arrows showing the direction of blood flow—from the heart to the lungs and back, and then to the rest of the body.[2]

While students may engage in this exercise, the sequence of chambers and vessels can feel like names to remember rather than a process to understand. I remembered when I was a student in the seventh grade and my science teacher explained the working of the frog's heart. That

Box 1. What is the 5E method?

This is a teaching approach that is especially useful in science. It gives students opportunities to question, observe, discuss, and apply ideas—all of which are important for science learning. Instead of beginning with explanation, the lesson moves through five connected stages:

1. **Engage:** Capture students' interest and curiosity. Use these to draw out the ideas and prior knowledge they already have about the topic.
2. **Explore:** Allow students to investigate, observe, or experience the concept in a concrete and hands-on way before formal explanations are introduced.
3. **Explain:** Invite students to share what they noticed during exploration. The teacher then introduces scientific terms, concepts, and explanations to clarify and organise their understanding.
4. **Elaborate:** Extend understanding by applying the concept in new situations, activities, or examples. This helps strengthen and deepen learning.
5. **Evaluate:** Check students' understanding through discussion, reflection, questioning, or simple assessments. Evaluation can happen throughout the lesson, not only at the end.

This approach helps students connect new ideas to what they already know and build concepts step by step. Because students actively participate in the learning process, their understanding is often clearer and more lasting.[3, 4]

lesson has stayed with me even today. I wanted my lesson on the human heart to remain with my students just as strongly. I felt that if students learned through play, they would both enjoy it and remember it for longer. To structure this play, I decided to use the 5E method (see **Box 1**).

In the classroom

First, I engaged the students by asking them what they already knew about the heart and blood circulation (see **Teacher's Guide**). Many of them said that the heart is related to feelings and emotions.

I then showed them a model of the human heart and explained its structure, pointing to the four chambers—right atrium, right ventricle, left atrium, and left ventricle. Some students tried to draw the structure of the heart by looking at the model. I also showed them an animated video of blood circulation. Many students looked fully engaged in the video, and I felt satisfied seeing their interest. But I wondered—are all the children equally involved? Watching and listening are not the same as participating. I realised that explanation alone was not enough. Students needed to experience circulation as a process. So I decided to turn the classroom into a giant heart.

With the help of chalk, I drew a large heart diagram on the classroom floor, clearly marking the four chambers and the major blood vessels (see **Fig. 1**). The students stood around it. I told them, *"Now I will become blood and travel through the heart."*

I entered the right atrium through the vena cava. From the right atrium, I moved into the right ventricle. From there, I went to the lungs through the pulmonary artery. I explained that the blood is deoxygenated at this stage. To make this visible, I hopped on one foot to represent deoxygenated blood. When I reached the lungs, I said, *"Here, deoxygenated blood becomes oxygenated blood."* Then I switched to walking on both feet to represent oxygenated blood. From the lungs, I returned to the left atrium through the pulmonary vein. From the left atrium, I moved into the left ventricle. Finally, I travelled to all parts of the body through the aorta. Here is the sequence: Vena cava → Right atrium → Right ventricle → Pulmonary artery → Lungs → Pulmonary vein → Left atrium → Left ventricle → Aorta → Body.

The students watched carefully. Then I invited the students to play the role of blood, calling out the names of the chambers and blood vessels aloud as they moved. What made me especially happy was

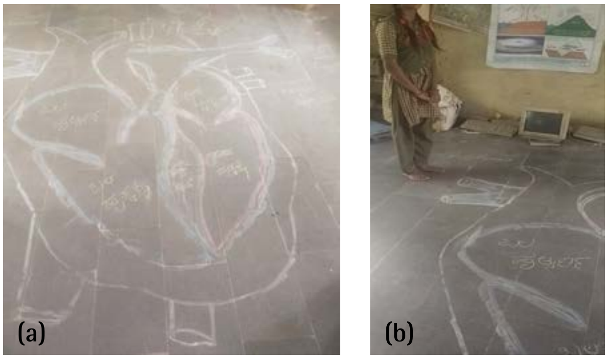

Fig. 1. Using classroom space to give students an embodied experience of circulation. (a) A large diagram of the heart drawn on the classroom floor showing its chambers and major blood vessels. **(b)** Students move through the diagram to represent the pathway of blood through the heart.

Credits: Vishwanath Gurubhim Kulkarni. License:

that every student wanted to participate. Through this activity, they began to speak more confidently about the process of blood circulation.

At one point, a student said, *"Sir, we say that emotions are in the heart. But here there are no emotions—only blood!"* This led to an important discussion. I explained that the heart is often represented as the source of feelings in poems and stories. But, scientifically, emotions are controlled by the brain. The heart's main function is to pump blood throughout the body.

Next, students played in groups of five. A student stood inside each chamber of the heart drawn on the floor. The fifth student would say, *"I am blood, I will come to your position,"* and move into the chamber. The student standing there would guide the 'blood' to the next correct chamber or blood vessel, pushing it forward in the correct sequence. In their excitement of playing the game, the students did not realise that they were recapitulating what they had learnt. They repeated the names of the chambers, explained the direction of blood flow, and corrected one another when someone made a mistake.

As the game was ending, the bell rang. The mid-day meal was waiting for us. We walked out of the classroom together, still talking about the heart and laughing about who had been the best 'blood' in the game. I felt that perhaps this lesson would remain in my students' memory—just as my teacher's lesson has remained in mine (see **Box 2**).

Parting thoughts

When I first planned this lesson on circulation, I wanted my students to remember it. While the textbook includes information on the circulatory system, this is not something students can see directly. The 5E strategy can help make abstract concepts more concrete by encouraging active learning. So I used this strategy to plan the lesson in a sequence that would make this invisible process clearer to students in small steps.

In the first step, students were introduced to the diagram in the textbook. But when students look at a diagram alone, they can think of the heart

Box 2. Curricular connections:

Discussions and activities around the structure of the heart and the movement of blood through it can help teachers meet the following:

A) Curricular goal for middle-stage science:

- CG-7: [The student] communicates questions, observations, and conclusions related to science. Specifically, this lesson can help students develop the competency (C-7.1) to: *"Use scientific vocabulary to communicate science accurately in oral and written form, and through visual representation."*[5]

B) Learning objectives for middle-stage students:

- Describe the location and function of the heart in relation to blood circulation in the body.
- Analyse the implications of [the] intermixing of oxygenated and deoxygenated blood in order to explain the existence of four chambers in the heart.[6]

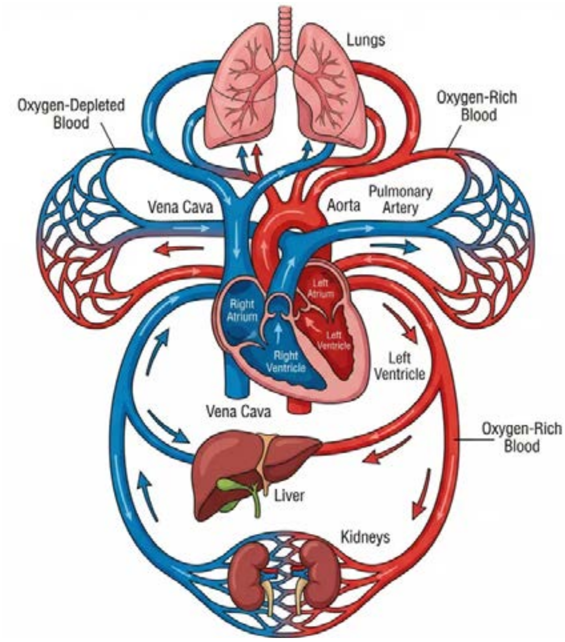

Fig. 2. Understanding the role of the heart in the circulatory system.

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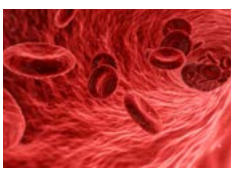
only as arrows and labels (see **Fig. 2**). In the next step, I introduced them to a model of the heart. Before learning how blood moves, students need to see where it moves. The model helped them see that the heart is not flat like a picture in the book. They could observe its shape and structure more clearly. Not only could they identify the four chambers, but they were also able to notice how these were arranged in relation to one another. This helped move their understanding from a textbook image to something that feels like a real organ inside the body. Building on this, we watched an animated video on blood circulation. This allowed students to see the continuous movement of blood from one chamber to another, and from the heart to different parts of the body and back again. They could observe the direction of flow and notice how oxygenated and deoxygenated blood follow different pathways. This helped shift their understanding from the separate parts of the heart model to how these parts worked together.

After this, I drew a giant heart on the floor. This made the process of circulation more visible and active. When I demonstrated the flow of blood by moving through the chambers, students could observe the sequence step by step. Hopping on one foot to show deoxygenated blood and using both feet for oxygenated blood allowed students to more directly relate to the specific pathways followed by the different kinds of blood. When students themselves became 'blood' and moved through the heart, they did more than watch—they experienced the sequence. The classroom became the heart, and they stood inside its chambers. As they walked through the chambers and said the names aloud, the process became clearer. They began to relate to circulation as continuous movement and transport within their own bodies.[7] The group activity further strengthened their understanding through discussion and peer learning. One student became blood, and others directed the flow. If someone made a mistake, others corrected it. Students had to think carefully about where the blood should go next. In addition to physical experience, they needed to apply reasoning. Students explained the pathway in their own words. This built their confidence, helped them check their understanding, and learn from one another. The activity on the floor did not remain a game; it became a way for students to apply, repeat, and check their understanding together. In this way, structure and play worked together.

This approach gave every student a chance to participate in the lesson, not only those who are confident in speaking or writing. It also reminded me that when students experience a scientific idea physically and socially, understanding becomes stronger. And when understanding becomes stronger, learning is more likely to stay with students over time.

Key takeaways



- Students are introduced to the structure of the heart and its role in circulation through a textbook diagram. While the diagram presents key labels and basic structure, it can make a complex system appear flat and static.
- Allowing students to handle a model of the heart helps them observe its shape and internal structure more closely. Seeing the four chambers and their arrangement supports understanding of the heart as a three-dimensional organ with organised parts.
- Showing an animated video of blood circulation helps students visualise movement within the heart. They can observe direction, sequence, and the difference between oxygenated and deoxygenated blood.
- Demonstrating blood flow through a large floor model makes the sequence of circulation visible. Using different movements to represent oxygenated and deoxygenated blood helps students distinguish between the two pathways.
- Inviting students to enact blood flow strengthens conceptual understanding. Moving through the chambers and saying the names aloud helps them internalise the sequence and connect structure with function.
- Organising group activities where students guide and correct one another promotes reasoning and peer learning. Explaining the pathway and identifying mistakes helps them see circulation as a connected system rather than separate parts.
- Designing activities in which all students participate builds engagement and confidence. Embodied and collaborative tasks allow every student to contribute.
- Observing students during enactment and discussion supports informal assessment. Their movements, explanations, and corrections reveal their level of understanding.

Notes:

(a) Credits for the image (Blood flow) used in the background of the article title: qimono, Pixabay. URL: https://pixabay.com/illustrations/cells-red-medical-medicine-anatomy-1813410/. License: CC0 1. 0 Universal Deed.

(b) This article includes one classroom resource: **Teacher's Guide: Thinking About the Human Heart.**

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DID YOU KNOW?

WHAT 'STOPPING' TEACHES US ABOUT BIRDS

What inspired Neharika D, a Grade VII student from Bela village in Kasaragod, Kerala, to publish a 45-page guide titled 'Birds–The Hidden World in Our Campus?' Her journey began with a Grade IV EVS lesson and a birdwatching session with ornithologist and teacher Raju Kidoor.[1, 2] While she started by observing a few familiar species, she soon realized her campus was *"full of birds... hiding, singing, feeding, playing... things we don't see unless we stop."*[1] Her book documents a full year of observations (November 2024 to October 2025), tracking how bird activity shifts with the seasons. Through this systematic approach, Neharika learned how weather and human activity influence bird behavior, while gaining a vital scientific skill: *"patience, the art of waiting without expecting."*[1]

NCERT science textbooks for the preparatory and middle stages already include activities to observe neighborhood birds. But how can students use these to build scientific capacities or document interdependencies between birds, humans, and the environment? In our December 2025 issue, Adithi Muralidhar and Anand Krishnan share how birdwatching without special equipment can give students practical experience of the scientific process.[3] An accompanying activity sheet and student handout help learners make detailed observations and document behaviors with care.[4, 5] A teacher's guide further suggests ways to deepen this learning—by helping students compare data, identify patterns, and create illustrated resources.[6] Encouraging such explorations helps students appreciate the ecological role of birds and *"re-establish our fading connection with the natural world."*[3] Have you invited your students to observe and document the birdlife in and around your school? What did they learn from this experience? Share your story with us.

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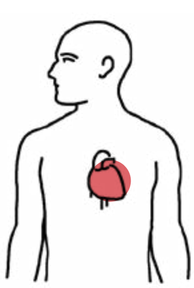
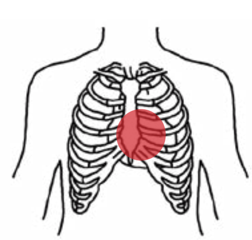
Experiences

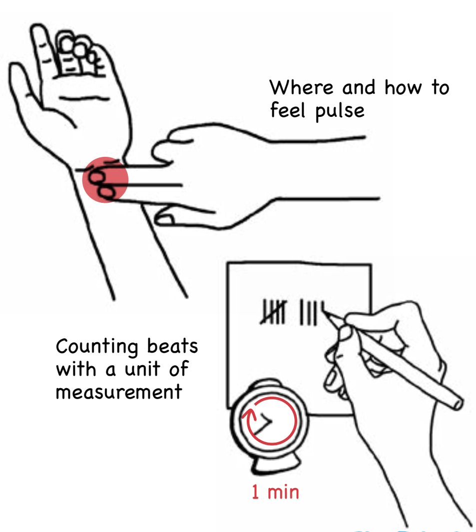
TEACHER'S GUIDE: THINKING ABOUT THE HUMAN HEART

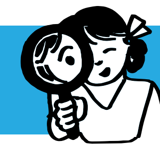
This guide is designed to support classroom discussion on the human heart. It presents a set of facts along with 1-3 related prompts that can help students observe, reason, and connect ideas to their own bodies. You may choose to use a few selected facts rather than all of them in a single class. Encourage students to think about each of the prompts in pairs and respond in their own words. It may be useful to tell them that the focus of this exercise is less on finding correct answers and more on thinking about and explaining their ideas. Their responses can be used to guide a wider classroom discussion. Where possible, invite them to use their bodies or immediate surroundings. This could include, for example, identifying the location of their heart, feeling their pulse, and measuring volume.

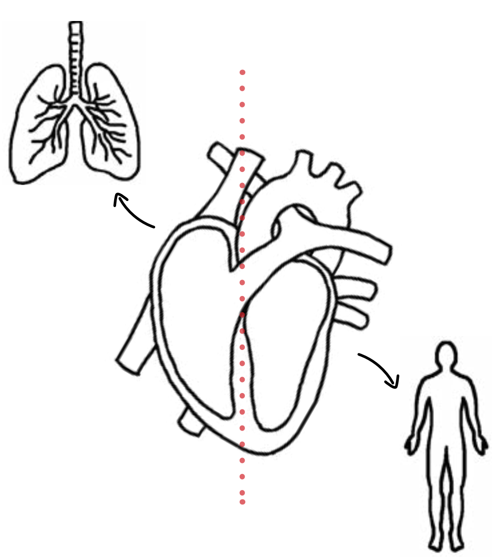
Since the functioning of the human heart may not be covered in detail in the textbook, teachers may first need to briefly introduce the idea of how the heart works, or connect it to related concepts such as respiration. Teachers may use simple charts, diagrams, or short videos to support this introduction before or during the activity.

S. No.	Facts	Possible prompts
1	**Location:** The heart is in the middle of the chest, slightly to the left, behind the breastbone. It is also slightly tilted to the left. 	• Where do you think your heart is located? Place your hand on your chest to indicate its position. • How did you decide the location of your heart—did you use what you have just learnt, something you have seen before, or your heartbeat? • Try to feel your heartbeat. Where does it feel strongest? Does this match what you expected?
2	**Protection:** Your ribs protect your heart. 	• Feel your ribs. Where is your heart in relation to them? • Gently press your chest. Now press your cheek, your belly, and your knee one by one. Do you notice any differences in how soft or hard each area feels? • Does the heart need such strong protection? Why?

TEACHER'S GUIDE

S. No.	Facts	Possible prompts 
3	**Size:** An adult heart is about the size of two hands clasped together. A child's heart is about the size of a single fist.	• Make a fist and place it against your chest. Does this seem like a reasonable size for your heart? Why or why not? What other everyday things can you think of that are this size?
4	**Weight:** The actual weight of a person's heart depends on factors such as body size, sex, age, physical activity level, and overall health. On average, an adult heart weighs about 200–425 g. A middle-school student's heart weighs roughly 150–300 g and continues to grow as the body grows.	• Pick up or think of an object (for example, a book, pencil box, or water bottle) that weighs as much as your heart? • How does the weight of your heart compare with the weight of your body? Does this surprise you? Why?
5	**Energy:** The heart uses a huge amount of energy each day. This amount would help move a truck about 30–32 km.	• Think of a place about 30 km away. Does this seem like a short or long distance to you? • What does this comparison help you imagine about how much work the heart is doing? • From where do you think the heart gets the energy it needs to keep working? • What might the heart use this much energy for?
6	**Heart rate:** An adult heart beats about 60-100 times per minute. The average heart rate (beats per minute) is around 80 beats per minute. This can vary from person to person and with activity (for example, during physical work or running). 	• Find your pulse. Count how many times **your** heart beats in one minute. Is this number within the average range? • Does your heart rate change through the day? Can you think of some factors that may make it faster or slower (for example, movement, rest, emotions)? How would you test this? • How do you think your heart rate would compare with that of your classmates? Do you expect any differences and why? • Now, really compare your actual heart rate with that of your classmates. Did it match what you had predicted? Why?



S. No.	Facts	Possible prompts
7	**Variations in heart rate:** Your heart beats more slowly when you sleep than when you are awake.	• Think about how your body feels when you are resting or asleep. What do you think changes about it at this time? • Why might the body need less work from the heart during sleep? • What do you think might happen if the heart did not slow down during sleep? • Contrast this with times when your heart beats faster. Can you record such instances?
8	**Work:** The heart pumps about 70 mL of blood with each beat.	• Each heartbeat pumps about 70 mL of blood. Use your heart rate to calculate how much blood **your** heart pumps in one minute. Now extend this to estimate how much blood it pumps in a day. • What might these numbers tell you about how much work your heart does each day? Does this change how you think about your heart? Why?
9	**Structure:** Your heart has four chambers. But they are not all the same size.	• Look at a model or diagram of the human heart. Which parts look bigger than the others? • Why might some chambers need to be larger than the others? Can you guess their function?
10	**Function:** The right side of the heart sends blood to the lungs. The left side sends blood to the rest of the body. 	• Why do you think the heart is divided into two sides? Why might it be useful to keep these pathways separate? • Which side of the heart do you think has to work harder? Why? • The wall of one side of the heart is thicker than that of the other. Can you predict which side would be thicker and why? • Do you think there might be a difference in the kind of blood that is pumped by different sides of the heart? Why?

S. No.	Facts	Possible prompts
11	**Blood vessels:** Your body has a vast network of blood vessels. If all of them were joined end to end, their total length would be about 96,000 km. This length is twice the distance around the Earth at the equator.	• Use a measuring tape or scale to measure the distance from the centre of your chest to your fingertip or toe. How far apart are the two? • How does this length compare with the length of blood vessels? Why might blood need to travel such long distances in the body? • What might happen if this network were shorter or broken? How would it affect the body?

As students engage in pairs with these prompts, their responses may vary in accuracy and detail. It may be helpful to remind them that the focus is on how they use observation, measurement, and reasoning to make sense of their ideas. Their explanations, drawings, and comparisons can reveal how they are thinking about the heart—its structure, its work, and its connection to the rest of the body. Pair work can end with an invitation to students to share their responses to questions such as: *Which of these facts surprised you the most? Do you notice any connections between them? What would you like to understand better about your heart? What new questions do you have about how it works?* Class discussion can be used to refine and extend student understanding as well as to explore their questions.

Acknowledgements:
The author thanks Sushil Joshi and Hridaykant Dewan for their detailed feedback on an earlier version of this resource. They also thank Saurav Shome and Amol Anandrao Kate for their suggestions on this version.

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TEACHING SOIL: LISTENING TO STUDENTS' VOICES

SANTOSH KUMAR

Textbooks often introduce soil mainly as an abiotic component with a role in growing food, but students may bring a wider range of knowledge and experiences to the classroom. How can these shape the design of instruction?

According to the National Curriculum Framework for School Education (NCF-SE) 2023, *"Concepts by themselves are abstract. They need to be presented to students through content that helps them connect the concept with their previous knowledge as well as with their observations and experiences in the real world."*[1] One example of this is seen in Chapter 13 ('Our Home: Earth, a Unique Life-Sustaining Planet') of the Grade VIII science textbook (NCERT, 2026-2027), where students learn that *"soil may look like simple dirt, but it is rich in nutrients like nitrogen and potassium that plants need to grow."*[2] While these lines introduce soil in terms of its importance in supporting plant life, they may not connect to how students understand or relate to soil. For example, for many of us, one of the earliest memories of soil is a sensory one—that of playing with mud as children, where touch, smell, and even taste (yes, definitely) was involved. With increasing urbanisation, this experience may have changed, and there may be a growing alienation of children from nature. Many children from both urban and rural backgrounds may, therefore, find it harder to relate to soil as an entity that supports a range of life forms, including humans. How do we draw out their experiences and knowledge in the classroom? The NCF-SE 2023 highlights the importance of this process by suggesting that the pedagogy used in the middle stage should: *"Build on prior knowledge..."* and that content should be: *"connected to the students' lives and surroundings to the maximum possible extent. A student in Andaman and Nicobar Islands and a student in Jharkhand will observe different kinds of plants and animals around them."*[1] To probe students' prior understanding, I decided to initiate a dialogue on soil.

A dialogue with students

I invited two groups of Grade VII–VIII students to this dialogue. One group consisted of students from a predominantly urban background, studying in a residential school located in a rural area. The other group consisted of students from a rural background (a community of small farmers, pastoralists, potters, blacksmiths, and landless labourers), who were day scholars in a local private school. These were the questions I asked them:

(a) What feelings do you associate with soil? Here are some of their sensory experiences in their own words: *"Playing with soil brings a lot of joy..."*, *"Seeing crops grow is an enjoyable experience..."*, *"It is fun to make idols of gods and other toys with clay and mud and to play with them..."*, and, *"Farming and working with soil"* is *"soothing'*, *"satisfying"*, and *"fulfilling..."*.

(b) What is your first impression of soil? Students from urban communities mainly associated soil with textbook concepts such as fertility, earthworms, crops, agricultural fields, minerals, the water table, and pollution. Some students were unexpectedly lyrical. One of them was reminded of a Kabir composition, *"Maati kahe kumhar ko..."* Another student thought of a Hindi film song, *"Mere desh ki dharti sona ugle..."*.

For students from rural communities, the word soil conjured up the idea of diversity. They described the different kinds of soil in the area using the local Telugu dialect: black cotton soil (*nalla regada matti*), red soil (*yerra matti*), and so on. Soil, to them, also meant microorganisms, earthworms, insects, farmyard manure, dry leaves, cow dung, sheep droppings, etc. Many of them were reminded of the *"sweet smell"* of soil that accompanies the first spell of rain (known as *tulakari* in Telugu), during or at the end of the hot summer months. For most of them, their mental associations with soil were dominated by a wide range of issues related to fertility and crop production.

(c) What do you know about soil? What experiences shape this knowledge? Rural students seemed to have a very natural relationship with soil. Their understanding and knowledge came mainly from observing and participating in farming-related activities at home. For example, in Chapter 11 ('Nature's Treasures') of the Grade VI science textbook (NCERT, Reprint 2026-2027), students read that they are different types of soils, some of which *"...are good for growing certain types of plants while some are good for making bricks for buildings."*[3] Rural students knew which types of soil supported the growth of specific locally cultivated crops (for example, groundnut, tomato, red gram, and field bean). They were also able to describe how the soil near water bodies was different from that on the hills where they took their cattle to graze. They could identify the kinds of soil used for pottery (two of the children are from a village with many potters), building houses, or making bricks. Some also spoke about what they had learnt from conversations with their parents, grandparents, and other family members. At school, they said they had mainly learnt about soil through experiments. Some of them were also involved in a little bit of gardening. This included growing vegetables using wastewater from the school kitchen. However, it was clear that a significant part of their learning came from personal and practical experiences at home. In fact, this understanding of soil seemed to support their classroom learning.

In contrast, children from urban communities learnt most of what they knew about soil in school. Only two of these students mentioned having some exposure to soil at home as well.

One of these students mentioned that their grandparents lived on an agricultural university campus. The other student indicated that they came from Uttarakhand, where they had some exposure to soil through their home environment. Most of what they knew about soil came from science and social science classes, which provided several opportunities to learn about it both in theory and through outdoor experiences. These included activities such as gardening, fieldwork, planting trees, creating bunds to store water, and conversations with farmers during school visits. Many of the students were familiar with the concept of soil ecosystems and differences in soil types, such as alluvial, black, loamy, and sandy soils. Some of them were capable of strongly articulating the importance of soil—referring to its capacity to support diverse flora and fauna, or correlating soil health with human health. These students recognised that an area's agroclimatic conditions could support only certain kinds of agriculture and were able to discuss the impact of human activities on soil quality. Some of them were able to discuss the adverse impacts of monocropping on soil quality. Clearly, their theoretical understanding of soil was quite sound. However, it was difficult to assess the extent to which these students connected this understanding to their own lives, including what they ate and their own health.

(d) What do you want to learn about soil? The discussion on what they knew about soil spilt over into students expressing a desire to learn more about it. In terms of what they would like to learn about soil, there were many similarities between the two groups of students. For example, all of them wanted to learn about sustainable methods to grow food and improve soil fertility. Many students expressed strong interest in creating a 'soil atlas' that would illustrate the various kinds of soils found across the country, while also providing details like which soils are suitable for which crops. Another area that was of interest to many students was learning about the use of chemical fertilisers and pesticides and their impacts on soil ecology, groundwater aquifers, and human health. Specifically, students wanted to know the impacts of soil erosion and degradation on human society and the measures that could be taken to reduce this.

Some students from urban communities were interested in the history of agriculture, traditional cropping practices, and the impacts of the Green Revolution. They were also keen to learn more about the festivals, songs, and dances associated with sowing, cultivation, harvesting, etc. In contrast, students from the rural community were eager to learn more about microirrigation systems and crops that could be used by both humans and animals. This may have been because they lived in a drought-prone, semi-arid landscape and were constantly facing water scarcity. Another area of special interest to them was learning about the different kinds of mud that could be used in construction techniques and pottery. Although many of these students celebrated local harvest festivals themselves, they were as keen as students from urban communities to know more about

Box 1. Curricular connections:

Such discussions with students and the pedagogical approaches they inform can help meet the following:

A) Curricular goal for middle-stage science: CG-3: [The student] explores the living world in scientific terms. Specifically, it can help students develop the competency (C-3.3) to: *"Analyse patterns of relationships between living organisms and their environments in terms of dependence on and response to each other."*[1]

B) Learning outcomes (LO) for:

- Grade VII science: [The student] makes efforts to protect the environment. For example, ...by planting trees to avoid soil erosion; sensitising others with the consequences of excessive consumption of natural resources, etc.
- Grade VIII social science: [The student] justifies judicious use of natural resources such as water, soil, forest, etc. to maintain development in all areas.[4]

Fig. 1. Hands-on activities can be used to anchor students' conceptual learning in experience. Involving students in activities like gardening or the cultivation of vegetables in schools can help inculcate a sense of respect for hands-on work and for farming as a way of life.

them, especially since many of these practices were rapidly disappearing from their own communities.

Parting thoughts

This interaction with students turned out to be an enriching learning opportunity for me. I was touched by the enthusiasm with which they expressed their ideas. Their responses underlined the importance of context—revealing differences not only in students' exposure to soil, but also in how they connected school knowledge with their everyday lives (see the **Activity Sheet**). The dialogue also made me reconsider how soil is typically presented in textbooks—largely only as an abiotic component of ecosystems that plays a role in growing food. However, the dialogue with my students—from both urban and rural communities—showed that they viewed soil as a versatile, vibrant, and multifunctional system that supports life (see **Box 1**). Students also expressed eagerness to learn about multiple dimensions of soil—especially those related to traditional and community practices. This suggested a need to expand how soil is approached in the classroom—both in terms of what is taught and how.

Based on how I used this dialogue to design classroom instruction, here are some suggestions for other teachers: Instead of beginning with definitions, students could be encouraged to identify local poems and songs about soil, mud, and earth in various languages, taking the help of elders in their family or community, and sharing these in class. Teachers could also ask children, *"Where does your food come from?"* and work with them to trace the journey of food from seed, soil, manure or compost, and field or farm to their table to answer this question. Visits to a neighbouring farm can provide opportunities for students to interact with farmers and learn from their experiential knowledge of soil. Visiting a soil-testing lab or inviting technicians or scientists from such labs to school can help students consider how scientific techniques can support experiential knowledge. Their understanding can then be strengthened through hands-on activities like the cultivation of vegetables or gardening, pottery, and composting (see **Fig. 1**). Not only do such activities make classroom learning livelier and more interactive, but they can also help inculcate a sense of respect for hands-on work and for farming as a way of life. By powerfully engaging students' senses, they can also support the building of stronger connections to the theoretical concepts covered in the science or social science curriculum. This led me to reflect more seriously, and with renewed vigour, on our connection with soil, and reminded me, yet again, that the teacher is a learner too.

Key takeaways

- Students come to the classroom with diverse experiences of soil—sensory, cultural, and livelihood-related. Open dialogue can help draw out their prior learning in class.
- Students may differ not only in what they know about soil, but in whether this knowledge comes from lived experience or from formal instruction. Recognising this can help teachers respond more effectively to their learning needs.
- Activities such as farming/gardening and composting as well as interactions with farmers and soil technicians allow students to engage with the different dimensions of soil. Rather than being treated as add-ons, these activities can help teachers build stronger connections between experiential and theoretical understanding.

Acknowledgements: The author would like to convey their thanks to Radha Gopalan, a friend and former colleague, without whose guidance and support this article would not have been possible.

Notes:

(a) Credits for the image (Working with soil) used in the background of the article title: Santosh Kumar. License: CC BY-NC-ND 4.0 International Deed.

(b) This article includes one classroom resource: **Activity Sheet: Probing Soil Through Your Senses**.

(c) This article was first published in i wonder..., August 2018, pp. 54-57. The original version is available at: https://publications.azimpremjiuniversity.edu.in/2831/. The version published in this issue has been revised by Chitra Ravi to include direct connections to the NCF-SE (2023) and the middle-stage science curriculum.

(d) For more details on Santosh Kumar's approach to teaching soil, see this video: Azim Premji University (2024). 'i wonder... webinar: Soil in the Science Classroom'. YouTube. URL: https://www.youtube.com/watch?v=gnTDGaWWcJg&t=11s. Accessed on March 30, 2026.

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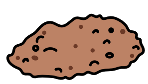
Experiences

ACTIVITY SHEET: PROBING SOIL THROUGH YOUR SENSES

Aim:

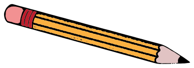
To explore soil through the senses and reflect on your own experiences and understanding of it.

What is needed?


A small sample of soil


A little water


Paper or notebook


Pencil or pen

What to do?

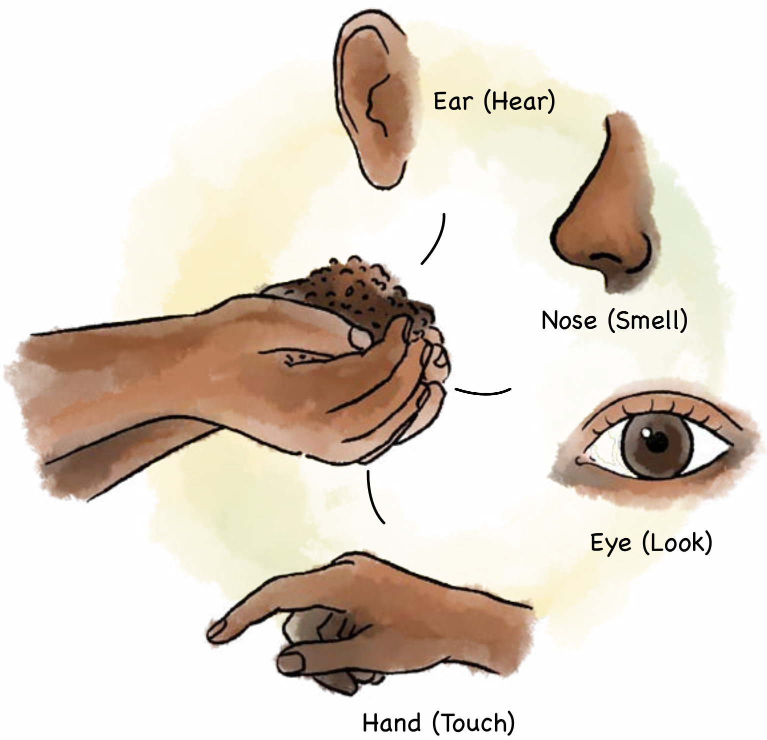
1) **Think**: When you hear the word 'soil', what comes to your mind? You can write words, sentences, or draw.

2) **Explore**: Where can you find a sample that is closest to what you think of as soil? It could be from places such as a garden, the school ground, a field, or the roadside. Where needed, take permission to collect it. Avoid areas near stagnant water or chemicals. Wash your hands after handling soil.

3) **Look**: Notice the colour and texture of the sample. Does it look the same throughout? Are there other things mixed in it? How many of these can you name?

4) **Hear**: Rub or press some of the sample between your fingers. Does it make any sound (for example, gritty, soft, silent)?

5) **Touch**: How does it feel (dry, rough, smooth, sticky, or grainy)? Does it feel cooler or warmer than your hand? Sprinkle a few drops of water on the sample. What changes about it? Does it become sticky? Can you shape it?



6) **Smell**: What does the smell of the sample remind you of? For example, does it smell like wet soil after rain, freshly dug garden soil, a clay pot before it is fired, a damp cloth left in a room, or something else?

Observe and record:

When I hear 'soil', this comes to mind:	
I collected soil from:	
It looked like:	
It felt like:	
It sounded like:	
It smelt like:	
It reminded me of:	

Think about:

Q1. Where have you seen or used soil before (at home, in your neighbourhood, farm, garden, playground, etc.)?

Q2. What do you know about soil from experience? How might the place where you live influence what you know about soil?

Q3. What do you know about soil from textbooks? How does this relate to your experience?

Q4. Did your observations of the sample match what you already knew or have learnt about soil? Did anything surprise you?

Q5. Have you seen soil that is different from the sample? Where? In what ways was it different?

Discuss:

Q1. How is your soil sample similar to or different from the samples collected by your classmates?

Q2. What similarities and differences do you notice in your experiences of soil and those of your classmates?

Q3. What are some questions you have about soil? What are some things you would like to learn about it?

Extend:

A) Interview someone at home or in your community about their relationship with soil. Record the following:

Who did you speak to and why? What do they use soil for?	
What questions did you ask to understand their use or experience of soil in daily life?	
What do they know about soil?	
How did they learn about it?	
What is one special memory they have of soil?	

B) What did you learn from this discussion that you did not know before? How is this similar to or different from what you read in your science textbooks?

Acknowledgements:
The author thanks Sushil Joshi and Amol Anandrao Kate for their suggestions on this resource.

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FOLLOWING PLANT GROWTH IN THE CLASSROOM

HARISH NAUTIYAL

Students from agricultural families are often familiar with growing plants from seeds. What do they observe, understand, and question when they follow this process in the classroom?

Plant growth is an important theme in the preparatory stage EVS curriculum. I decided to teach this theme to students from Grades III–V through an activity that allowed them to observe how plants grow over time. I chose this approach because hands-on activities can be an effective and lively way to engage students' interest at this stage. This would also allow students to observe and discuss this process together.

Observing plant growth

Since many of my students were from farming families, I started the class with a discussion to draw out what they knew about plant growth from everyday experience. Students were aware that plants need water, soil, and sunlight to grow. They could describe how several kinds of local seeds looked and could tell the specific time of the year when each kind of seed was sown. I invited them to bring different kinds of local seeds to class, with one condition: the seeds should be from plants whose growth changes become visible within about 10–15 days. Chapter 5 ('Seeds and Seeds') of the Grade V EVS textbook (NCERT, 2024-2025) poses the following question to students: *"Do*

Fig. 1. Soaking seeds in water before sowing. Students observed that soaked seeds swell up and germinate faster than unsoaked seeds.

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some plants grow without seeds?"[1] My students did not think this was possible. They believed that all plants grow from seeds. I suggested that we try planting stem cuttings of mint (*pudina*) and rose plants and observe how these change over time.

The students collected seeds of plants like wheat, rice, beans, corn (*makka*), kidney beans (*rajma*), and chickpea (*channa*). In Chapter 5 of the Grade V EVS textbook (NCERT, 2024-2025), students learn that *"sprouting time of seeds may vary according to the temperature and humidity of the weather."*[1] At the time of the activity, the weather in the region was quite cold. Since this could slow down the process of germination, we decided to soak some seeds in cold water and others in warm water. Chapter 19 ('Abdul in the Garden') of the Grade IV EVS textbook (NCERT, 2024-2025) suggests the following activity: *"Soak a few seeds (5-6) overnight in a bowl full of water... Did you observe the seedlings come out of the seeds... What difference did you observe in the seeds after soaking? Compare with dry seeds and write."*[2] Students observed that soaked seeds swell up in size and feel softer than unsoaked seeds (see **Fig. 1**). The outer covering of some seeds becomes slightly looser and more wrinkled. Within a couple of days, some of the soaked seeds had begun to germinate. Those soaked in warm water sprouted faster than those soaked in cold water.

In Chapter 5 of the Grade V EVS textbook (NCERT, 2024-2025), students are invited to sow seeds in *"a clay pot or a tin can with a wide mouth"* and observe: *"How long did it take for the plant to come out from the soil?... Did new leaves come out of the plant every day? Was there any change in the stem of the plant?"*[1] We decided to plant the seeds and cuttings in disposable plastic cups. Since they have transparent sides, we would be able to observe root growth below the soil surface. These cups are also easily available and inexpensive. Students attached a label to each cup with the name of the plant. They then made a small hole at the bottom of each cup and filled it with fertile soil from the garden. In

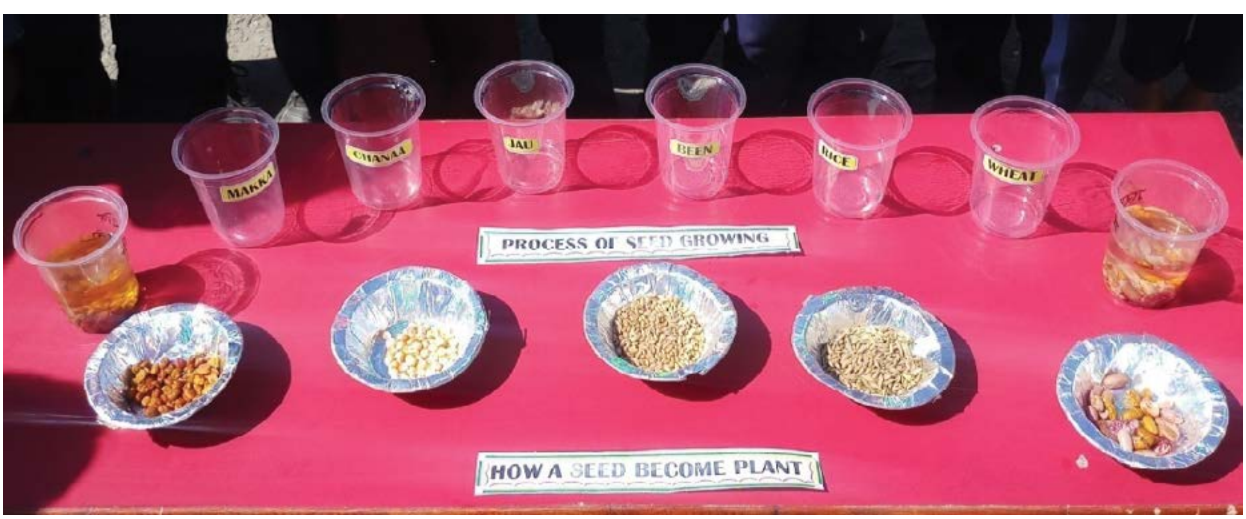

Fig. 2. Sowing seeds in transparent plastic cups. Students labelled each cup, made a small hole at the bottom of it, filled it with soil from the garden, and buried a few seeds of the same kind in it.

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some cups, part of a stem cutting was buried in the soil. In others, 2–3 seeds of the same kind were pressed into the soil (see **Fig. 2**). All the cups were kept in a place with enough light for the plants to grow. For the next 15–20 days, we observed the cups every day. Students recorded that roots became visible along the sides of the cup within 4–5 days. These thin, white, filament-like structures were seen growing downward into the soil. Chapter 19 of the Grade IV EVS textbook (NCERT, 2024-2025) suggests that students grow plants in cotton wool and observe the following: *"In which direction did the roots grow?... What is the colour of the roots? Did you see any hair on the roots? Try and pull out one little plant from the cotton wool. Were you able to pull it out? Why? Did you see how the roots grip the cotton wool? Do you think that the roots hold the soil in the same way?"*[2] We cut open a few of the cups and carefully removed the soil around their roots. Students were able to see how the roots had grown and spread inside the soil. This exercise also allowed students to observe for themselves how roots hold the soil. Within 6–7 days, small green shoots began to appear above the soil.

Students were excited to see seedlings emerging from seeds that had appeared dry and lifeless just a few days earlier. At this stage, we compared the physical features of rice and bean seedlings. Students were able to see how the bean seedlings showed two thick, fleshy seed leaves, while the rice seedling showed one thin, shoot-like blade. I used this clearly visible feature to introduce students to the difference between monocots and dicots. This concept is lightly touched upon in Chapter 3 ('Nature Trail') of the Grade IV EVS textbook (Reprint 2026–27), when students are invited to observe the different colours, textures, and shapes of leaves: *"...did you observe that the leaves also have different types of lines on them? These lines are called veins."*[3] This is followed by images of two different kinds of leaves showing parallel and reticulate venation respectively.[3] Student observations in the preparatory stage can lay the foundation for a more formal understanding of these ideas at later stages. For example, the difference between monocots and dicots is developed in greater detail in Chapter 2 ('Diversity in the Living World') of the Grade VI science textbook (NCERT, Reprint 2026-2027):

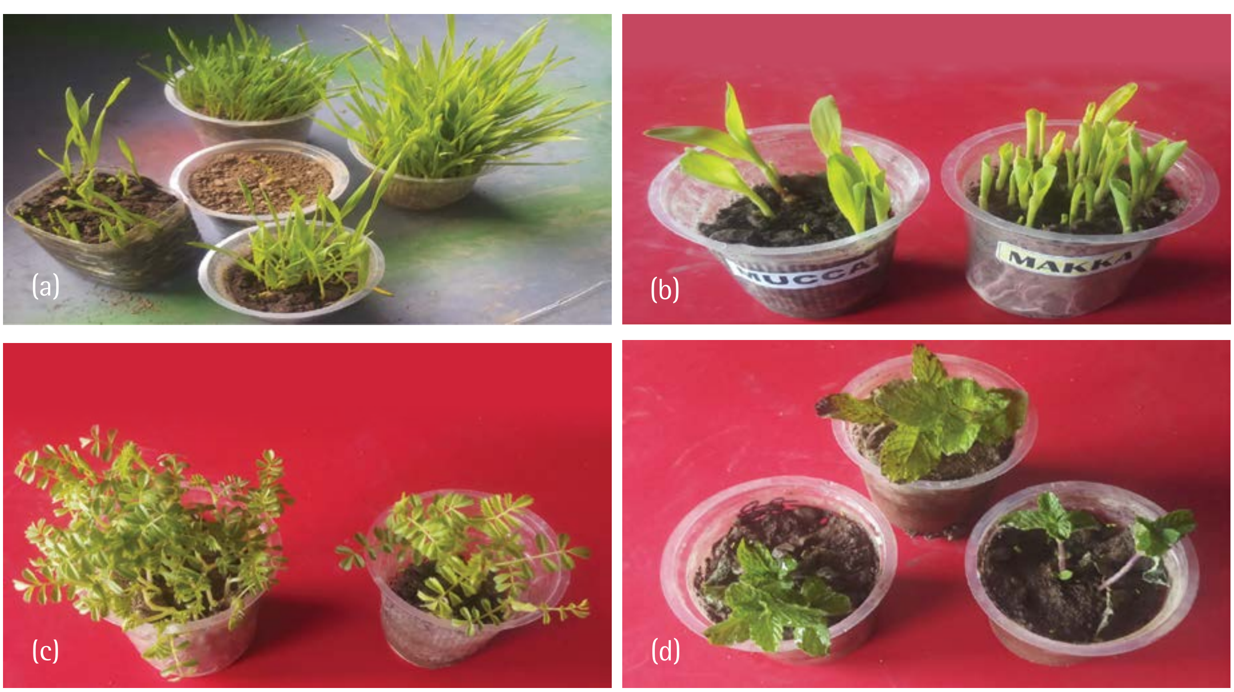

Fig. 3. Observing the difference in size and shape of the leaves of different plants: (a) Wheat; **(b)** Corn; **(c)** Beans; and **(d)** Mint.

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Box 1. Curricular connections:

This activity and related discussions can help teachers meet the following:

A) Curricular goals for preparatory-stage EVS:

- CG-1: [The student] explores and engages with the natural and socio-cultural environment in their surroundings. Specifically, this lesson can help students develop the competency (C-1.2) to: *"Ask questions and make predictions about simple patterns observed in the immediate environment."*
- CG-4: [The student] develops sensitivity towards social and natural environment. Specifically, this lesson can help students develop the competency (C-4.1) to: *"Observe and describe diversity among plants… in their immediate environment (shape, sounds, food habits, growth, habitat)."*[6]

B) Learning objectives for preparatory-stage EVS students:

- Observe and share experiences for different phenomena such as how seeds germinate and the direction in which roots and shoots grow and conduct simple experiments and activities to find out the same.
- Conduct activities and simple experiments to check the properties/ features of different seeds.[7]

"You would notice that chickpea seeds are split into two parts… Each part is called a cotyledon. Plants that have seeds with two cotyledons are called dicotyledons (dicots). Maize has a single thin cotyledon… Plants with such seeds are called monocotyledons (monocots)."[4] The same chapter also invites students to observe other features of these two categories of plants: "*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.*"[4] Over the following days, students continued to observe the different kinds of seedlings grow. They noticed and recorded differences in the shape and size of the true leaves of these different categories of plants (see **Fig. 3**). As students observed these changes, the discussion began to move from how seeds germinate to the broader question of how plants grow and develop. Students had observed that new plants could grow from stems as well. I used this observation to introduce them to the idea that plants can reproduce in different ways. This idea is developed in Chapter 8 ('Reproduction in Plants') of the Grade VII science textbook (NCERT, Reprint 2024-2025), where students are expected to learn that vegetative propagation is a process in which *"new plants are produced from roots, stems, leaves and buds."*[5] But at this stage, I focused on helping students recognise that familiar plants such as mint and rose can grow from plant parts other than seeds.

Parting thoughts

Since many of my students were from agricultural backgrounds, they were familiar with many aspects of plant growth. For example, they knew that seeds grow into new plants. But this activity allowed them to observe the sequence of growth—roots emerge first, followed by shoots, and then leaves. They knew that seeds are often soaked before sowing, but were now able to understand how soaking helps speed up germination. They had assumed that new plants emerge only from seeds. But they had now seen how some plants emerge from vegetative parts. Using transparent cups allowed students to observe changes that were often not visible to them. For example, they were able to see how roots grow downward and spread into the soil. They were also able to identify certain patterns in plant growth. For example, they observed that not all seeds germinate, that different kinds of seeds show different growth rates, and that the leaves of different plants can vary in many ways (see **Box 1**). These observations also led students to more carefully observe familiar plants in their surroundings and ask new questions about them. For example:

- Why do bananas not have seeds? How do these plants grow?

- Is soil always necessary for plant growth?
- Can plants grow in water alone?
- Who grows plants in forests, and who looks after them?
- How do forest plants get nutrients?
- Why are the leaves of different plants different in shape?
- Why is it that only certain plants grow in our fields?

For students, following plant growth in the classroom made concepts related to this phenomenon more meaningful than simply reading about them in a textbook. This activity also created opportunities to connect what they already knew from their surroundings with what they were learning in the classroom, and to ask new questions about both.

Key takeaways

- Students from agricultural backgrounds might already know that seeds grow into new plants. Following plant growth in the classroom can help draw their attention to how this happens and in what sequence.
- Such students may be familiar with local seeds, the practice of soaking them before sowing them, and even know when it might be best to sow them. Classroom activities that engage with these aspects can help students examine them more closely and understand how conditions like temperature and moisture can affect plant growth.
- Choosing different kinds of plants for this exercise based on their ability to grow from vegetative parts as well as seeds allows students to see that plants can reproduce in multiple ways. This can lead students to more carefully observe how different plants in their surroundings reproduce and ask new questions.

Notes:

(a) Credits for the image (Plants in the classroom) used in the background of the article title: Harish Nautiyal. License: CC BY-NC-ND 4.0 International Deed.

(b) Teachers interested in trying an activity-based approach on this theme in the middle stage classroom may find it useful to refer to this article by Dhanya K: 'An Inquiry-Based Approach to Germination' in the December 2022 issue of i wonder... (https://publications.azimpremjiuniversity.edu.in/5118/).

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DID YOU KNOW?

WHY INSECTS MATTER TO FORESTS (PART I)

In Chapter 12 ("How Nature Works in Harmony") of the Grade VIII science textbook (NCERT, 2026–2027), students learn: *"… how one small change can lead to many others. For example, many plants in a pond start dying because of pollution. With fewer plants less oxygen will be produced in water which will lead to a drop in the fish population in that water body. Reduction in fish population will have cascading effects and there will be less number of consumers in the pond. As a result, insects will increase in number. These insects will spread to nearby farmlands. This is how farmers will be compelled to use pesticides to grow their crops which may again adversely affect the environment. Further consequences may emerge in the form of other environmental issues."*[1] A critical environmental issue today is this disruption of these insect populations.

Insects play a critical role in maintaining forest health: they pollinate plants, break down dead wood and carcasses, turn the soil, and disperse seeds.[2] In the film 'Battle of the Bugs', Pramod Potoi, an Adivasi from the Gond community in Bastar district, Chhattisgarh, explains: *"If there are insects, forests will develop. If there are no insects, forests will not develop. Insects pollinate plants. More diversity of insects means diverse plants are pollinated."*[3]

But insect populations are impacted by multiple factors, including pesticide use and climate change. Kailas Chandra, director of the Zoological Survey of India, notes that *"the extensive use of pesticides which have leaked into our soil and water… has destroyed native insects, aquatic insects, unique species, and crushed our insect biodiversity."*[2] Scientists and forest communities also report that changing temperatures and rainfall patterns are disrupting insect habitats and seasonal cycles. Dr. Jayashree Ratnam describes how flowering and pollinator activity are falling *"out of sync"*, while warming temperatures and irregular rainfall are making it harder for insects to survive and reproduce.[2] As native insect populations decline, locust swarms running into the millions have devastated crops across several states. Some ant species have begun behaving as agricultural pests, cicadas are appearing in new regions, and termites are attacking healthy wood rather than decomposing dead matter.[2]

What happens to people when insect populations decline? Read Part II on **page 51**.

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Contributed by: Priti David, who leads the People's Archive of Rural India (PARI) Education She can be contacted at: pritidavid@yahoo.co.in.

CONNECTING
LIGHT AND HEAT

VIPIN VARGHESE & DAVID BLAIR

Students are formally introduced to light and heat in separate chapters of the Grade VII science curriculum. How can comparing the warmth of surfaces that interact differently with sunlight help them connect these two themes?

The middle-stage science curriculum introduces students to two important themes: light and heat. The connection between the two is explored in Chapter 7 (Heat Transfer in Nature') of the Grade VII science textbook (NCERT, Reprint 2026-27) through this fictional, but relatable example, *"Pema and her brother Palden reside in Gangtok. On a cold winter evening, they are sitting around a fireplace... They felt warm."*[1] Pema asks: *"I wonder how heat from the fire reaches us?"*[1] This example is used to introduce students to the process of radiation: *"...heat transfer, in this case, takes place directly from the fire (hot object) to us."*[1]

To see if my students recognise this connection, I asked, *"Can light heat things?"* They respond confidently: *"Yes!"* I followed up with the question: *"How do you know this?"* The room becomes quieter. Then, students begin to share observations from their everyday world: *"A metal bench left in the Sun becomes hot"*, *"dark-coloured clothes feel warmer than light-coloured ones"*, and *"on a sunny day, the ground can feel too hot to walk on barefoot."* Then, I ask: *"How does sunlight heat things?"* There is more hesitation before students respond: *"Because the Sun is hot"*, or *"because sunlight is hot."* These responses are related to what students read about light in Chapter 12 ('Beyond Earth') of the Grade VI science textbook (NCERT, Reprint 2026-27): *"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. The Sun produces heat and light, and is the main source of energy on the Earth."*[2]

This suggested that the students recognised familiar experiences—that the Sun gave both light and heat, and that some objects became warm in sunlight. However, they were less certain about how this heating happened. How could I help my students think more clearly about the connection between heat and light?

Creating a tangible experience

We designed a simple classroom activity using materials commonly available in government schools (see the **Activity Sheet**). In this activity, students place near-identical objects (like metal spoons) on different surfaces (black paper, white paper, and aluminium foil) and expose them to sunlight. After about 15-20 minutes, students are invited to touch the objects and compare their warmth.

I start the activity by placing the setup in the Sun. Then I ask students: *"What do you think would happen to the metal spoons after 20 minutes?"*

Students respond: *"They will become warm."*

"Why? Where will the heat come from?"

Students respond confidently: *"From the Sun."*

I ask a different question: *"Is there some way I can show that the heat is coming from the Sun and not from any other part of the setup?"*

Some students respond, *"Keep it in the shade."*

"If we kept an identical setup in a cool, dark part of the school, can you predict what would happen to the three spoons?" Many students respond, *"Nothing,"* and *"The spoons would not heat up."*

"So when the spoons are kept under the Sun, they will heat up. This does not happen when they are kept in the shade. Are you all sure that the heat comes from the Sun?"

"Yes," the students respond.

I ask: "*Is the Sun in contact with the spoons?"*

"No."

"Then how does heat from the Sun reach the spoons?"

There is silence as students think about this. Then one of them suggests, *"Maybe it is carried by air."*

"What is the process of transfer of heat by air called?" I ask.

There is silence. At this point, I remind them that Chapter 7 of the Grade VII science textbook (NCERT, Reprint 2026-27) introduces them to three ways in which heat is transferred *"from one place to another"*: conduction, convection, and radiation.[1] I also summarise the difference between the three ways on the board (see **Table I**).

Then I ask students the same question I had asked previously: *"What is the process of transfer of*

	Conduction	Convection	Radiation
Needs the two objects to be in physical contact with each other	Yes	No	No
Needs some material (like a liquid or a gas) to move between the two objects and carry heat with it	No	Yes	No

Table I: My summary of the difference between conduction, convection, and radiation.

heat by air called?" Now, some students respond, *"Convection."*

"Is this what could be happening with the spoons kept in sunlight?" I ask.

Many students say, *"Yes."*

I go back to an earlier part of the discussion. *"On a sunny day, if you stand in the Sun and then step into the shade, what changes immediately?"*

The students respond, *"It feels cooler in the shade."*

I ask: *"Has the air changed suddenly?"*

I see students consider the question before saying, *"No."*

"For heat from the Sun to be carried to our setup by air, the air would need to move between the two. When we step into the shade, we feel cooler even though the air is still there."

I let students think about this for a few minutes before I draw their attention to this part of Chapter 7 of the Grade VII science textbook (NCERT, Reprint 2026-27): *"Heat from the Sun reaches the Earth through radiation."*[1] This process is described in a little more detail: *"Do you remember when Pema and Palden were sitting around the fireplace? They felt warm. Their grandfather tells them that the heat transfer, in this case, takes place directly from the fire (hot object) to us by a process known as radiation. The heat of the Sun reaches us through this process. Heat transfer by radiation does not require any medium."*[1]

I invite students to test their prediction about the spoons. They touch the spoons and share their observations: *"The spoon on the black paper is hotter,"* and *"the foil one is not very warm."*

"You predicted that spoons kept in the sunlight would become warm and ones kept in the shade would not. All three spoons are made of the same material and are nearly identical in shape and size. Shouldn't all the spoons feel equally warm?"

Some students responded: "Yes."

"Why does this not happen? Can you see any difference between them?" I ask.

A student replies, *"Is it because of the paper beneath them?"* I invite the student to elaborate. Other students join in, and we discuss different ideas. A student comments that the foil may be *"sending light away."* Another student says, *"Shiny objects send back light."* This revealed their prior understanding of an idea that is explored in an activity in Chapter 11 ('Light: Shadows and Reflections') of the Grade VII science textbook (NCERT, Reprint 2026-27), where students are invited to observe the effect of shining light on a shiny surface like a metal plate. This activity is used to introduce the idea that: *"a shiny surface or a mirror changes the direction of light that falls upon it. This change in direction of light by a mirror is called the reflection of light."*[3] I ask students if they can think of other shiny materials that would have the same effect as the foil. We discuss some examples (such as steel utensils, tin roofs, mirrors, and the shiny wrappers used in some potato chip packets) from their everyday experience.

Then I ask, *"What about the black and white paper?"* Some students say that black paper *"takes in"* more light than white paper. I draw their attention to what they read in Chapter 7 of the Grade VII science textbook (NCERT, Reprint 2026-27): *"Light-coloured clothes reflect most of the heat that falls on them, and therefore, we feel more comfortable wearing them during summers. Dark surfaces, on the other hand, absorb more heat, and therefore, we feel more comfortable with dark-coloured clothes during winters."*[1] This explanation uses the terms 'heat' and 'light' somewhat interchangeably. So I clarified that it is sunlight that is absorbed or reflected, and that heating follows from this. *"The spoon on the black paper feels warmest because the black paper absorbs more sunlight than the other two* *surfaces and becomes hotter. This heat is then transferred to the spoon in contact with it. The white paper and foil reflect more sunlight than the black paper, so they remain cooler and transfer less heat to the spoons in contact with them."*

Through this discussion, students begin to understand the idea that something happens to sunlight when it reaches different materials. One student captured this insight in an interesting way: *"So sunlight does not just come and go—it actually leaves something behind."*

Parting thoughts

Students are formally introduced to the topic of light in Chapter 11 of the Grade VII science textbook (NCERT, Reprint 2026-27). Here, they learn that light is reflected from shiny surfaces, forms shadows, and allows us to see objects.[3] They are formally introduced to the topic of heat in Chapter 7 of the same textbook. Here, they learn that the Sun is a source of heat and light and that its heat is transferred to objects on Earth by radiation.[1] While students may recognise from everyday experience that sunlight warms objects, the middle-stage science curriculum does not explore this connection adequately.

My aim was to design a hands-on experience that brought students' learning from these two chapters together in a concrete way (see **Box 1**). By comparing how similar objects warm up under the Sun, students notice that the effect of sunlight is not uniform. This comparison draws students' attention to what happens when light falls on different surfaces (see **Fig. 1**). Students can see that the way a surface interacts with light—whether it reflects more or absorbs more—has a direct connection to how warm it becomes in sunlight. This allows students to develop a deeper understanding of ideas they are already familiar with. For example, by directly observing the warming of surfaces kept in the Sun, students can begin to relate this to the idea that sunlight carries energy. Engaging with the question of how heat from the Sun reaches objects on Earth without any visible physical contact and without needing the movement of material like air opens a way for students to see that sunlight can travel through space. Comparing the warmth of spoons kept on different surfaces allows them to see that reflection does not just explain changes in the direction of light, but also why some objects and surfaces remain relatively cooler than others. This understanding of sunlight can be extended into a more coherent understanding of light itself: it carries energy, can travel through space, and interacts differently with different materials. In this way, students begin to connect interrelated ideas that are presented as separate facts in the curriculum. They can also begin to use this interconnected understanding to explain everyday observations more clearly.

Box 1. Curricular connections:

This activity and related discussions can help teachers meet the following curricular goal for middle-stage science (CG-6): [The student] explores the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry. Specifically, this lesson can help students develop the competency (C-6.2) to: *"Formulate questions using scientific terminology (to identify possible causes for an event, patterns, or behaviour of objects) and collect data as evidence (through observation of the natural environment, design of simple experiments, or use of simple scientific instruments)."*[4]

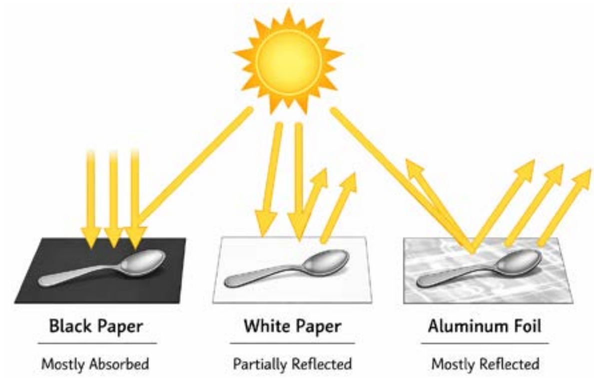

Fig. 1. Sunlight interacts differently with black paper, white paper, and aluminium foil. Surfaces that absorb more light heat up more, while those that reflect more remain relatively cooler.

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Key takeaways

- The Grade VII science textbook introduces students to light and heat, but does not explore the connection between the two in sufficient detail.
- This connection can be explored by offering students the opportunity to investigate the heating effects of sunlight on surfaces with different reflective properties.
- What students learn from such an investigation can be used to build a more coherent understanding of light: that it carries energy, can travel through space, and interacts with materials in different ways.
- This understanding can help students explain everyday observations by bringing together their understanding of concepts from separate textbook chapters on light and heat.

Acknowledgements: This article draws inspiration from the Einstein-First project, a science education initiative focused on introducing modern physics ideas in school classrooms through activity-based learning. For background ideas and classroom resources, see: https://www.einsteinianphysics.com/. The authors also gratefully acknowledge Dr. Rahul Choudhary and Dr. Anastasia Popkova of the Einstein-First project for discussions that informed this article.

Notes:

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(b) This article includes two classroom resources: **Activity Sheet: How Are Light and Heat Related?** and **Teacher's Guide: Thinking About Heat.**

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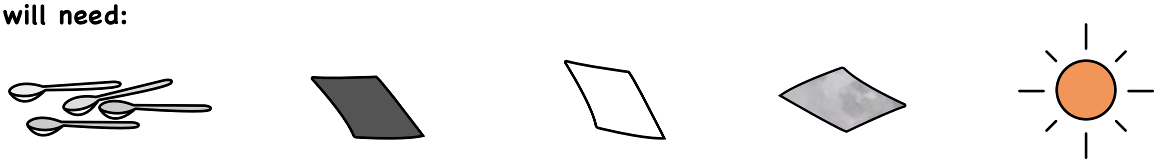
Azim Premji University

ACTIVITY SHEET: HOW ARE LIGHT AND HEAT RELATED?

Aim:

To explore how different surfaces absorb sunlight and transfer that heat to objects placed on them.

You will need:



4 identical metal spoons | Black paper | White paper | Aluminium foil | A sunny outdoor space

What to do:

1) Place the black paper, white paper, and aluminium foil side by side in a spot that will remain in direct sunlight for at least 20 minutes. Make sure that they do not fly or move and the sun falls evenly on them.
2) Place one identical metal spoon in the centre of each surface.
3) If possible, place a fourth spoon on the bare ground nearby.
4) If you have extra spoons and papers, place the same setup in the shade. If not, you could simply move your sun-warmed setup into the shade after you are done (do the spoons stay at different temperatures, or do they all eventually feel the same?).

5) Predict which spoon will feel the warmest and which will be the coolest. Write down your reasons in the table in the **Observe and record** section.

6) Leave the setup undisturbed in the Sun for 15–20 minutes.

7) Use the back of your finger to carefully touch each spoon. Then touch the paper or foil underneath it. Compare their degrees of hotness. Rank the spoons in the table from 1 (hottest) to 4 (coolest).

Observe and record:

	Predict	Observe	Was your observation different from your prediction?
Spoon on black paper			
Spoon on white paper			
Spoon on aluminium foil			
Spoon on ground			

Think about:

- Why did the spoons in the shade feel different from those in the Sun? What does this tell you about the relationship between sunlight and heat?
- Why did the spoon on the black paper get hotter than the one on the white paper or foil? What is the black paper doing with the light that the others are not?
- Was the spoon on the black paper hotter than the one on the bare ground? What does this tell you about how the surface underneath an object affects its heating?
- Did the spoon heat the paper, or did the paper heat the spoon? How can you tell? (**Hint:** Which one felt hotter when you touched them?) How does the heat move from the surface into the object resting on it?

Discuss:

Q1. Based on your observations, which surface absorbed the most sunlight and which reflected the most? How does a surface's ability to reflect light change its temperature?

Q2. How does warmth from the Sun reach the spoons through millions of kilometres of empty space without any physical contact?

Q3. Why do people in hot climates often paint their houses white or wear light-coloured clothes? Can you use your results with the black and white paper to explain this?

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TEACHER'S GUIDE: THINKING ABOUT HEAT

The hands-on activity in '**Activity Sheet: How are Light and Heat Related?**' can be used to encourage students to think about the connection between light and heat. This guide is designed to support teachers in classroom instruction around the theme of 'Heat' in the middle-stage science curriculum. It can help students move beyond a comparison of which object or surface is warmer to a discussion of **how** and **why** heating occurs.

The guide is organised into three non-sequential sections for discussion and inquiry. Each section includes a set of prompts along with connections to the middle-stage science curriculum. Each set of prompts is designed to provide one possible sequence of questions that can help students move in small steps towards developing an understanding of heat transfer. The questions in each prompt are meant to be indicative, not exhaustive. Not all of them need to be used in class, nor do they need to be followed in the exact sequence offered here.

Section I: Heating properties of materials:

This section can help students move from: *"Objects in the Sun become hot"* to: *"Do all objects heat up in the same way?"* and *"What difference do different materials or surfaces make?"*.

a) Prompts:

- Why choose metallic spoons? How does metal respond to heating? Compared to other materials, does metal heat up quickly or slowly? Does it retain heat or cool down quickly?
- What would you expect to observe if you used wood, plastic, metal coins, clay, or pebbles instead of spoons? How are the heating properties of these materials different from metal spoons? What everyday observations support your ideas?
- Can you think of any other everyday material (apart from the ones we have already thought of) that could replace spoons? What kind of material would you use and why? How would the size or shape of this material change the activity? For example, would the material need more time in the sun, or would you need to place it differently on the paper?
- Why choose black paper, white paper, and aluminium foil? How do these materials respond to sunlight? What everyday observations support your ideas? What do you expect to happen when sunlight falls on each of these surfaces?
- Why were the spoons 'placed' on different surfaces? If the spoons were 'wrapped' in black paper, white paper, or foil instead—how would it change the way they receive or lose heat? For example, would wrapping the spoons trap air around them? How might that air change how quickly the spoons warm up or cool down?

b) Connections with Chapter 7 ('Heat Transfer in Nature') of the Grade VII science textbook (NCERT, 2025):

- **Absorption and reflection:** Dark-coloured surfaces absorb more of sunlight, while light-coloured and shiny surfaces reflect more. Surfaces that absorb more sunlight tend to become warmer.

- **Thermal conductivity:** Some materials (like metals) allow heat to pass through them easily (conductors), while others (like wood, plastic, or clay) do not (insulators).

Section II: Sensing heat:

This section can help students move from *"This feels hotter"* to: *"What factors affect what I feel?"* and *"Can I measure it more exactly?"*.

a) Prompts:

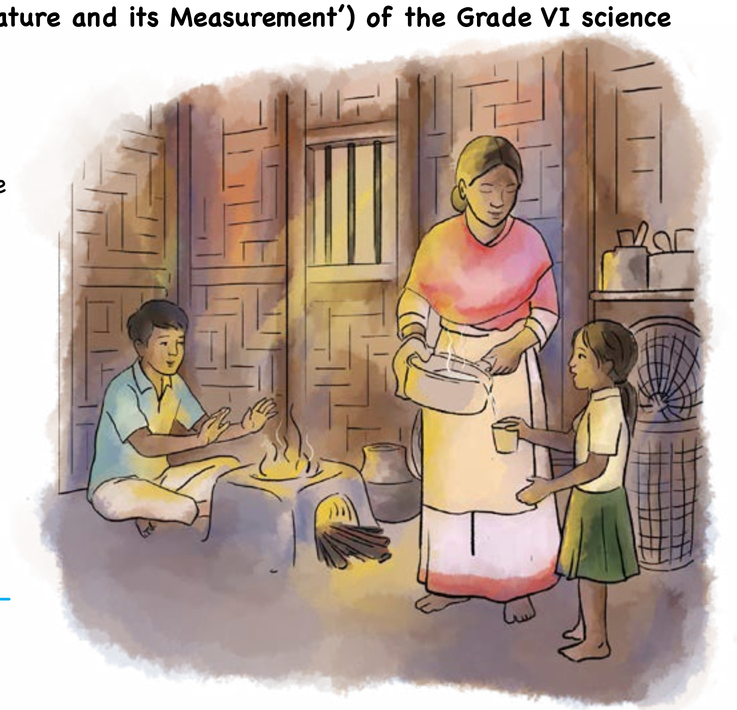
- Is touch a reliable method to compare the warmth of the spoons? Does this method have any limitations? Can you think of a tool that would help you get an exact measurement of the temperature of the spoons? What changes would you need to make to the activity to include this tool in it?
- Is 15–20 minutes of exposure to the Sun necessary? How do you think your observations would change if the time were shorter or longer? What factors (such as sunlight intensity or the material used) might affect how quickly the spoons warm up? How would you find the shortest time needed to see a clear difference in the warmth of the spoons? Can you think of a way to test this? What would you keep the same in such a test and what would you change? At what point do you think the spoons would stop getting hotter?
- Imagine the spoons and paper in this activity were replaced with other materials. Can you think of any everyday materials that would make differences in warmth easier to feel? Why? What properties of these materials (such as how quickly they let heat pass through them) would make these differences easier to notice?

b) Connections with Chapter 7 ('Temperature and its Measurement') of the Grade VI science textbook (NCERT, 2025):

- **Subjectivity:** Our sense of touch can be misleading. Materials at the same temperature can feel different because they transfer heat to our skin at different rates. Metals, for example, feel colder because they conduct heat away from your hand quickly, and feel hotter because they conduct heat to your hand quickly.
- **Tools:** Instruments like thermometers provide a more reliable and exact measurement of temperature than our senses can.

Section III: Transfer of heat:

This section can help students move from *"The Sun heats things"* to: *"How exactly is heat transferred?"* and *"Are different processes happening in different parts of the setup?"*.



How many different examples of heat transfer can you identify in this image? Hint: Look closely at why the mother is using a cloth, why the boy's hand is to the side rather than above the fire, and how the heat travels from the hot milk into the girl's hands!

a) Prompts:

- Have you found a steel spoon becoming too hot to hold after you dip it into a bowl of hot *kheer*? If only one end of the spoon is in the hot kheer, how does the heat reach your fingers at the other end? How do your feet feel when you walk barefoot on hot ground? Would you feel the same heat if you were wearing *chappals*? What does this tell you about this specific kind of heat transfer?

- In this activity, is the Sun in direct contact with the spoons? How do you think heat from the Sun reaches the setup through empty space? What makes this different from the *kheer* and *chappal* examples?

- Can you think of other everyday examples where heating happens without physical contact? Are such examples limited to the Sun, or can they involve other sources?

- You may have felt the warmth of a *chulha* or stove when you sit near it. How is its heat reaching you without physical contact? If you place your hand (at a safe distance) above the flame, it feels much hotter than when your hand is to the side. Why? What does this suggest about the direction in which heated air moves? How is this different from heat coming directly from the Sun?

- Could the Sun still heat the spoons if there were no air in between? Can you think of a way you could test or verify this idea? For example, if we put the spoon in a glass jar and sucked all the air out, would the spoon still get hot? Would this result support the idea that air is needed or challenge it?

- How does heat from the paper surfaces reach the spoons? How does heat from the spoons reach your hand? Are these processes the same or different? How can you tell?

b) Connections with Chapter 7 ('Heat Transfer in Nature') of the Grade VII science textbook (NCERT, 2025):

- **Three modes of heat transfer:** Heat is transferred through direct contact (conduction), through the movement of liquids or gases (convection), and without needing contact or a medium (radiation).

- **Radiation:** The sun heats the paper and spoons through radiation. This transfer can occur without physical contact and even without air.

We invite you to test this guide in your classroom. Since classroom discussions can move in many unexpected directions, the hope is that each such discussion will help develop other possible examples and sequences to build understanding of the same ideas. We would be interested in hearing your experience. Do tell us:

(a) Which sections and prompts did you use?

(b) How did you adapt them to match your students' prior knowledge and observations?

(c) What new prompts would you add based on their responses?

Share these with us at: iwonder@apu.edu.in.

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TEACHING FORESTS: INTERPRETING CURRICULAR AIMS

LOKESH DASILA

The textbook chapter 'Whose Jungle?' introduces forests through diverse community narratives from different parts of India. How do policy documents support teachers in connecting this chapter to both broader curricular aims and the everyday realities of their students?

Textbooks play a central role in helping many practising school teachers across India meet the aims of the curriculum.[1] However, textbooks are often designed for a broad readership (for example, NCERT textbooks are written for students across India). When children in geographically distinct areas, like Uttarakhand, study ecological themes from these books, the teacher's role becomes critical. Rather than read from the textbook, teachers are required to interpret textbook content in classroom instruction in ways that both meet the broader aims of school education and connect learning to local contexts.[2] This raises important questions for teachers: How do we identify where the textbook content might fall short of curricular aims? What direction do policy documents offer to teachers engaged in this work? In this article, I explore these questions through a specific example for government school teachers in Uttarakhand. This example is based on Chapter 20 ('Whose Jungle?') from the Grade V EVS textbook (NCERT, 2024–25), which introduces students to questions of nature, community life, and social responsibility.[3]

Where teacher work is needed

The National Curriculum Framework (NCF) 2005 defines six criteria that can be used to review how effectively EVS and science textbook chapters meet curricular aims. I used these criteria to review the chapter on forests:

1) Content validity: This criterion *"requires that the curriculum must convey significant and correct scientific information. Simplification of content, which is necessary for adapting the curriculum to the cognitive level of the learner, must not be so trivialised as to convey something basically flawed and/or meaningless."*[2] In the chapter, children are introduced to forests through the true story of Suryamani, a woman from the Kurukh tribal community in Jharkhand; a letter written to the Chief Minister of Odisha by Sikhya, a Class X student from the state; and the story of Saima Sir and *jhum* farming in Mizoram. These aspects address content validity because they draw attention to:

a) Whose lives are represented in the textbook (introducing forests through the experiences of forest-dependent communities);
b) What forms of knowledge are treated as important (including community knowledge, forest-based livelihoods, and cultural practices);
c) How science is positioned in relation to society (by linking ecology with livelihood and identity).

Among these narratives, Suryamani's story is likely to be most culturally relatable for students in Uttarakhand. She shares a close relationship with the forest and, through education, works to strengthen both her own identity and that of her community. Every Sunday, she takes children from her village into the forest to help them learn about wild plants and animals. This allows them to see the forest not only as a source of livelihood, but also as an integral part of everyday life: *"Suryamani always says, "To learn to read the forest is as important as reading books." She says, "We are forest people (Adivasis). Our lives are linked to the forests. If the forests are not there, we too will not remain.""*[3] The chapter also refers to her setting up a community centre called 'Torang' (meaning 'forest' in the Kurukh language), where people are encouraged to value their songs, dances, dress, language, literature, and traditional musical instruments.[3] From a curricular perspective, this content aligns with the emphasis in NCF 2005 on diversity, inclusion, and knowledge embedded in social life.

2) Cognitive validity: This criterion *"requires that the content, process, language, and pedagogical practices of the curriculum are age appropriate, and within the cognitive reach of the child."*[2] Much of the information presented in the chapter appears appropriate for Grade V students. Because it draws closely on community life, children in many Uttarakhand classrooms are likely to find this content very relatable, easily connecting it to their own experiences.

However, the chapter also introduces some ideas that may be difficult given children's prior knowledge and level of understanding. For example, questions under the heading "Think" are intended to encourage reflection and analysis. One such question asks: *"Collect reports about forests from newspapers. Did you find any news about how the cutting down of forests affects the weather? How?"*[3] While Grade V students can collect news reports and identify some visible effects of deforestation, the second part of the question assumes some prior understanding of climate change and long-term environmental processes. Without additional explanation, this expectation may be beyond the cognitive reach of many children at this level.

Apart from words that come directly from tribal vocabulary, the chapter's language is largely simple and accessible. However, the Hindi version uses certain words—such as *'halaat'* and *'pansari'*—that might be unfamiliar to students in Uttarakhand. The word 'scholarship' could be replaced with an appropriate Hindi term. Finally, while using *'chawal'* to refer to the crop is acceptable, *'dhan'* is more accurate in discussions on sowing.

3) Process validity: This criterion *"requires that the curriculum should engage the learner in acquiring the methods and processes that lead to the generation and validation of scientific knowledge and nurture the natural curiosity and creativity of the child in science. Process validity is an important criterion since it helps the student in 'learning to learn' science."*[2]

The story of Suryamani's struggle, the dialogue between her and Maniya Chacha, the words of Budhiyamai, and the letter written by Sikhya to the Chief Minister all provide opportunities for children to engage with how scientific knowledge is created and validated. Drawn from lived experience and traditional knowledge, these examples invite children to reflect, question, and make sense of ideas, rather than simply accept information. Through these narratives, the chapter supports the development of reasoning and encourages engagement with evidence, enquiry, and understanding.

4) Historical validity: This criterion *"requires that the science curriculum be informed by a historical perspective, enabling the learner to appreciate how the concepts of science evolve over time. It also helps the learner to view science as a social enterprise and to understand how social factors influence the development of science."*[2] This chapter includes a brief box on the Forest Rights Act, 2006: *"People who have been living in the forests for at least 25 years, have a right over the forest land and what is grown on it. They should not be removed from the forest. The work of protecting the forest should be done by their Gram Sabha."*[3]

Beyond this, however, historical context is largely absent. There is little indication that control over forests and the rights of forest-dependent communities have been contested for a long time. For example, it would have been relevant to mention that forest laws introduced during British rule placed forests under state control, restricted customary access, and altered long-standing relationships between forest-dependent communities and forest land. After independence, these struggles did not disappear; they continued through changing policies related to conservation, development projects, and displacement, leading to ongoing debates about forest rights.[4] Since the chapter focuses on rights over forests, the absence of such context makes the discussion appear disconnected from the longer history through which these rights have emerged. Even brief references to a few key developments from the colonial period to the present could have helped students see forest rights as part of an ongoing social and historical struggle.

5) Environmental validity: This criterion *"requires that science be placed in the wider context of the learner's environment, local and global, enabling him/her to appreciate the issues at the interface of science, technology and society, and equipping him/her with the requisite knowledge and skills to enter the world of work."*[2] The chapter describes the practice of *jhum* farming in North-East India: "*After cutting one crop, the land is left as it is for some years. Nothing is grown there. The bamboo or weeds which grow on that land are not pulled out. They are cut and burnt. The ash makes the land fertile. While burning, care is taken so that the fire does not spread to the other parts of the forest. When the land is ready for farming it is lightly dug up, not ploughed. Seeds are dropped on it. In one farm different types of crops like maize, vegetables, chillies, rice can be grown. Weeds and other unwanted plants are also not pulled out; they are just cut. So that they get mixed with the soil. This also helps in making the soil fertile. If some family is not able to do farming on time, others help them and are given food."*[3] This description provides teachers with an opportunity to discuss how farming practices are shaped by environmental conditions and community needs. For example, *jhum* farming is used by communities living in tropical and subtropical forest regions, especially in Northeast India and neighbouring parts of South and Southeast Asia. It has evolved in response to specific ecological conditions and social arrangements. This discussion can also help children appreciate how people can work with their environment rather than against it. Teachers can strengthen this understanding by relating *jhum* farming to local agricultural or forest-based practices familiar to students, helping them notice similarities and differences across regions.

6) Ethical validity: This criterion *"requires that the curriculum promote the values of honesty, objectivity, cooperation, and freedom from fear and prejudice, and inculcate in the learner a concern for life and preservation of the environment."*[2] In this chapter, ethical validity is reflected in how the three narratives are presented. Suryamani's life and cultural practices, for example, are shown in a positive and respectful manner. She is portrayed as someone who strongly advocates holding on to one's culture while also working to connect her community with wider society.[3] Through such portrayals, the chapter supports the development of values related to cooperation, dignity, and environmental responsibility.

Assessing a textbook chapter through these criteria can help teachers plan their role in classroom instruction more effectively. By seeing the kind of learning the chapter content makes possible in the classroom, this exercise allows teachers to identify where explanation, discussion, local examples, or additional context may need to be provided for students to fully engage with the curriculum (see **Box 1**). For example:

- **Bridging Concepts:** Concepts related to deforestation and environmental change may not be immediately clear to all children. Teachers can begin with examples from nearby forests, farms, or fields, encouraging children to share observations before introducing new terms or explanations.
- **Adding Historical Context:** Since the chapter provides limited historical information, teachers may need to briefly explain that forest use and forest laws have changed over time. Even simple references can help children understand that such issues did not arise suddenly, but have developed through social and political processes.
- **Connecting Local Experiences:** Although Suryamani's story is set in Jharkhand, its themes of forest dependence and community knowledge are common to states where forests are a central aspect of life. For example, according to the

Box 1. Curricular connections:

This assessment can support teachers in planning classroom instruction that meets the following **curricular goals for preparatory-stage EVS:**

- CG-1: [The student] explores and engages with the natural and socio-cultural environment in their surroundings. Specifically, this lesson can help students develop the competency (C-1.2) to: *"Describe relationships (including between humans and animals/nature) and traditions (art forms, celebrations, festivals) in the family and community."*
- CG-2: [The student] understands the interdependence in their environment through observation and experiences, developing the basis for appreciation of the idea of *'Vasudhaiva Kutumbakam'*. Specifically, this lesson can help students develop the competency (C-2.2) to: *"Describe the relationship between the natural environment and cultural practices in their immediate environment (nature of work, food, festivals, traditions)."*
- CG-4: [The student] develops sensitivity towards social and natural environment. Specifically, this lesson can help students develop the competency to:
    - (C-4.2): "*Observe and describe cultural diversity in their immediate environment (food, clothing, games, different seasons, festivals related to harvest and sowing).*"
    - (C-4.3): "*Describe usage of natural resources in their immediate environment.*"
    - (C-4.4): "*Demonstrate how natural resources can be shared, maintained, and conserved (trees, use of rainwater, benefits of millets).*"
    - (C-4.6): "*Identify the needs of people in different situations—in terms of access to resources, equal opportunities, work distribution, and shelter.*'[2]

India State of Forest Report 2023, Uttarakhand's total forest and tree cover is around 43.7% of the state's geographical area.[5] Except for some urban areas, many children in the state are familiar with forests through family work, local travel, or community practices. In such states, therefore, teachers have many opportunities to connect Suryamani's experiences with those of their own students. Her statement, *"If the forests are not saved, we will not be saved either,"* provides a useful starting point for class discussion.[3] Children can be encouraged to talk about what forests provide, what recent changes have been noticed by their community, and what elders in their families say about these changes. Giving time for such discussions to develop will help make the lesson more meaningful.

- **Contextualising Culture:** The chapter also introduces ideas related to culture and community life. When children read about the Torang centre and the pride taken in traditional practices, teachers can help them think about what culture means in their own context (see **Fig. 1**). Teachers can also draw attention to how the festivals, food habits, and folksongs of agricultural communities are centred around crops and seasons, whereas those of fishing communities revolve around water bodies and aquatic life. Such discussions can help children see culture not as a fixed set of practices, but as a dynamic aspect of everyday life shaped by livelihood and environment. While helping students appreciate their own culture, teachers can also foster respect for different ways of living, taking care not to reduce other cultures to stereotypes.

Fig. 1. A traditional dance of the Kurukh community. Teachers can use such examples to help students notice how cultural practices in their own communities connect with land, forests, and everyday life.

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Parting thoughts

While NCERT textbooks are written for children across the country, this chapter leaves space for teachers to connect its main ideas with local realities. When classroom instruction draws on local forests, livelihoods, and experiences, teachers help children move from information in the textbook to lived understanding. This allows students and teachers to explore large issues, such as deforestation, in their everyday lives. This engagement with local experience can then be used to return to wider national questions—such as changes in forest use, development pressures, and policies that affect forest-dependent communities across India. To support such learning, teachers need to continue developing their own understanding, remain attentive to students' experiences, and make space for discussion in the classroom. Through such an approach, students can begin to develop a broader sense of belonging that connects their local experiences with national concerns within a democratic framework.

Key takeaways

- Curricular documents view textbook chapters like 'Whose Jungle?' as a starting point for learning about forests. Teachers are expected to interpret such chapters with an approach that bridges the gap between broad national goals and the local realities of their classrooms.
- Teachers can identify the strengths and limitations of this textbook chapter by reviewing it against the curricular criteria described in NCF 2005. These criteria help teachers assess whether the content is accurate, age-appropriate, historically informed, and relevant to their students' environment.
- Since this chapter is written for students across India, it highlights examples from diverse regions or communities. Teachers play a vital role in helping students connect distant textbook narratives to the landscapes and cultural practices in their own surroundings.
- Planning classroom instruction in this way opens opportunities for deeper learning. This helps students link what they read about forests in this textbook chapter with broader questions about the environment, livelihoods, and society.

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Notes: Credits for the image (Teacher reading the textbook) used in the background of the article title: Created for i wonder… using ChatGPT, under prompting by Chitra Ravi (Mar 2026). License: CC BY-NC-ND 4.0 International Deed.

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PERSPECTIVES

TEACHING ABOUT FORESTS AMIDST SAND DUNES

NACHIKET SANDEEP SHIRUDE

The Grade VII science textbook introduces forests through an example of dense, multilayered vegetation and large wildlife typical of wetter landscapes. What role do teachers play in helping students interpret this concept in arid landscapes?

In Chapter 17 ('Forests: Our Lifeline') of the Grade VII science textbook (NCERT, Reprint 2024–2025), students read a fictionalised experience of a forest, described through the eyes of Boojho and Paheli, two children of their age.[1] When seen from a height, this forest forms such a continuous green cover that the children *"could not see any land."* When they enter the forest, they notice that it is cool, shaded, and moist. It is also multilayered as "*giant and tall trees constituted the top layer followed by shrubs and tall grasses, and herbs formed the lowest layer."* The children identify a variety of trees, such as sal, teak, red silk-cotton tree (*semal*), Indian rosewood (*sheesham*), neem, flame of the forest (*palash*), fig, cutch tree (*khair*), Indian gooseberry (*amla*), bamboo, and orchid tree (*kachnar*). They hear that animals such as elephants, bison, wild boar, monkeys, and jackals can be spotted in denser parts of the forest. They notice that the floor is covered with a thick layer of dead and decaying plant matter (like leaves, fruits, seeds, twigs, and small herbs).[1] Through this example, students learn how forests support biodiversity by providing a habitat for a wide range of plant and animal species, while also helping to regulate the water table, rainfall, and climate.[1] In addition to these ecological functions, the chapter introduces the many ways humans benefit from these ecosystems. This is reinforced in Chapter 12 ('How Nature Works in Harmony') of the Grade VIII science textbook (NCERT, Reprint 2026-2027), where students read how forests *"provide fresh air, fertile soil, food, fibres, timber, and medicines."*[2]

The National Curriculum Framework for School Education (NCF-SE) 2023 emphasises the importance of teachers in connecting classroom learning with the lived experiences of students.[3] In practice, however, translating this principle into classroom instruction is not straightforward. Students in many landscapes may not be able to relate to the forest described in their textbook. For example, I was teaching this chapter to 16 students in a small government school in Barmer, Rajasthan. Located on the western edge of India, Barmer is part of the expansive Thar Desert. These children were born and raised in a landscape characterised by sand dunes, sparse vegetation, and hardy plants adapted to extremely arid conditions. How would they be able to connect the elephants and towering trees in the textbook with their lived experience?

The textbook recognises these challenges. Boojho asks: *"Would we see similar kind of trees in every forest?"* and is told, *"No, due to different climatic conditions there are variations in the types of trees and other plants. The types of animals also differ from forest to forest."* It also encourages children to: *"visit a forest or a park in your neighbourhood."*[1] So this was the question I worked with: How do I design the field component suggested in the chapter? Which ecological spaces in Barmer might help students interpret the concept of forests in their own context?

Reading local landscapes

From my colleague Premaram, a naturalist familiar with local ecology, I learnt that Thar Desert's vegetation is classified into tropical thorn forests, tropical dry deciduous forests, and desert scrublands. These ecosystems are uniquely adapted to very low rainfall, high temperatures, and sandy soils. Some patches are community-managed, including groves called orans and grazing lands called gauchars. Orans are considered sacred spaces, where cutting trees or disturbing the ecosystem is traditionally discouraged through social and cultural practices. This allows these patches to retain native vegetation and support local biodiversity.[4] Gauchars, in contrast, are primarily intended for livestock grazing. Yet they, too, support a diversity of plant and animal life. From a documentary called 'Wild India: Deserts', I learnt how these ecosystems support conservation projects for endangered species such as the Great Indian Bustard (Rajasthan's state bird) and Blackbuck.[5] Soon after, during a visit to Chohtan, a neighbouring town, I was able to experience an oran firsthand.

With this background, I started the lesson by asking students, *"What do you know about forests?"* Most students mentioned that forests were places where tigers and lions live. I used a series of questions to broaden this understanding. For example, I asked, *"Besides lions and tigers, what else does a forest contain?"* The students replied that forests also have large trees and dense vegetation; some mentioned animals like deer, bears, and monkeys. I then asked, *"What about humans? Do they have any relationship with forests?"* Some students said that people go to forests to collect wood. Many of these responses reflected images that students had encountered in textbooks or media. My next question was, *"So, would you think of a forest as a space where plants are in abundance and some wild animals are present?"* The students agreed with this definition. Building on this understanding, I asked whether they had visited such spaces. A student immediately said, *"Yes, sir, we have a forest in our village."* Another added, *"Sir, we call it oran."* A third student mentioned that, in addition to the oran in his village, he had enjoyed a visit to one in Chohtan.

From this point, the classroom became a space of inquiry, moving beyond definitions into lived experiences, social practices, and cultural memories. I learnt that students regularly visit the oran in their village—to play, or to graze goats and cows. When I asked what made this oran a forest, they explained that they had seen many plants and wild animals there. Curious, I asked, *"Does the oran really have wild animals in it?"* A student replied, *"Yes, we have deer there."* Others shared that they had seen peacocks and desert foxes in the oran. Some mentioned seeing dogs attack the deer. One girl told me how she and her friends go there to play every evening and throw stones to chase dogs attacking peacocks and deer. This discussion sparked further questions: *What makes an animal wild or domestic? Why do we not keep deer at home?* One student explained, *"We keep cows because they give us milk."* This led to a discussion about how early humans had domesticated wild animals. Students were able to relate to this because humans and wild animals in this region continue to live in proximity. Since grazing land is limited in Rajasthan, students often take livestock to spaces shared with wildlife. Many described visiting orans during community festivals. I could see a shift in the discussion. While already familiar with orans, students now began to see them as part of a broader ecological idea of a forest ecosystem.

Next, I planned a visit to an oran, spanning nearly two square kilometres, located just 500 metres from the school. This oran is believed to be associated with a local deity, whose temple is situated within the grove. Every year, the deity is honoured through a religious ceremony, and people from different faiths actively participate in these rituals. I discussed the plan for the visit with the school's science teacher and obtained permission from the principal. Since the visit involved taking students outside the school premises, we also discussed safety guidelines. Students were instructed to cross the road carefully, stay together as a group, and avoid disturbing plants or animals by throwing stones, plucking flowers, or damaging vegetation. These rules were strictly followed for most of the visit. However, when we reached a *ber (Ziziphus mauritiana)* tree toward the end of our visit, a few students plucked its fruit and shared it with us. Each student was also asked to bring a notebook to record their observations of: *"features of stems, leaves, flowers and anything interesting in various plants."*[6] This instruction helped ensure that students observed the oran with more careful attention.

Students could name many plants in the oran that were part of their daily lives. Building on this familiarity, we introduced students to the process of sorting plants into trees, shrubs, and herbs. These categories are introduced in Chapter 2 ('Diversity in the Living World') of the Grade VI science textbook (NCERT, Reprint 2026-27): *"Plants can be grouped into herbs, shrubs, and trees based on their heights, types of stems, and branching patterns."*[6] By handling examples of each category in the oran, students soon gained the confidence to engage in this exercise on their own. Their observations of the diversity in shape, size, and arrangement of spines on many local plants sparked one of our most interesting discussions. The science teacher asked students what role these features might play for the plants. The students admitted that they had not thought of this before. To them, spines were simply a common feature of all local plants. When prodded, they suggested that spines might deter animals from grazing on the plant and people from plucking flowers. Since the students had not yet studied transpiration, the teacher explained that plants lose water as vapour through their leaves. The heat and dry air in deserts can accelerate this loss. Leaves modified into spines expose significantly less surface area to the air, reducing water loss. This led students to recognise spines not just as protective structures, but as vital 'adaptations' for survival in a hot, dry environment. This concept is introduced in Chapter 2 ('Diversity in the Living World') of the Grade VI science textbook (NCERT, Reprint 2025-26): *"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."*[6] We asked students if they knew of any other such adaptations that allowed local plants to survive in an environment where water is scarce for most of the year (see **Fig. 1**). This led to a discussion on

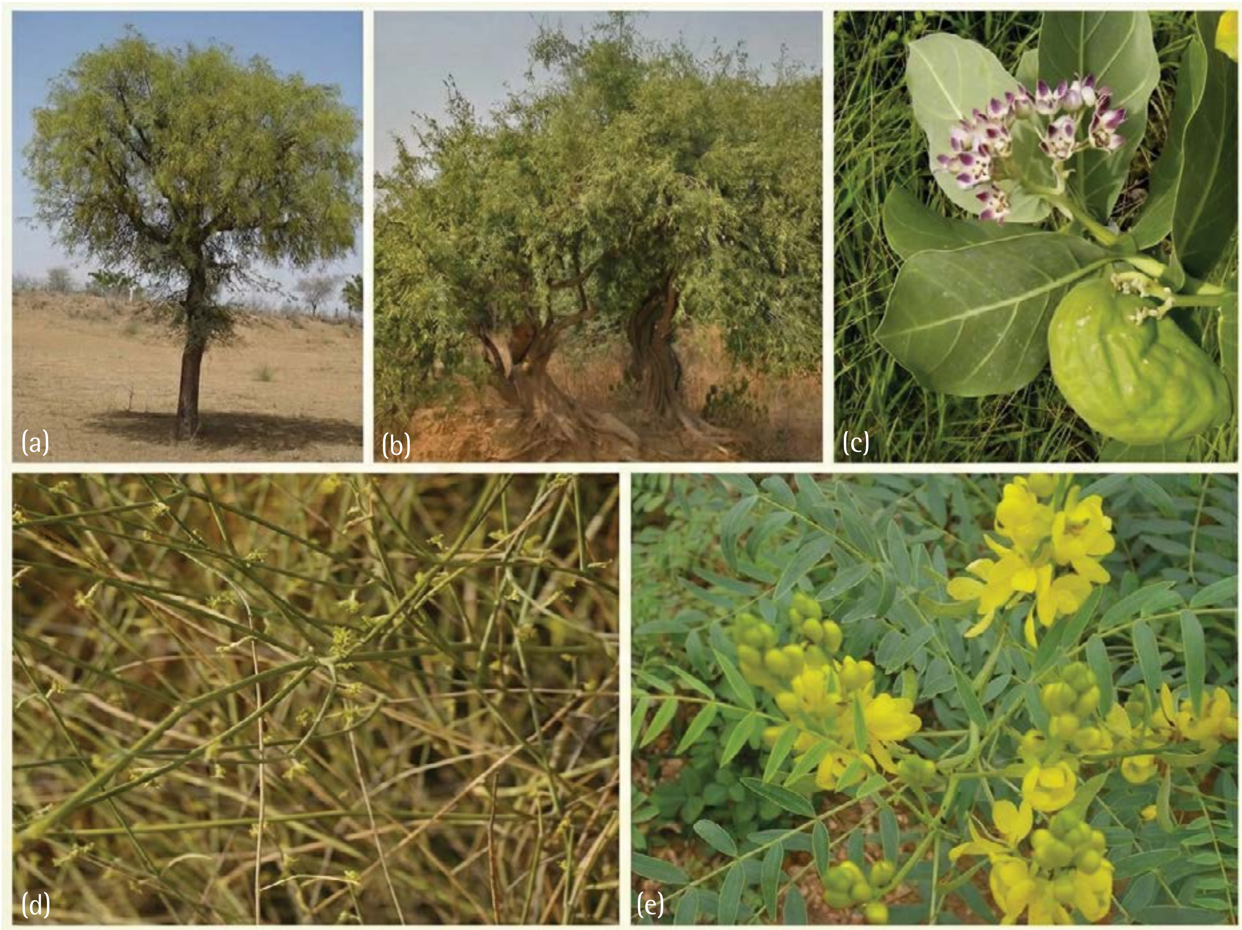

Fig. 1. Desert plants observed during the class visit to a nearby oran. To understand how vegetation adapts to the arid conditions of the Thar Desert, students examined species such as: (a) *khejri*, (b) *jaal*, (c) *akada*, (d) *kheenp*, and (e) *son makhai*.

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the deep tap roots and nitrogen-fixing capacity of *khejri* (*Prosopis cineraria*), the hardy structure and drought resistance of *jaal* (*Salvadora oleoides*), the role of the leafless herb *kheenp* (*Leptadenia pyrotechnica*) in stabilising dunes, and the fleshy leaves and thick cuticle of *akada* (*Calotropis procera*) and *son makhai* (*Senna alexandrina*).

While exploring the oran, we observed some camels browsing on the leaves of local trees like *desi babul* (*Acacia nilotica*). Students pointed out that these animals moved freely across the landscape, illustrating the open nature of the ecosystem. Although we did not spot any insects, we observed various birds, including peacocks, crows, and eagles, as well as a small group of *chinkara* (*Indian gazelle*) in the distance. These sightings sparked a discussion on how orans serve as vital sanctuaries for wildlife in an otherwise sparse environment. Students added to this by describing animals they had encountered during evening visits to their own village orans, such as desert foxes, parakeets, and *teetar* (*Grey francolin*). In Chapter 2 of the Grade VI science textbook (NCERT, Reprint 2026-27), students learn that: *"The variety of plants and animals found in a particular region contributes to the biodiversity of that region. 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."*[6] Back in the classroom, students recorded the diversity of plants and animals they had observed in the oran by preparing simple ecological maps. Some of them included notes on the local uses of these plants (see **Fig. 2**). They mentioned, for example, that *ker* (*Capparis decidua*) and *ber* (*Ziziphus mauritiana*) provide fruit, shade, and fodder; and *akada* (*Calotropis procera*) and *son makhai* are used for medicinal purposes. These notes led to discussions about how these plants support not only the ecosystem, but also the socioeconomic life of the village (see **Box 1**).

As a follow-up activity, students were asked: *How was your village 20–30 years ago? What animals and plants were common then? Can you find someone who has worked to protect trees or forests?* This approach of drawing on community memory is touched upon in Chapter 4 ('Growing up with Nature') of the Grade IV EVS textbook

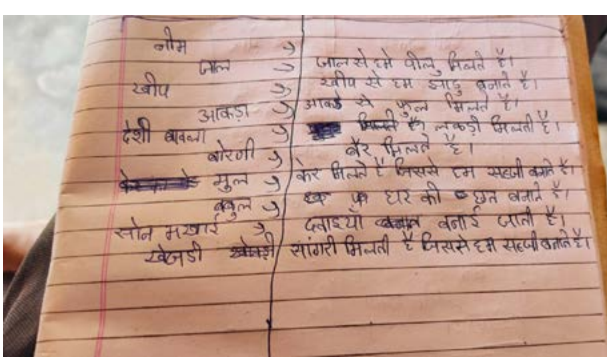

Fig. 2. Students recorded local uses of the plants they identified in the oran. These notes anchored class discussion on how plants in orans support the socioeconomic life of communities that manage them.

(NCERT, Reprint 2026-2027), where students read how sacred groves are: *"...important places for the community to gather, worship, and celebrate the beauty of nature."*[7] *They are then encouraged to: "Talk to your elders and find out the rituals in connection to animals and plants which are celebrated in your locality."*[7] Although only a few students brought their responses to class, their stories sparked powerful discussions about change, memory, and local stewardship. Students shared stories of village deities, traditional taboos against tree-cutting, and the history of the Bishnoi community, who famously protected trees at the cost of their lives. These oral histories, passed down from elders, illustrated how cultural ethics are intertwined with environmental conservation. Using the example of the *godawan* (The Great Indian Bustard), we explored the broader issues of habitat loss and communal responsibility. The students observed that villagers do not perceive orans as merely 'government' or 'forest' land; instead, they regard them as a shared heritage. This collective sense of ownership ensures that people protect local flora and fauna—not because they are told to, but by an internal sense of duty to the land. Connecting these local values to the historic acts of protection by Amrita Devi and Sunderlal Bahuguna helped students see conservation as a living tradition within their own cultural and ecological heritage.[8, 9]

I concluded the lesson by showing a short video of a rainforest in Karnataka, where dense canopy cover and heavy rainfall support a vastly different ecosystem. Contrasting these lush forests with the arid landscapes of Barmer helped students return to the meaning of the term 'forest' and understand that it covers a wide variety of ecosystems that can look very different depending on where they are in the world. I also clarified that orans might not always be called 'forests' on official maps. But they function just like them by sustaining many different plants and animals in desert environments. Chapter 2 of the Grade VI science textbook (NCERT, Reprint 2026-2027) offers a window for this kind of local connection. In a section on traditionally protected forests, students

Box 1. Curricular connections:

Planning classroom instruction around such explorations and discussions can help meet the following:

A) Curricular goal for middle-stage science: CG-3: [The student] explores the living world in scientific terms. Specifically, this lesson can help students develop the competency to:

- (C-3.1): *"Describe the diversity of living things observed in the natural surroundings (insects, earthworms, snails, birds, mammals, reptiles, spiders, diverse plants, and fungi), including at a smaller scale (microscopic organisms)."*
- (C-3.3): *"Analyse patterns of relationships between living organisms and their environments in terms of dependence on and response to each other."*[3]

B) Learning objectives for middle-stage students:

- Outline features of forests that are responsible for sustenance of life.
- Design a forest ecosystem by considering a few plants and animals and explaining how they support one another.[10]

read that: "*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...*"[6] Students are then encouraged to: *"Find out about the sacred groves in your region."*[6] This comparison broadened the students' perspective—instead of viewing forests as only distant habitats for large animals, they began to recognise that the key relationships defining these ecosystems also exist in the familiar landscape of their own community.

Parting thoughts

This experience reinforced the critical role teachers play in bridging the gap between textbook ideas and students' lived environments. The specific examples of ecosystems that textbooks use to illustrate a concept may provide a useful foundation for discussion, but may be very different from the ecological realities of many regions. By drawing on local landscapes—such as orans, gauchars, wetlands, or grasslands—teachers can anchor scientific concepts in the world students see every day. In the arid landscape of Barmer, for example, the oran served as a powerful lens for exploring ecosystems, biodiversity, and adaptation. Here, the concept of a 'forest' did not need to be abandoned or simplified; it simply needed to be translated through the ecological features of the local landscape. When students begin to see their own surroundings as sites of ecological significance, science becomes both relevant and deeply engaging. It allows students to appreciate that even in a dry, thorny desert, vital ecological lifelines are present all around. Fostering this connection requires only the curiosity and care to help students see the landscapes they already know in a new light.

Key takeaways

- Textbook descriptions of forests often draw on the dense vegetation and wildlife typical of wetter regions. Teachers play an important role in helping students interpret this concept by instead connecting it to ecological spaces in their own surroundings, such as orans and gauchars in the Thar Desert.
- Local landscapes provide opportunities for students to observe ecological relationships directly. In arid environments, teachers can use features such as thorns and deep roots to discuss plant adaptations to heat, grazing pressure, and water scarcity.
- Community practices associated with spaces such as orans show how local beliefs and traditions contribute to protecting ecological habitats. Discussing the cultural significance of these spaces helps students see conservation not only as a formal policy goal, but also as a practice embedded in their everyday social life.

Acknowledgements: The i wonder… team thanks Amol Anandrao Kate from Azim Premji Foundation for sharing this draft with us and for his support in publishing it.

Notes:

(a) Credits for the image (A view of the oran near school) used in the background of the article title: Nachiket Sandeep Shirude. License: CC BY-NC-ND 4.0 International Deed.

(b) This article includes one classroom resource: **Activity Sheet: Reading a Local Landscape.**

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DID YOU KNOW?

WHY INSECTS MATTER TO FORESTS (PART II)

Insects help maintain forest ecosystems by pollinating plants, dispersing seeds, and supporting food chains. When insect populations decline or change because of pesticide use and climate change, the effects are felt not only in forests, but also in the lives of people who depend on them.[1, 2] Honey hunters report a steep decline in bee populations and honey yield. For example, Jai Kishan Bharti, a Bharia Adivasi honey hunter from Chhindwara district in Madhya Pradesh, says: *"We each used to get 25–30 quintals of honey on these trips, now we are lucky to get 10 kilos."*[2] Trees in the jungle, like *jamun* (Indian blackberry), *behera* (Beleric myrobalan), mango, and saal (Sal), have also reduced, leading to fewer flowers and less food for bees and other insects. Surjan Prajapati, a 60-year-old potter in Parasi in central India who also gathers Mahua flowers in the forest, explains: *"Mahua is useful. I cannot survive on the money I get from selling pots."*[2] When he runs out of salt or oil at home, he sells a few kilos of dried Mahua flowers to buy essentials. Munnibai Kachlan, a Gond Adivasi from Narayanpur district, Chhattisgarh, who gathers edible red ants from the forest to sell, says: *"There was a time when we women could easily find them in the jungle. Now there are far fewer of them and you find them only on tall trees."*[2] This story helps students see that when human activity alters one part of a forest ecosystem—through pesticide use or climate change—the effects ripple outward. Insect populations decline, forest regeneration and productivity are affected, and the people who depend on forest produce for food and income bear the consequences.

How are pesticide use and climate change changing insect populations across forests? Read Part I on **page 27**.

Question for students: Ask students to interview a grandparent or elder in their neighbourhood about a local insect or plant (for example, a butterfly, honeybee, or a flowering tree like Neem or Mahua). Ask: When you were my age, when did this flower bloom? Did you see more or fewer of these insects than today? Students can draw a simple 'Then versus Now' map marking where these organisms were found earlier and where they are found now. In class, discuss what students have learned to see if the community is noticing a local 'out of sync' pattern.

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Experiences

ACTIVITY SHEET: READING A LOCAL LANDSCAPE

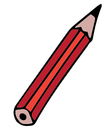
Aim:

To explore a local space and discover how living beings, non-living features, and humans interact in an ecosystem.

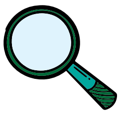
You will need:

A safe nearby outdoor space (like the school ground, roadside, park, field edge, pond edge, scrubland, grove, etc.)

Notebook



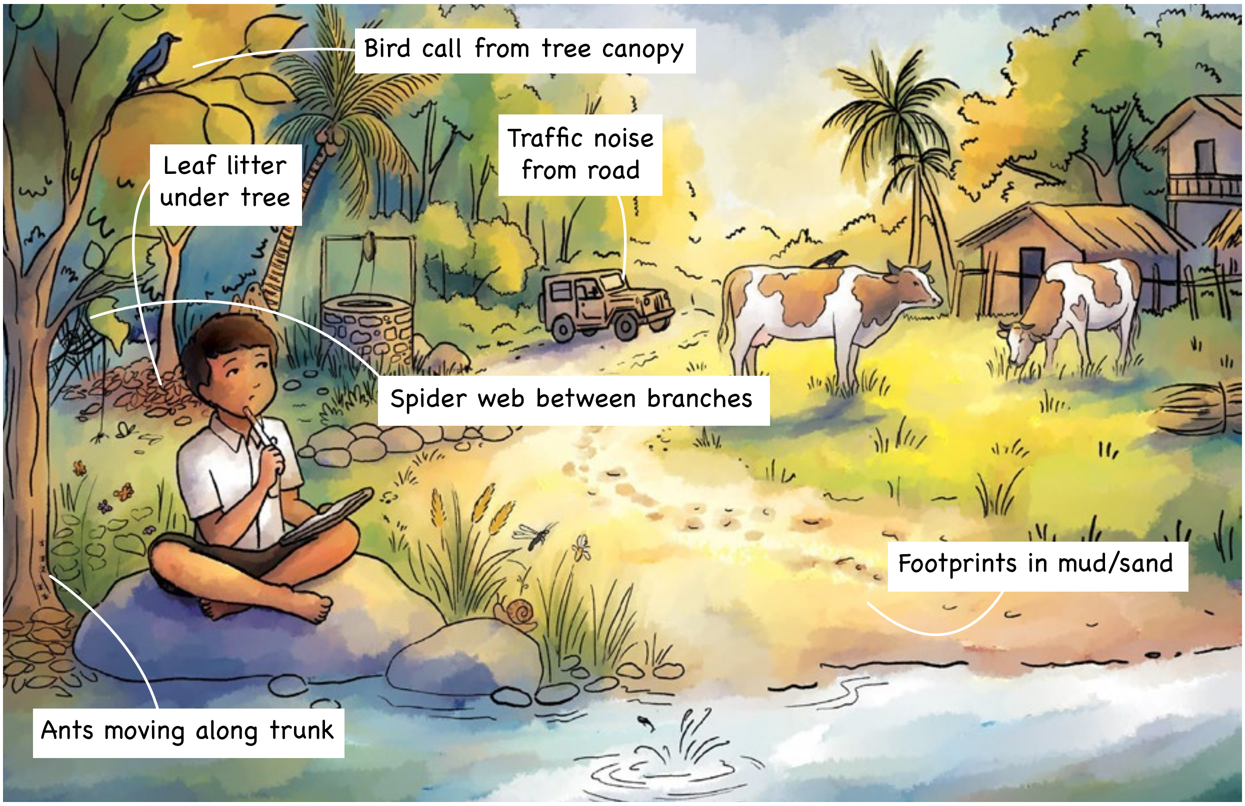
Pencil



Magnifying glass

What to do?

1. Visit a nearby outdoor space with your class, in a small group, or with an adult.
2. Walk slowly, looking at the ground, at eye level, and above you. Identify living beings, non-living features, signs of interactions, and evidence of human use.
3. Choose a spot to sit quietly for 5-10 minutes. Pay attention to smells, sounds, and sights. You can close your eyes to help you listen more carefully.



Observe not only plants and animals, but also sounds, smells, interactions, and signs of human use.

Observe and record:

a) **Context:** Note the date, day, and time. What is the current season?

b) **Sensory mapping:**

- Can you hear bird calls, insect noises, or wind in the plants? Do you hear any sounds made by people or machines (traffic, construction)? In your notebook, draw an 'X' to represent yourself. Draw symbols or write words to show where sounds are coming from (like a plant icon to the left, a car icon behind you).
- Draw a simple map of the area. Use sketches and words to show living beings, non-living features, and signs of interactions (like a hole in a leaf or a nest in a branch). Feel free to include bark rubbings or leaf prints!
- Do different parts of the space smell different (e.g., near water vs. near a road)? Why might that be?

c) **Field observations:** Use **Table I** as a guide to make sure that you notice as many details as you can.

Features	Observe
Non-living features	• **Physical:** Do you see rocky outcrops, walls, fences, or buildings? • **Micro-climate:** Is it sunny, shady, or cool? How does the air feel? • **Soil:** Is it dry, sandy, or muddy? Is it visible or covered by leaf litter? • **Land:** Is it flat, sloping, or uneven? • **Water:** Are there ponds, puddles, wells, or signs of where rain collects?
Living features	• **Plants:** Trees, shrubs, grasses, or climbers? Which are most common? How many different kinds? Clustered in one part or scattered across? • **Denseness:** If it rained, would the plants catch the water or would it hit the ground directly? • **Animals:** Where are they (on ground, on plants, under rocks, in the air, etc.)? What are they doing (like feeding, resting, hiding, hunting etc.)? What signs (like footprints, scat, chewed leaves, feathers, webs, nests, burrows, holes, etc.) can you spot of their presence? • **Hidden world:** Carefully use a stick to peek under logs or leaf litter. What small beings (like snails, millipedes etc.) are hiding there?
Ecological interactions	• **Direct:** What interactions can you observe between different living beings (like ants carrying a dead moth, a bird feeding on a lizard, etc.)?

Features	Observe
Ecological interactions	• **Indirect:** Can you identify signs of one being depending on another, even if you do not directly observe the interaction (like a spider web on a plant, an old snake skin caught in a rough bark, etc.)? • **Support:** How do the living and non-living features of this place appear to support one another (like a lizard basking on a hot rock, moss growing in the shade of a large tree, etc.)?
Human use	• **Presence:** Do you see people using this place? What are they doing? • **Structures:** Do you see signs of use by people? Look for trails, paths, fences, shrines, water tanks, etc. • **Impact:** Are plants being grown, cut, protected, or collected? Are there signs of grazing cattle? Is the human activity helping or disturbing this space?

Table I: Here are some details to look for. What pointers would you add to the list?

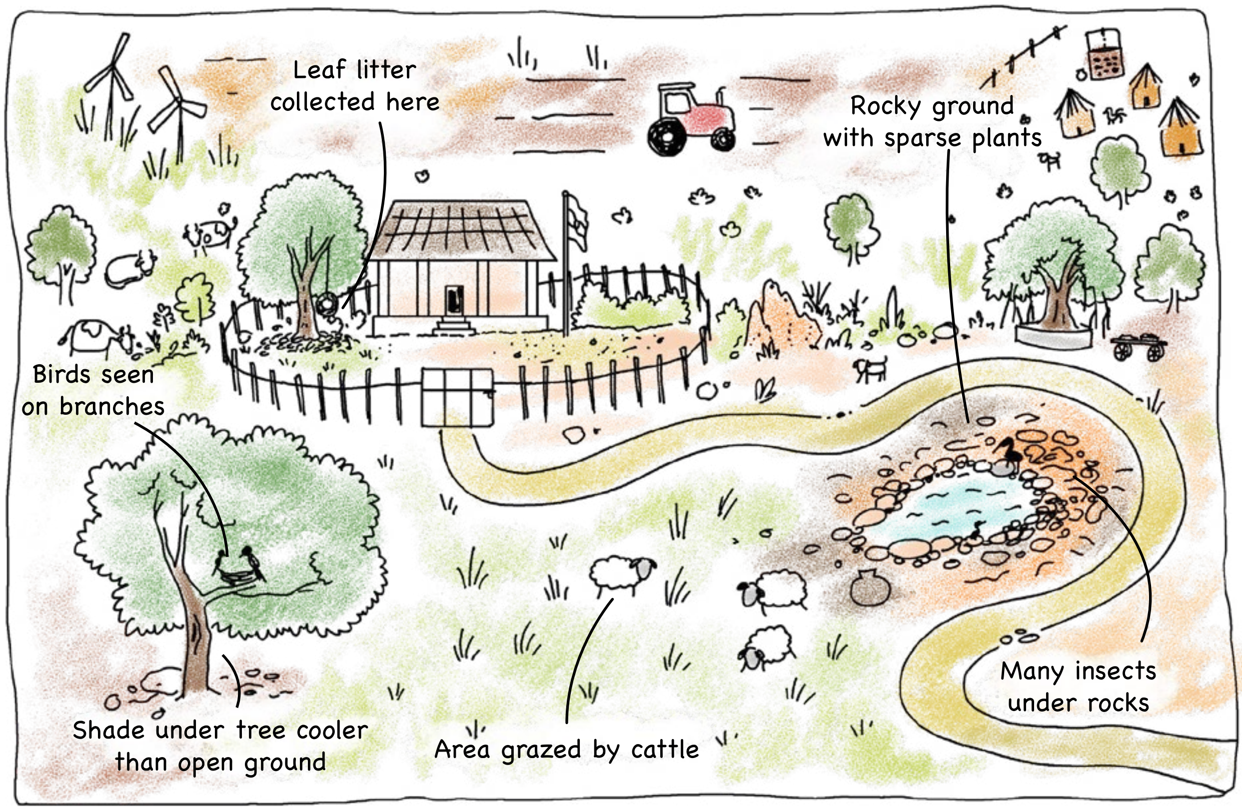
Think about:

- Does this space support many forms of life? Which specific observations suggest this? Think about the variety of plants you saw and 'animal clues' like nests, burrows, tracks, or even chewed leaves and feathers.
- How do the non-living features (like sunlight, soil, and water) influence where different plants and animals are found? For example, did you notice certain plants that only grow in the dampest or sunniest spots? Did you spot animals that appear to depend on others for food, shelter, or support (like an insect on a flower)?
- How might the living beings here affect their own environment (think about the soil, shade, moisture, or temperature)? For example, did you see some plants offer shade or think about how some animals might change the soil? Did you see any signs that this place is changing over time, such as decaying logs, new sprouts, or seasonal shifts? What do you think is causing these changes?
- How do human activities influence this space? Are there signs that people are protecting the area? Or are they disturbing it (like through plastic litter or heavy foot traffic)? In what ways is this local space similar to, or different from, the 'forest' or 'ecosystem' described in your textbook?

Discuss:

Q1. Do spaces that support life always need to look like dense forests or national parks? Based on your visit, should this local spot be considered an ecosystem? Why or why not?

Q2. What can this place teach us about: (a) how living beings depend on one another, and (b) how people's daily actions (like walking a certain path or planting a tree) shape ecosystems?



Example of an ecological map showing how the living and non-living features in a landscape can be recorded.

Q3. Why do people often fail to notice the ecological importance of familiar, everyday landscapes? What happens to the biodiversity of a town if these small spaces are cleared or paved over?

Q4. What is the most surprising thing you learned from 'reading' this landscape that you may not have learnt by reading a textbook? How would you now define an 'ecosystem' using your own words?

Extend:

A. Find one sign of an animal you **did not** actually see. What was the animal doing there, and why did it choose this specific spot instead of the middle of a busy road?

B. If we removed just one feature from this space (for example, the nearby water source or a large shady tree), list three living beings that would be most affected and why.

C. Is it possible for humans to use this space **without** harming the other living beings here? Suggest one way people could improve the 'health' of this local ecosystem.

D. If humans stopped visiting this space for one year, which one living being would benefit the most? Can you also think of one which might actually be harmed?

i wonder...
Rediscovering school science

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TEACHING ABOUT FORESTS IN THE LABORATORY OF THE REAL WORLD

PRITI DAVID

The middle-stage science curriculum introduces students to India's most iconic conservation models. What do students learn from rural stories about the real-world impacts of these models on ecosystems, wildlife, and forest-dependent communities?

In Chapter 2 ("Diversity in the Living World") of the Grade VI science textbook (NCERT, Reprint 2026-2027), students learn that: *"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 Bustard have been declared as Protected Areas in the states of Gujarat, Rajasthan, and Maharashtra."*[1]

During a discussion with middle-stage students, we were stopped mid-flow by a student who had seen ghost villages on a recent safari in a national park. *"It is good there are no people inside the park. The tiger population will increase and hunting will come down."*

This observation became an opportunity to examine the complex relationship between conservation and communities in the classroom.

Exploring real-world rural stories

I start by sharing an overview of our forests: they cover a fifth of the country's land and are highly diverse in nature. Adivasi communities have lived in and around them for centuries, caring for and guarding the trees and animals that feature in their art and songs. I also share that an estimated one hundred million Indians depend on forests for minor forest produce (such as resins, flowers, fruits, leaves, and firewood) for their daily livelihoods.[2] With this context, we look at the examples in the textbook in more detail.

(a) **Project Tiger**: I start by confirming that tiger numbers are reported to be increasing across India.[3] While this increase is often linked to conservation models such as Project Tiger, I share an example from Vidarbha, in eastern Maharashtra, to illustrate how this plays out in the real world. Forests here, as in much of central India, are becoming increasingly fragmented due to development projects, including the construction of roads.[4] As the space available to tigers shrinks, they spill out of protected areas into adjoining villages (see **Fig. 1**). As Nitin Desai of the Wildlife Protection Society of India explains: *"If there were 60 tigers in these regions then, there will be a 100 today in the same area. Where will they go? How will we manage a growing population of tigers in the same area? We don't have any plan."*[4] What effect does this have? Between 2010 and July 2018, about 330 people died in Maharashtra due to attacks by wildlife, mostly by tigers and leopards. Most of these incidents were reported around tiger reserves and sanctuaries in Vidarbha.[4] For example, in May 2018, three-year-old Vihan Kodwate and his father, Beersingh Kodwate, Gond Adivasis from Nagpur district, Maharashtra, were attacked by a tiger while travelling through a forested area near Pench Tiger Reserve. They were on their way to collect *tendu* leaves, which are dried and used for making *beedis*—a major source of summer livelihood in the forests of central India. Both father and son suffered serious injuries and were hospitalised for a week.[4] Sixty-five-year-old Babanrao Yeole, a member of the nomadic

Fig. 1. Tiger numbers in the Vidarbha region of Maharashtra have increased, but their habitats have shrunk. These animals spill out of protected areas into adjoining villages.

Credits: Davidvraju, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Tiger_chasing_a_wild_Pig.jpg. License: CC BY-SA 4.0 International Deed.

pastoralist Gowli (Nanda-Gawali) community that breeds the indigenous Gaolao cow, shares: *"But never ever in the past did we have such a tragedy, we had this practice of leaving a couple of male calves for the tigers…"*[4] Members of his community left their cattle to graze in the forest for nearly six months each year, from summer until after Diwali. The cattle were brought back to the village in winter, when fodder and water became available locally. *"There was a symbiotic relationship between us and the forests,"* Yeole says. *"It got broken when… [it] was declared a tiger reserve… We feel the forest and wildlife are no more part of our ecology."*[4] This discussion can be used to invite students to compare: **Success measured by counting tigers | Success measured by health of the forest for tigers and Adivasis.**

I also shared that India's Forest Rights Act (2006) protects the rights of forest-dependent communities, mandating that people cannot be evicted from forests unless there is evidence to show that their presence definitively harms wildlife and coexistence between people and tigers is impossible.[5] Yet, in 2008–2009, when Madhya Pradesh's Panna Tiger Reserve lost all its tigers, 12 villages were relocated to make space for tiger recovery. Among those displaced were the Raj Gond Adivasi families of Talgaon village, whose testimonies suggest their eviction bypassed legal protocols.[5] For example:

- Villagers say they were pressured to leave. As Deelan Kuandhar, now a daily wage labourer, shared: *"They [the forest department] harassed us every day. On some days, they would bring old tiger skins and threaten us that they will file a fake case against us for poaching tigers. I was even imprisoned once for a few days because they said I killed a sambar deer. One day, they brought elephants to destroy our homes. What else could we do after that?"*[5]
- Under Project Tiger, families being relocated should either receive money (10 lakh rupees per family) to arrange their own move or be properly resettled by the government. As Babulal Kuandhar, a resident of the village, shared: *"Some accepted the offer… in the beginning and left for towns and cities. But without land, what use is the money for our survival outside the jungle? So, some of us refused."*[5] The 37 families who resisted relocation later moved to a hamlet called Sarathpura, about 16 kilometres away. They say they received only 8 lakh rupees per family.[5]

This relocation had serious impacts on Adivasi livelihoods that were closely tied to the forest ecosystem. For example, In Talgaon, Babulal's family grew *urad* (black gram) and maize on five acres of land and supplemented their income by harvesting seasonal forest produce. As Babulal's mother, Shobha, shares, *"We had everything in the forest before—tendu, mahua, chironji. In summer, we collected and sold them. But now the forest guards do not allow us to enter the forest, even to collect firewood."*[5] Cut off from access to the forest, Babulal is dependent on erratic daily wage labor at nearby farms or at construction sites in a nearby *tehsil*, earning just 200–250 rupees a day when work is available.[5] This discussion can be used to invite students to think about: **The rules for evicting a village from a forest | What a community loses when their link to the forest is broken.**

(b) **Cheetah Reintroduction Project:** Cheetahs are charismatic animals, and the arrival of the African species (*Acinonyx jubatus*) in Kuno National Park in Madhya Pradesh has been widely covered in the news (see **Fig. 2**). This is a developing story and can keep students engaged for months. I find that choosing a focus like the cheetah allows us, as teachers, to return to a theme repeatedly, building deeper engagement over time. I started by sharing how, more than two decades ago, around 1,600 families (predominantly from Sahariya Adivasi, Dalit, and OBC communities) were displaced from 24 villages in Kuno to accommodate lions from Gujarat's Gir forest.[6] Told their sacrifice served an 'important conservation cause,' they hastily abandoned ancestral homes, primary schools, hand pumps, wells, and land they had tilled for generations. Even cattle were abandoned, since they would be a burden to feed without the grazing resources of the forest. Displacement

Fig. 2. African cheetahs are being introduced in Kuno National Park, Madhya Pradesh. The forest-dwelling communities that lived here were displaced in 1999 to create a second home for lions from the Gir forest in Gujarat.

also meant loss of access to the forest resources that sustained their livelihoods. As Kedar Adivasi, a 23-year-old teacher, expressed, *"All this kept us fed and clothed."*[6] Without these resources, many families found that farming alone could not sustain them. Some now migrate seasonally to nearby cities for construction labour and other work.[6] The lions did not come to Kuno. But 23 years later, the cheetahs arrived. At this point, I asked two students to come to the board and make a list: **Benefits of bringing Cheetahs to India | Sacrifices made and by whom.**

Most students' first responses focused on conservation needs: *"Forests should be left to animals only,"* and, *"yes, what to do, sometimes people have to sacrifice..."* I played a video of the displaced families speaking about the sacrifices they had made.[7] This changed the tone of the discussion. Students began asking about the land and livelihood options available to these communities. I contrasted their struggle with the money spent on transporting cheetahs from Africa on chartered planes. I also pointed out that for the chance to see one of these animals, visitors to the park pay around 3,000 rupees for a single safari ride. This, I shared, was roughly the amount that a displaced forest-dweller earned from 10 days of daily wage work at a construction site in the area. Essentially, thousands were displaced for a 20-animal experiment accessible only to those who have sufficient money to view them.[8] Other teachers present in the session picked up on this theme. One of them asked the class to compare a zoo with a free-ranging jungle: *"Which one is about conservation and which one is for human viewing pleasure?"* she asked the children. Another teacher asked how many endangered animals they could name. This discussion led students to read documents such as the Wildlife Action Plan 2017–2031 and the Cheetah Annual Report.[9, 10] Based on their research, students compared: **Funding allocated to the relocation of nonnative species | Funding allocated to the conservation of threatened native species.**

(c) **Protection of the Great Indian Bustard's Habitat:** Once common across the grasslands of India and Pakistan, the Great Indian Bustard

(*Ardeotis nigriceps*) is now one of the world's rarest birds, with only 120–150 remaining in the wild. These birds are scattered across five states in small, isolated groups. For example, only 8–10 survive near the borders of Karnataka, Maharashtra, and Telangana, while just four females have been recorded in Gujarat. The largest population is found in the grasslands of western Rajasthan's Jaisalmer district, split between Pokaran and the Desert National Park (see **Fig. 3**).[11] Importantly, this bird is listed in India's Wildlife Action Plan as a *"highly threatened... priority species."*[9] To illustrate the threats facing this priority species, I share a story from Jaisalmer detailing how the grasslands vital for its survival are being rapidly used for large-scale solar and wind energy projects.[11] The associated infrastructure—specifically a massive web of high-tension power lines—has proven deadly. A 2018 Wildlife Institute of India study estimates that powerline collisions kill around 84,000 birds annually within a 4,200 sq. km area around the Desert National Park. This includes the heavy-bodied bustards, which frequently collide with these overhead high-tension wires. Radheshyam Bishnoi, a wildlife photographer and naturalist based in Pokaran *tehsil*, shares: *"If the electric shock on encountering the wires don't kill it, the fall usually does."*[11] Sumer Singh Bhati, a local environmentalist, shares: *"In my own lifetime I have seen these birds in flocks in the sky. Now I see the single bird, occasionally and rarely in flight."*[11]

Fig. 3. The largest population of Great Indian Bustards survive in the grasslands of western Rajasthan. The habitat of these highly threatened birds is used and protected by local communities.

Credits: SVKMBFLY, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Ardeotis_nigriceps,_Desert_National_Park,_Rajasthan,_India_1.jpg. License: CC BY-SA 4.0 International Deed.

The challenge is not only in the sky. On the ground, large tracts of grasslands and sacred groves—areas where even cutting a branch was traditionally forbidden—have been taken over by wind and solar farms. As a result, local pastoralists can no longer move freely across these lands to graze their livestock. Instead, they are forced to navigate around fences, windmills and other energy infrastructure.[11] Dhanee, a 25-year-old who visits this protected area to collect grass for her four cows and five goats, says: *"If I leave in the morning, I get home only by evening. I get a shock from the wires sometimes..."*[11] In April 2021, the Supreme Court ordered that power lines in critical bustard habitats be moved underground wherever possible. Until that happened, it mandated that bird diverters (reflective markers that help birds see the power lines) be placed on existing power lines. According to the order, 104 kilometers of power lines in Rajasthan would be put underground and 1,238 kilometers of lines would receive diverters. Yet, two years later, much of this work is pending. Scientists stress that proper execution of this order could have prevented many deaths.[11] As Radheshyam observes, losing the bird also hurts local agriculture: *"Godawan doesn't harm anyone. In fact, it eats small snakes, scorpions, small lizards and is beneficial for farmers."*[11] In class, we teach the science of climate change and the need for renewable technologies. But stories like this invite students to critically examine the real-world impact of our technology choices, prompting discussion on:

Benefits of green energy for our cities | Costs for grasslands, birds, and local herders.

Parting thoughts

In Chapter 12 ('How Nature Works in Harmony') of the Grade VIII science textbook (NCERT, Reprint 2026-2027), students read that: *"... biotic components and abiotic components of an ecosystem depend on each other and support various life processes. Humans also benefit from ecosystems. For example, forests provide fresh air, fertile soil, food, fibres, timber, and medicines... Ecosystems also offer aesthetic and recreational value. These support our well-being and shows how closely nature and humans are connected... An ecosystem stays in balance when interactions among organisms and their environment keep populations and resources stable. This balance is dynamic, not fixed, and can be disrupted by natural or human-made changes... Problems like deforestation, overuse of natural resources, the spread of invasive species, unsustainable land use, and pollution are damaging forests, rivers, scrublands, wetlands, grasslands, and coastal areas. How can we stop damaging forests, rivers, and wetlands? Think about what actions you and your community can take to protect these important places."*[12] This chapter outlines the many threats to diverse ecosystems in the country and asks how we can protect them. In the classroom, we can approach this question in two ways: by focusing strictly on scientific processes, or by acknowledging that conservation involves competing needs and uneven outcomes for both the natural environment and human lives (see **Box 1**). When classrooms prioritize the transfer of textbook learning, they often sideline the social and ethical questions that must accompany scientific knowledge. Teaching science without its social context leaves students ill-equipped to navigate the complex realities of the real world. A greater risk is of nurturing a generation of young people who think more about personal achievement than about the well-being of others.

In a world of growing inequalities, education must extend beyond the petri dish of textbook information. We must reexamine what we teach and how we teach it, equipping students with the tools to question the application of science while also cultivating the ability to think and feel for others. One powerful way to bridge textbook knowledge with lived reality is by bringing rigorously researched journalistic stories, developed from public data, into the classroom. These narratives—often supported by photos and videos—breathe life into verified facts. Our experience shows that drawing students into such stories changes their perspectives. As one student reflected: *"...I realised how little I question what I see around me, and how important it is to change that."* Another shared: *"I learned the importance of listening and being more aware of what is happening in my immediate surroundings."*

Whether exploring species, habitats, or climate change, the science classroom offers multiple entry points to examine the socio-ecological impacts of conservation. These discussions help students trace how their everyday decisions impact people they may never meet, mapping the chain from conservation to displacement to who pays the price. Bringing these questions into the curriculum empowers teachers to nurture sensitive, empathetic students—young citizens who view science not merely as a collection of facts, but as a tool to contribute to a more just world.

Box 1. Curricular connections:

Planning classroom instruction around such explorations and discussions can help meet the following **curricular goal for middle-stage science:** CG-5: [The student] understands the interface of Science, Technology, and Society. Specifically, this lesson can help students develop the competency to:

- (C-5.1): *"Illustrate how Science and Technology can help to improve the quality of human life (health care, ... food security, mitigation of climate change, judicious consumption of resources...)."*
- (C-5.2): *"Share views on news and articles related to the impact that Science/Technology and society have on each other."*[13]

Key takeaways

- Middle-stage science textbooks introduce students to the importance of conserving forest ecosystems. But they do not adequately explore the impacts of conservation-related decisions on the lives and livelihoods of forest-dependent communities.
- Integrating journalistic stories about rural communities into classroom discussions on forests can help bridge the gap between textbook knowledge and real-world complexities. The most effective stories use public data, are rigorously researched, and present verified facts.
- Such stories reveal the competing needs and uneven consequences of decisions around ecosystem conservation. They can help students trace how conservation models and our everyday choices affect marginalised communities.

Notes:

(a) Credits for the image (Mahua season in Madhya Pradesh) used in the background of the article title: Nagarjun, Wikimedia Commons. URL: https://commons.wikimedia.org/wiki/File:Mahua_collection.jpg. License: CC BY 2.0 Generic Deed.

(b) This article includes one classroom resource: **Critical Thinking Story: One Forest, Many Lives.**

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DID YOU KNOW?

MENSTRUAL HEALTH IS A CONSTITUTIONAL RIGHT

On January 30, 2026, the Supreme Court of India ruled: *"The right to life under Article 21 of the Constitution includes the right to menstrual health… The right to a healthy reproductive life embraces the right to access education and information about sexual health."*[1] In practical terms, schools are now mandated to provide gender-segregated toilets, access to sanitary products, and menstrual hygiene education to girls. The judgment goes further, recognizing that *"ignorance breeds insensitivity; knowledge breeds empathy."* It emphasizes the need to build awareness among boys, parents, and teachers: *"When menstruation is discussed openly in schools, it ceases to be a source of shame. It is recognized as what it is: a biological fact."*[1, 2] The Court directed the NCERT and SCERTs to update curricula, particularly *"on menstruation, puberty, and other related health concerns… with a view to break stigma and taboo associated with menstrual health and hygiene."* This judgment raises many critical questions for us as teachers: How can our classrooms become safe spaces for open discussion on menstruation? What opportunities does the middle-stage science curriculum offer for discussing questions, fears, and misconceptions about adolescence and reproductive health? What capacities do we need to build in ourselves and our students to critically examine and address related social taboos?

Chapter 6 ('Adolescence: A Stage of Growth and Change') of the Grade VII science textbook (NCERT, Reprint 2026–27) introduces students to the physical, biological, and emotional changes during adolescence.[3] In our December 2025 issue, Anita Rawat shares how she adapted the ideas in this chapter to facilitate open discussions rooted in her students' contexts and life experiences.[4] She demonstrates how sensitive discussions on menstruation, when supported by student-friendly classroom resources, can go beyond building awareness about menstrual hygiene. They can also help build empathy among boys and encourage critical reflection on social taboos. Anita also draws our attention to what is critical for creating supportive classroom spaces for such discussions: teachers overcoming their own social conditioning and inhibitions. By approaching these discussions with care and confidence., we can help students live and learn with dignity and to their full capacity.

How are you bringing these conversations to life in your school? We invite you to share your experiences, strategies, and classroom stories with us.

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Critical Thinking Story

One Forest, Many Lives

Before you begin

We all connect to forests in different ways. For some of us, forests are homes for tigers and places to protect wildlife. For others, forests give wood for our stoves, grass for our goats, and income from our knowledge of the land. Many of us would like to visit forests to see the wildlife that we otherwise only read about. Some of us may already know people whose lives and work depend on forests.

Here are stories of different people connected to a forest in India. As you read each story, imagine you are walking into the forest with the person in it—sometimes on a paved road, sometimes on a narrow goat path, and sometimes through tall, dry grass. All the while, keeping an ear out for signs of a tiger nearby. As you read, think about:

- How does each person depend on the forest?
- How is this forest changing?
- Who is helped by these changes?
- Who faces difficulties because of them?

Each story is followed by its own questions. But the stories are all interconnected—just like the lives of the people in them. So, read all the stories before you think about the questions. Discuss them with your friends and teacher. Remember: For many of these questions, there may not be just one 'right' answer.

A forest produce gatherer

In summer, Sukmati wakes before sunrise to walk with other women to the nearby forest. This is the season when mahua trees flower. The women spread cloth under the trees to collect flowers that have fallen overnight. Later, the harvest is dried and sold at the *haat* (local weekly market). Sukmati carries them in a basket woven from bamboo gathered from the forest. With her earnings, she buys salt and cooking oil. Each week, Sukmati also gathers dry, fallen branches for the *chulha* (clay stove) on which she cooks. Before each monsoon, she collects dry grass to rethatch the roof of her mud house. When food is scarce, she digs for wild tubers or gathers fruits, edible leaves, and mushrooms. Sukmati knows what she can find where in every season.

In recent years, large parts of the forest have been fenced off. Forest watchers no longer allow villagers to enter many areas. She must walk farther and spend more time collecting the produce her family depends on. Some years, Sukmati walks through forest patches blackened by summer fires before new grass begins to grow again. While moving through the forest, she watches for signs of tigers.

- Sukmati depends on the forest for cooking fuel, food, roofing grass, and income. Why might protecting forests matter differently to her than to someone like Noor who is only visiting for a short time?
- Many products used in cities come from forests, including timber, paper, and medicines. Sukmati collects only fallen branches for fuel. Why is it important to ask whether the scale of the two kinds of human use affects forests in the same way?
- Sukmati knows where to find different plants, flowers, mushrooms, and tubers in each season. Shankar is hired as a forest watcher because he knows this landscape. Why might this kind of local knowledge be important for both people and forests?

A goat herder

Lalsu's day begins by taking his goats to graze at the forest edges. He looks for patches of green and water holes. These are the only places his goats can find food during dry months when grazing near the village is scarce. Without them, the family must buy expensive fodder. He must be careful because wild animals, including tigers, come to drink from the same water holes. These days, he sees deer less often than before. Forest officials claim goats harm the forest by feeding on young stems. But Lalsu's family has grazed animals here for generations and knows which areas to avoid in different seasons. As the goats move through the forest edge, their droppings act as manure, helping fresh plants grow.

Some traditional paths now pass through fenced forest areas, while tar roads cut across others. Lalsu avoids certain forest patches at dusk, especially where tiger movement has increased. A week ago, another herder lost a goat to a tiger. Losing even one animal is a big loss for the family. He sold two goats to pay for his father's treatment from a snakebite last year. Goats are also sold to buy rice, oil, and school notebooks, or to repay debts during difficult months.

- Forest officials say goats damage young plants. But Lalsu says that goat droppings help plants grow. Can both be right? What else should we know before deciding how grazing should be managed?
- Lalsu sees fewer deer than before, while tiger movement near villages has increased. What might this suggest about changes happening inside the forest?
- Many people living far from forests use milk, leather, meat, roads, and electricity every day. How might the demands made by people in towns and cities affect families like Lalsu's?

A forest watcher

Shankar's day often begins before sunrise. Carrying a *lathi* (a bamboo stick), a water bottle, and a small cloth bag, he patrols the forest. He walks long distances (almost 25 km) daily, looking for forest fires, poachers' traps, injured wildlife, or stray cattle. Some villagers are angry with him for stopping them from grazing animals or cutting wood in protected areas. Shankar sometimes patrols near railway tracks and roads that cut through the forest. At night, animals crossing these stretches can be injured or killed by speeding vehicles and trains. In recent years, Shankar has been asked more often to monitor tiger movement near villages and farms outside the reserve boundary.

Shankar was hired for this job because he is from a nearby village and knows the landscape well. But his job is not permanent. He earns about six thousand rupees a month, but his salary has been delayed for two months. He sometimes stays for several days in a bare, one-room anti-poaching log hut deep in the forest, lit only by a dim solar lamp. Each night, before sleeping, he checks the floor and mat for scorpions or snakes that may have entered through gaps in the wood while seeking shelter from the heat. Patrolling can be risky. Last year, a watcher in a nearby range was injured in a wild animal attack. Even so, Shankar continues his rounds every day because his family depends on his income.

- Shankar is a villager himself, yet his neighbours are angry with him. How do you think it feels to be caught between your job and your community?
- Shankar stops villagers from grazing animals in the forest. But he also patrols near roads and railway tracks where animals are often killed by vehicles. Which of these seem more dangerous to you? What factors decide which activities in a forest are restricted and which are allowed?
- Shankar's job is to 'protect' the forest. Yet his job is not permanent and his salary is often delayed. What does this say about how much we value forest watchers?
- Shankar is now asked to monitor tiger movement outside reserve boundaries more often than before. What does this tell you about the health of the forest?

A student visitor

Noor had read about Project Tiger in her science textbook, so she was excited when her school announced a visit to a nearby tiger reserve. But the forest was not as silent as she had imagined. Jeeps moved up and down the safari route carrying tourists with large cameras and binoculars. Noor noticed plastic bottles and snack wrappers by the roadside. At first, she kept asking, "*Will we see a tiger?*" The guide pointed out pugmarks on the ground and explained that one had passed through the area earlier.

As they moved further into the forest, Noor saw a road cutting through the trees and power lines overhead. In some places, there were fences, and in others, she saw open patches where trees had been cleared. Her teacher had explained that tigers are quiet, solitary animals that need large, connected forests to move, hunt, and find mates. Looking at the broken landscape, Noor wondered how easily these animals could move across these spaces and cross these barriers. By the end of the visit, Noor had not seen a tiger. But she had started to notice how the forest is used and changed in many different ways.

- Noor saw tourists leaving plastic and jeeps making noise. How might these affect tigers? Why are tourists allowed in 'protected' areas while people like Sukmati and Lalsu are often kept out?
- The textbook says tigers need 'connected forests,' but Noor notices roads and power lines cutting through the forest. Why are such infrastructure projects allowed to fragment tiger habitat?
- Shankar protects forests every day, but he does not fully benefit from the tourism or attention tiger reserves receive. Who gains the most from wildlife conservation, and who carries most of the burden?
- Noor wonders how animals cross the fences she sees. How might these physical barriers affect a tiger looking for a mate, Sukmati in her search for mahua flowers, and Lalsu in his access to grazing land?

After reading

Think about: All four people in these stories have different relationships with the forest. Who did you relate to most, and why? How did your feelings for that person shape your answers to the questions at the end of each story?

Discuss: As forests change because of conservation policies, roads, tourism, energy projects, and climate pressures, both wildlife and people are affected in different ways.

a) **The meaning of 'protection'**: If a forest is 'protected' from a woman gathering fallen mahua flowers, but not from a tar road or power line, what is actually being protected?

b) **Shared risks**: A tiger kills Lalsu's neighbour's goat, and a snake bites his father. These are some risks Lalsu faces every day. Does a person in a city who wants to 'save the tiger' share any of these risks? Why or why not?

c) **The role of knowledge**: Who do you think understands tiger movement better: a scientist who spends 2–3 months each year using camera traps and GPS to map it, or people like Lalsu, Shankar, and Sukmati who walk through the forest every day and use their senses to notice small changes in the forest itself? How might the knowledge of these two groups differ? Why is one often listened to more than the other? What might happen if a new forest law draws on knowledge from only one of them?

d) **Power and fairness:** Often, people living far away have the most power to make rules for the forest, while those living in or near it face the most risks. How can we make conservation fairer for both the people and the wildlife who call the forest home?

Your turn: Have you seen or met someone who gathers produce from a forest, grazes animals near them, or works to protect them? Create a fifth story card based on someone in your own area or your own experience. How would you write their story? What questions would you ask other children to think about?

i wonder... Rediscovering school science

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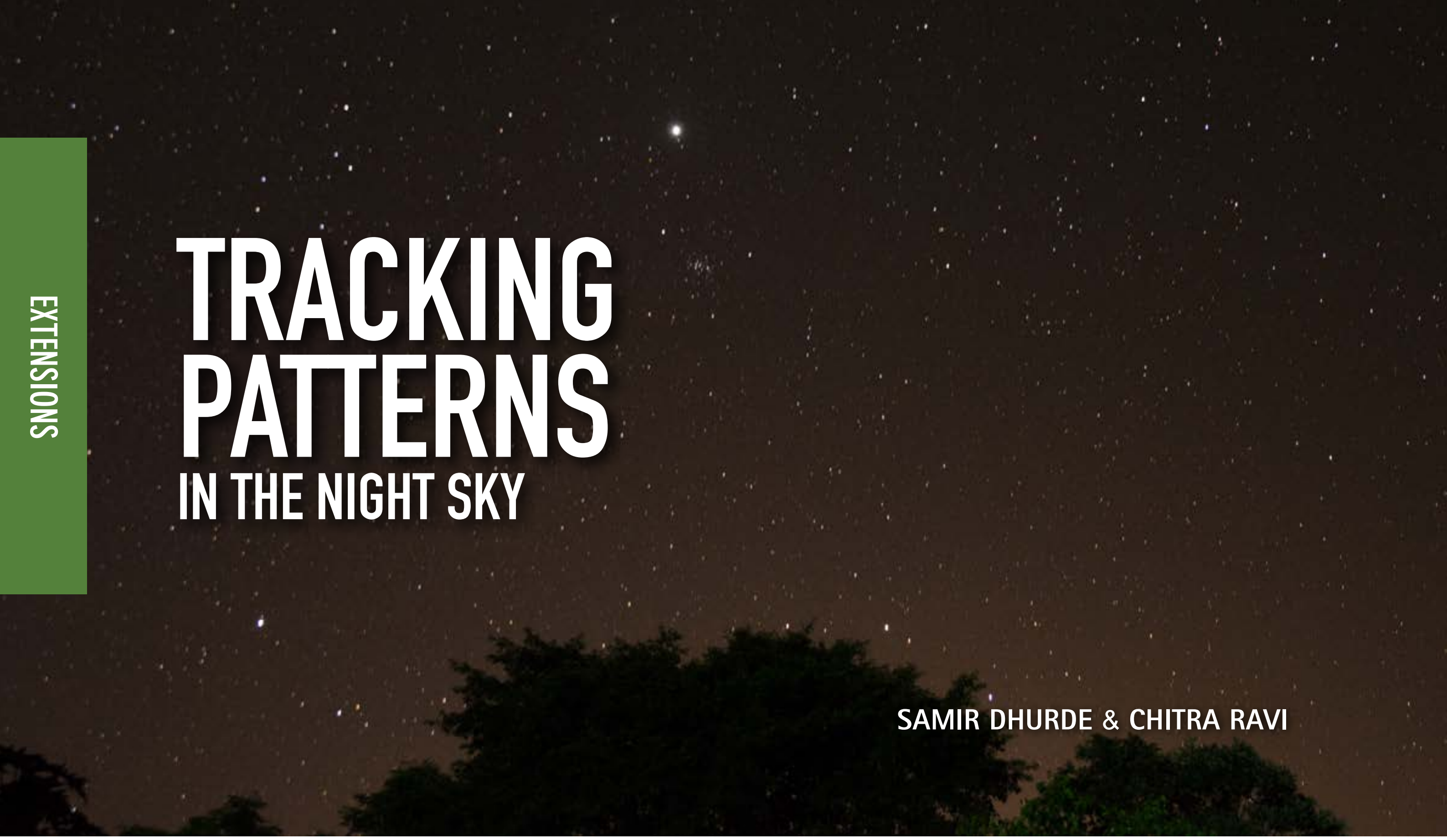

TRACKING PATTERNS
IN THE NIGHT SKY

SAMIR DHURDE & CHITRA RAVI

The Grade VI science textbook suggests an observation-based approach to introduce students to a range of celestial objects in the night sky. What patterns can students observe when they move from one-time tasks to regular observation?

Chapter 12 ('Beyond Earth') of the Grade VI science textbook (NCERT, Reprint 2026-27) introduces students to many celestial objects: stars, planets, satellites, asteroids, comets, and galaxies.[1] It also includes ideas for four activities (12.1-12.4) that encourage students to observe these objects for themselves in the night sky.[1]

These activities recognise the night sky as a natural classroom filled with wandering planets and bright stars. More importantly, they remind us that students can see and study many of these objects, and the patterns they form in the sky, without any special equipment (see the **Field Guide**). They also suggest how students' curiosity about celestial objects can be deepened through observations that allow a clear progression in learning. For example, the first activity invites students to draw any patterns they observe in the sky and make stories around them. The next three activities encourage them to locate specific constellations (like Orion), specific stars (like Pole Star), and a specific planet (Venus) in the night sky.[1]

Rather than seeing these activities as one-time tasks, teachers can adapt them to encourage

Box 1. Extending textbook activities to encourage regular observations:

Chapter 12 of the Grade VI science textbook (NCERT, Reprint 2026-27) provides some instructions—such as choosing a dark location and allowing eyes to adjust to the dark—to help students make one-time observations of the night sky. These can be easily extended to regular observations. Here are a few other simple practices that can help students build this habit:

- Help them learn to identify the four cardinal directions (North, South, East, and West) even without a compass. Observing where the Sun sets can help students establish direction.
- Organise periodic observation sessions—either in school or as guided home activities. Emphasise the usefulness of observing the night sky regularly over several days or weeks to notice changes in the positions or patterns of celestial objects.
- Encourage students to focus on a few easily identifiable patterns in the sky, rather than trying to locate many objects at once. If students struggle with night observation, suggest that they use a flashlight (with its face covered with red cellophane to reduce glare).
- Encourage students to maintain records of their observations. They can sketch and/or describe what they observe each day. Invite students to share observations of patterns during class discussions. You can also connect their observations with stories from Indian astronomy and cultural traditions to broaden student engagement.

students to track and record structured observations of the night sky over longer periods (see **Box 1**). What scientific concepts and thinking skills can students develop from this extension?

Linking observations with textbook ideas

Regular observations of the night sky can be used to strengthen students' understanding of a variety of concepts and ideas introduced in the middle-stage science curriculum:

(a) **Observing constellations:** At first, the night sky may appear to students as a random collection of objects, with no clear pattern. This can be addressed by asking them to identify constellations. At this stage, the focus needs to be less on getting students to memorise the pattern of stars that form each constellation, and more on learning to make systematic observations of the night sky. Looking at the same constellation at different times over a single night, or over a period of weeks or months, may allow students to notice how its position in the sky changes over time. For example, they may observe that Orion appears to rise in the east, move across the sky, and set in the west. They may also notice a westward shift in its position relative to buildings, trees, or the horizon even within a period of 1–2 hours. Teachers can use these observations to point out that the apparent movement of constellations across the sky over a single night is due to the Earth's rotation. Similarly, students may notice that in certain months of the year (for example, from about November to February in India), Orion is visible in the evening sky. But in other months, it appears later at night or before sunrise. Teachers can explain such observations by pointing to the fact that the Earth revolves around our Sun—this movement changes which part of the sky is visible to us at the same hour across different times of the year.

(b) **Observing stars:** Observing the night sky allows students to pay closer attention to stars other than our Sun. Learning to locate constellations provides a way to organise this practice. For example, students can easily identify Orion by first locating the three bright stars that form its belt (see **Fig. 1**). These can be used to identify the other stars in this constellation. By drawing an imaginary line through the belt toward the southeast, students will hit an incredibly bright, twinkling star. This is Sirius. Locating this star makes it easier for students to trace the rest of Canis major. If students follow the line from the belt in the opposite direction (northwest), it will lead them to a reddish star. This is Aldebaran, the eye of Taurus the Bull. If they go a bit further in that same direction (northwest), they will run into a tiny, fuzzy cluster of stars that looks like a 'mini' Big Dipper. This is the Pleiades (the Seven Sisters). Students can also connect Sirius to Betelgeuse (the slightly reddish looking

Fig. 1. The stars that form the Orion constellation. The three bright stars forming Orion's belt are the most prominent and easiest to locate. Once these are identified, the other stars that outline the hunter become easier to recognise. Students may also observe that Betelgeuse appears reddish, while Rigel appears bluish-white.

star that forms Orion's shoulder) and Procyon (a star from Canis minor) that appears to rise shortly before Sirius in the Northern Hemisphere) to form the 'Winter Triangle'. This seasonal pattern with the shape of a nearly perfect equilateral triangle is often easy to spot, even from cities with light pollution. In this way, students can start building mental maps of the night sky from their location. As students practise locating these constellations regularly, they may begin asking questions about the differences they observe between stars within a constellation. For example, students may wonder why some stars appear brighter than others.

Teachers can explain that stars like Sirius appear brighter to us because it is one of our closest neighbors (only 8.6 light-years away) and emits about 25 times more light than our Sun. They can also contrast this with a star like Rigel (the brightest star in Orion) that emits 120,000 times more light than our Sun, but does not appear to be as bright as Sirius because it is much further (about 860 light-years) away. Comparisons like this can help students see that the sky has depth. Similarly, students may ask why stars appear to have different colours. Teachers can explain that some differences in colour are because of differences in surface temperature—bluish stars like Rigel are extremely hot, while reddish stars like Betelgeuse are cooler. They can also share how a star's colour often tells us where it is in its 'life cycle'. Young, energetic stars are often blue in colour; middle-aged stars (like our Sun) are often yellow; and stars like Betelgeuse, which are nearing the end of their lives, often turn red. Learning that Betelgeuse is expected to explode (as a supernova) 'soon' in cosmic time can make the sky feel more active and dynamic to students. Finally, by drawing attention to how Sirius often appears to flicker in multiple colours (red, blue, and white), teachers can explain that this effect is due to Earth's atmosphere. Because Sirius often appears low on the horizon, its light travels through a thicker layer of turbulent air before reaching our eyes. This air can split the light into different colours—we notice this effect so clearly because Sirius is so bright. Such contrasts help students appreciate how similar observations (differences in star colour) may not always have the same explanation.

(c) **Observing planets:** One of the most teachable observational cycles in the night sky relates to the changing position of Venus. Teachers can extend the one-time task in the textbook by asking students to locate Venus once a week over several weeks. As suggested in the textbook, students can do this either shortly after sunset or just before sunrise, depending on when the planet is visible from their location. During each observation, students can note the position of Venus relative to the horizon, the sunset/sunrise point, and fixed landmarks like trees

Box 2. Curricular connections:

Planning classroom instruction around such explorations and discussions can help meet the following:

A) Curricular goals for middle-stage science:

- CG-2: [The student] explores the physical world in scientific and mathematical terms. Specifically, it can help students develop the competency (C-2.5) to: "*Observe and identify celestial objects (stars, planets… constellations…) in the night sky using a simple telescope and images/ photographs, and explain their role in navigation, calendars, and other phenomena…*"
- CG-6: [The student] explores the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry. Specifically, it can help students develop the competency (C-6.2) to: *"Formulate questions using scientific terminology (to identify possible causes for an event, patterns, or behaviour of objects) and collect data as evidence (through observation of the natural environment, design of simple experiments, or use of simple scientific instruments)."*[2]

B) Learning objectives for middle-stage students:

- The learner distinguishes between stars, planets, and satellites e.g., Sun, Earth, and Moon.[3]
- List commonly seen objects in the sky as celestial objects.[4]
- Categorise... commonly known groups of stars in order to explain that constellations are groups of stars with recognisable shapes.[4]

or buildings. They can record whether it appears higher or lower in the sky than in the previous week, and how long it remains visible. These observations can be recorded as brief, dated sketches or notes and compared over time. What pattern are students likely to notice through these weekly observations? If they first spot Venus after sunset in the western sky, it will initially appear close to the horizon. Over several months (about 8-9), it will appear brighter as it climbs higher each week and moves further away from our Sun's position in the sky. Eventually, it 'drops' back toward the Sun, becoming harder to see, and disappears for about 1-3 weeks. It reappears in the eastern sky before sunrise, as the 'morning star'. From this point onward, it quickly reaches its highest point before slowly sinking lower over several months (about 8-9). Its visibility decreases each week as it moves closer to the rising Sun. It then disappears again for a longer period (about 2-3 months) before reappearing as the 'evening star.' Through this exercise, students will observe firsthand that planets do not stay in fixed positions relative to the horizon or stars. Teachers can also point out that Venus never appears high overhead at midnight. They can explain that because Venus orbits closer to our Sun than Earth, it always appears to us as being tethered to our Sun. This also means that if a student sees a bright object with a steady light directly overhead at midnight, they can be certain it is not Venus. Instead, it is likely a planet that orbits outside Earth's path, such as Jupiter or Mars. Over time, this exercise can strengthen students' understanding that Earth and Venus are continuously revolving around our Sun at different speeds.

Parting thoughts

Chapter 12 of the Grade VI science textbook (NCERT, Reprint 2026–2027) encourages teachers to introduce students to the night sky without specialised equipment.[1] Extending the focus of the activities shared in this chapter from one-time identification to regular observation has the potential to spark a lifetime of curiosity in celestial objects among students. Teachers can support this shift by guiding students on what to observe, encouraging them to record their findings through simple sketches and notes, and providing opportunities to compare and discuss their observations across weeks. In doing so, teachers can draw attention to patterns that emerge over time and use them to strengthen students' understanding of ideas such as motion, light, and scale. Such an approach allows students to move beyond memorising celestial names and definitions to begin thinking like astronomers (see **Box 2**). They begin to engage with the night sky not as a fixed image, but as a changing system that they can continually observe, question, and learn from.

Key takeaways

- Textbook activities in the Grade VI science curriculum can be treated as opportunities for regular and structured observation, rather than one-time tasks, to help students notice patterns and changes in the night sky over time.
- Identifiable constellations, prominent stars, and visible planets can be used as reference points to help students organise their observations and build mental maps of the night sky.
- Teachers can support students in connecting observations to concepts (such as motion, apparent size, and distance) by guiding what they notice, record, and discuss.

Acknowledgements: The i wonder… team thanks Anand Narayanan from the Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram, for connecting us with Samir Dhurde.

Notes:

(a) Credits for the image (A View of the Night Sky, India) used in the background of the article title: Ashwin Kumar. License: CC BY-SA 2.0 Generic Deed. URL: https://flickr.com/photos/ashwinkumar/18288146776/in/photostream/.

(b) This article includes one classroom resource: **Field Guide: A Beginner's Map to the Night Sky**.

(c) The order of authors' names and bios in this article reflects the sequence in which contributions were made. The author who made the first concrete contribution is listed first, and the author who contributed most recently is listed last. Unlike in academic publications, this order does not indicate the relative extent or importance of each author's contribution.

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FIELD GUIDE: A BEGINNER'S MAP TO THE NIGHT SKY

Welcome to the Night Sky!

Have you ever looked up at the night sky? You already recognise the biggest and brightest object—the Moon. But what about the rest of the sky? Has someone pointed out another bright object or a cluster of stars in a familiar pattern?

The night sky can sometimes look like a dark canvas with many mysterious, shiny objects. Some of these look big and bright, others tiny and faint. Some twinkle; others shine steadily. With so many dots of light, one part of the sky can easily look like another. This is why we look for patterns. Learning these patterns is like finding landmarks in your neighbourhood—they help you find your way around the vast sky. You don't need a telescope to do this. There is so much you can see with just three tools: your eyes, your patience, and your curiosity.

How to start:

1) **Partner with an adult:** Always make sure you have an adult with you when you go out to observe the night sky. It is safer and more fun to have a partner to spot patterns with.

2) **Give your eyes time:** It takes about 20 minutes for your eyes to adjust to the dark. Stay away from phone screens and bright lights during this time so you can see the fainter stars.

3) **Look closely:** Constellations appear in different parts of the sky in different seasons. But you can track them by their pattern of stars, which does not change. Planets are trickier. You will not always find a planet in the same part of the sky or near the same stars. They drift over even shorter periods (days and weeks). Once you spot a planet, note the general part of the sky where it appears and any star patterns around it. Track how its position changes over time.

Understanding seasons:

The sky changes as the Earth moves. Here is what to expect throughout the year:

1) **Winter skies (November to February)**: These are the best for beginners! The air is usually crisp and steady, which makes the stars appear sharp and bright. Do remember to carry something warm if you plan to be outside for a long time.

2) **Summer skies (May to July)**: The air can be a bit hazy during these months, especially if you are near a city. However, the brightest star patterns are still easy to find.

3) **Monsoon and Autumn skies (August to October)**: The weather can be tricky, but the sky begins to clear up by late September. This is a wonderful time to spot massive patterns and very bright individual stars as the clouds disappear.

(a) Orion (The Hunter) or Mriga – The Deer):

Best months: December to February.

How to find: Look in the east to southeast in the early evening for three bright stars (Alnitak, Alnilam, and Mintaka) in a short, straight line (Orion's Belt). They are almost equally bright, evenly spaced, and easy to spot, even in city skies. Once you find the belt, look for the four bright stars that form a large rectangle around it. The reddish star at the top-left is Betelgeuse (the shoulder), and the bright blue-white star at the bottom-right is Rigel (the foot). Together, these stars create the unmistakable shape of a hunter or a giant hourglass.

Look closely: Betelgeuse, to the north of the belt, is different in colour from Rigel to the south. One glows with a warm orange-red light, while the other shines with a crisp blue-white light.

Think about: Colours can tell us how hot a star is. Which one do you think is hotter—Betelgeuse or Rigel? Why?

(b) Taurus or Vrishabh (The Bull):

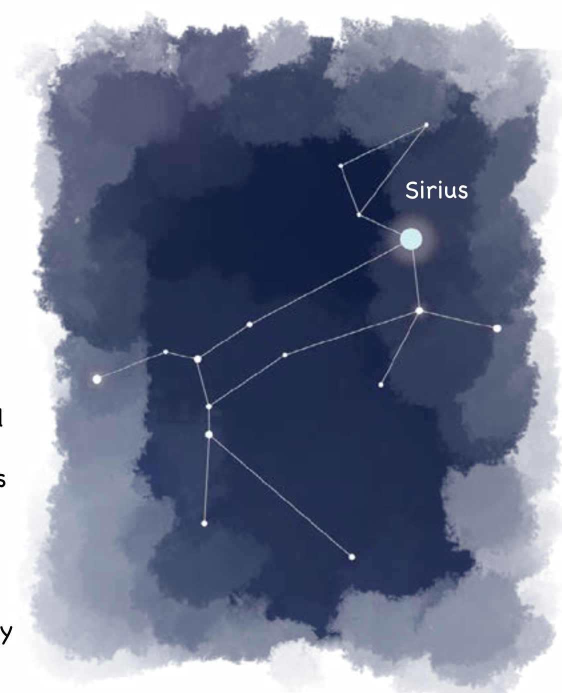
Best months: December to February.

How to find it: Look north of Orion's right "shoulder" (Betelgeuse). You will see this V-shaped pattern of stars that forms the face of the Bull. Within this pattern, look for a bright orange star (Aldebaran), which marks the Bull's eye. Following the lines of the "V" further out leads to two bright stars that mark the tips of the Bull's long horns. Just past the "V," look for a tiny, shimmering cluster of stars called the Pleiades (Krittika), which sits on the Bull's shoulder.

Look closely: At first, the Pleiades may look like a faint, blurry patch. When you look carefully, you may begin to see individual stars.

Think about: Are the stars in Pleiades really that close to each other, or do they only appear that way from Earth?

(c) Canis Major (The Big Dog) or Vyadh (The Hunter):



Best months: December to February

How to find: Start at Orion's Belt and draw an imaginary line downward toward the southeast until you reach the brightest star in the night sky. This is Sirius. It marks the chest of the Big Dog. From Sirius, look for a small triangle of stars above it that forms the head and a larger group of stars extending further southeast to form the Dog's body, legs, and tail.

Look closely: Sirius shines very brightly and may twinkle strongly. It stands out clearly from all other stars nearby.

Think about: Does Sirius appear so bright because it is closer to Earth, or because it is bigger and hotter than other stars?

(d) Scorpius or Vrushchik (The Scorpion):

Best months: May to July.

How to find: Look toward the southeast after 9 PM. Search for a long, curved chain of stars that looks like a giant fishhook or a backwards question mark.

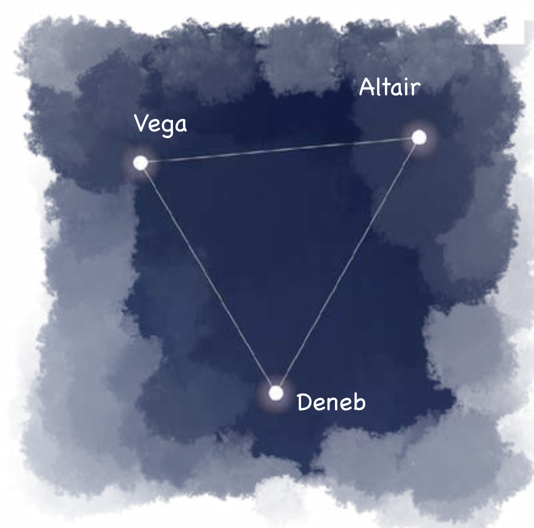
Look closely: The curve of stars at the bottom bends downward and then hooks back up to form a "stinger." Near the top of the hook, look for the bright reddish star Antares. This star marks the "heart" of the scorpion.

Think about:	Can you imagine other shapes with the same stars? For example, if you ignore the "stinger" at the end, can you imagine these stars forming a kite with a long tail?

(e) Sagittarius (The Archer) or Dhanu (The Bow):

Best months:	June to August.
How to find:	Look just east of Scorpius for a pattern of eight stars that looks exactly like a teapot.
Look closely:	On very dark, clear nights, you will notice a faint, glowing band of light rising like "steam" from the teapot's spout. This cloudy band is the Milky Way, the galaxy we live in.
Think about:	When you look into the "steam" coming from the spout, you are actually looking directly toward the densely packed center of our galaxy! How does it feel to know that we are inside a much larger system of stars?

(f) The Summer Triangle (Trayambak):



Best months:	June to September
How to find:	Look high in the eastern sky during summer evenings for three very bright stars forming a massive triangle. These stars are Vega, Deneb, and Altair.
Look closely:	These stars are very far apart. So you will need to use your whole field of view to spot this pattern. Vega is usually the brightest and highest of the three.
Think about:	The Summer Triangle is not an "official" constellation. It is an asterism—a recognisable pattern made by connecting bright stars from different constellations. Each of the three stars in this asterism belongs to a different constellation: Vega is in Lyra (The Harp), Deneb is in Cygnus (The Swan), and Altair is in Aquila (The Eagle). Can you spot the harp, swan, or eagle hiding in the sky around them? What new asterisms would you invent by connecting bright stars from other constellations?

(g) Pegasus (The Winged Horse) or Bhadrapada (The Lucky Feet):

Best months: September to November.

How to find it: Look high in the eastern sky during autumn evenings for four bright stars that form a massive box. This is known as the Great Square of Pegasus.

Look closely: The large space inside the square looks like a dark, open "window" in the sky. It appears almost empty of other bright stars.

Think about: Large, simple patterns like this are very useful signposts. If you were to use the straight lines of the Great Square as pointers, which other stars or constellations could you find? For example, can you follow a diagonal line to spot a "W" or "M" shape (Cassiopeia or Sharmishtha), or look just below the square to find a long, faint trail of stars that looks like two fish (Pisces or Meena)?

Galaxies

(a) Milky Way or Akashganga:

Best months: March to October. The brighter central region is most visible during the summer and monsoon months. The fainter outer regions are visible in winter.

How to find it: You must be far away from city lights on a moonless night. Look for a hazy, faintly glowing band of light that arches across the night sky, passing through constellations like Sagittarius and Cassiopeia.

Look closely: It looks like a glowing trail of spilled milk or a faint, cloudy river. This "cloud" is actually the combined light of billions of distant stars that are too far away to see individually.

Think about: We are living inside a giant, flat disk of stars. Because we are inside it, we cannot see its spiral shape directly. Can you imagine what our galaxy would look like if you could fly a spaceship outside of it?

(b) Andromeda Galaxy or Devayani:

Best months: September to December

How to find: Start at the northeastern star of the Great Square of Pegasus. From there, follow the curved chain of stars extending away from the square for about the same distance as one side of the square. The Andromeda Galaxy appears nearby as a faint glowing patch.

Look closely: You will need a dark location on a night without the Moon. It will appear as a very faint, glowing, misty patch. You will not see sharp details, but just spotting this fuzzy smudge is an incredible achievement.

Think about: Almost every other star you see in the sky is inside our own Milky Way. But this faint patch is an entirely different galaxy containing about a trillion stars. How does it feel to look at an object so far away that its light took 2.5 million years to reach your eyes?

Planets

(a) Venus or Shukra:

How to find: Look in the west just after sunset (the "Evening Star") or in the east just before sunrise (the "Morning Star"). It is very bright and is often one of the first bright objects visible as the sky darkens.

Look closely: It shines with a steady, piercing white light and does not twinkle much. You will also never see Venus high in the middle of the night sky or on the opposite side of the sky from the Sun.

Think about: Venus never strays far from the Sun in our sky. What does this tell you about its path in space?

(b) Jupiter or Brihaspati/Guru:

How to find it: Look for a bright and steady point of light. It is often the second-brightest planet after Venus and is often brighter than Sirius.

Look closely: Unlike stars, Jupiter does not twinkle. If you watch it carefully over a few weeks, you will notice it slowly shifting its position against the background of stars.

Think about: The word "planet" comes from an ancient Greek word meaning "wanderer." While stars stay locked in their constellation patterns, planets wander freely through them. How would you explain this difference?

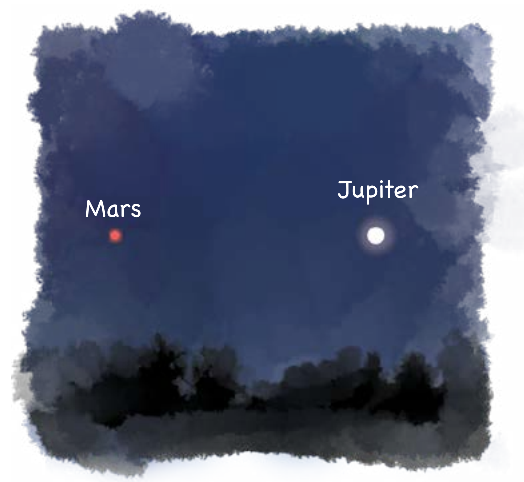
(c) Saturn or Shani:

How to find it: Look for a steady, yellowish-white point of light. It is noticeably dimmer than Jupiter and Venus.

Look closely: Just like Jupiter, it does not twinkle much. Because it is so far away, it moves very slowly. You will need to track it over many months to clearly see it shift in position.

Think about: Saturn takes nearly 30 years to make one full trip around the Sun. How old will you be when Saturn returns to this exact spot in the sky?

(d) Mars or Mangal:



How to find it: Look for a bright, star-like object that has a distinct reddish-orange colour.

Look closely: Compare its colour with nearby stars. It often looks very similar to the red star Antares in Scorpius! (In fact, the name "Antares" literally means "Rival of Mars" because they look so much alike).

Think about: Antares appears red because its outer layers are relatively cool for a star. But Mars is a cold, solid planet. Do you know what makes its rocky surface look red? (Hint: Think about what happens to iron when it gets rusty!)

(e) Mercury or Budh:

How to find it: This is the hardest planet to spot with the naked eye! Look very low near the horizon, either just after sunset or just before sunrise.

Look closely: It is only visible for a short time before it dips below the horizon or disappears into the bright glare of the Sun. It might twinkle slightly.

Think about: Because Mercury is the closest planet to the Sun, it never gets far enough away for us to see it in the dark, middle part of the night. If you were standing on Mercury, how massive do you think the Sun would look in your sky?

Keep looking up!

The night sky is always changing, but it does so slowly. The more you observe, the more you will begin to recognize patterns, movements, and differences. What looks like a random scattering of stars at first will become a familiar map over time. A star pattern you miss in the summer will return like an old friend next year. A planet you watch tonight will have wandered to a new neighbourhood by next month.

Remember: you are doing exactly what the world's first astronomers did thousands of years ago. So take your time, trust your eyes, and keep asking questions. Every time you step outside and look up, the sky will reveal a little bit more to you.

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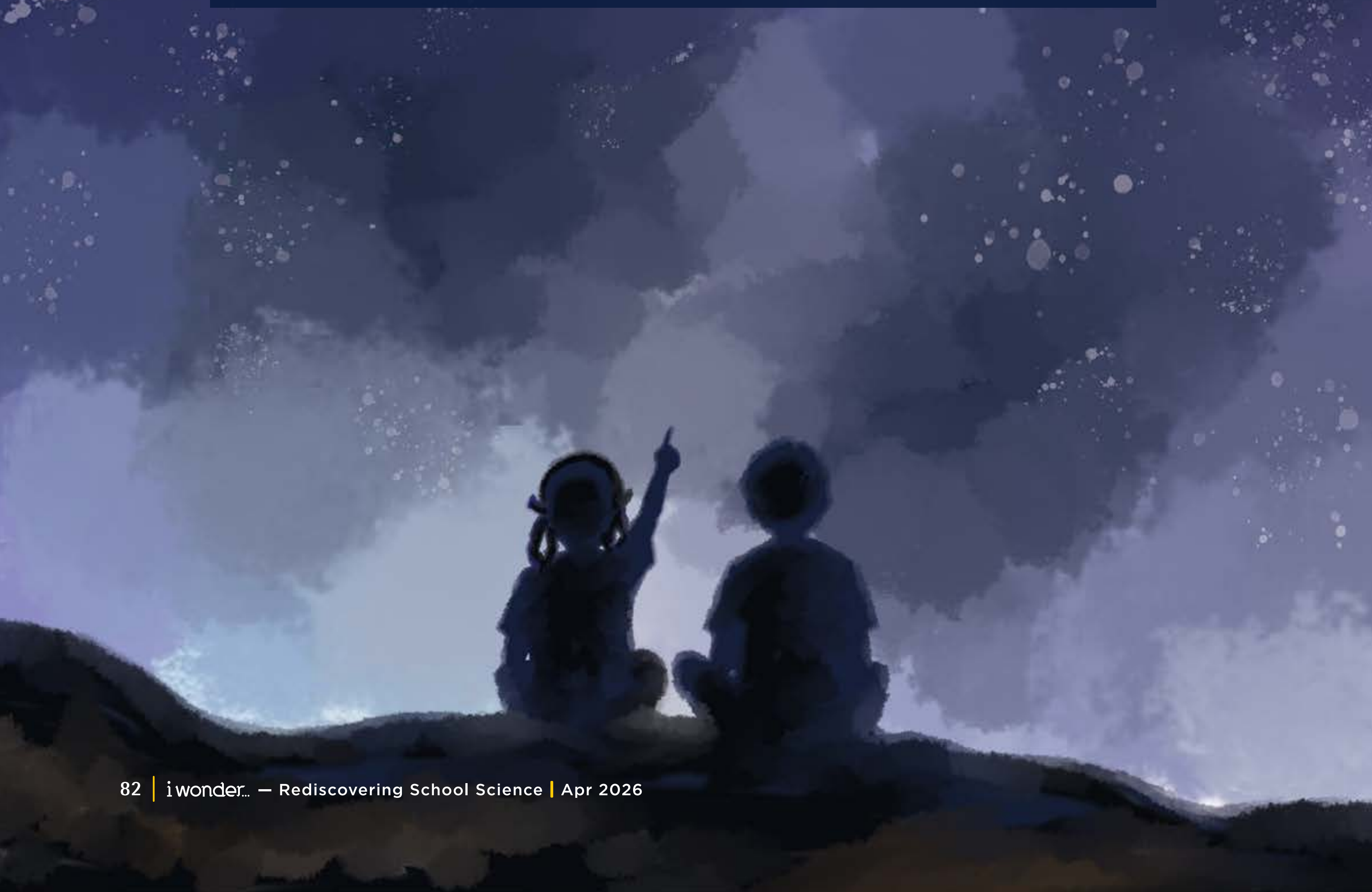

WRITE FOR US

i wonder... is an Azim Premji University publication for preparatory-stage (Grades III–V) Environmental Studies (EVS) and middle-stage (Grades VI–VIII) science teachers. Our aim is to share articles and resources that support classroom instruction, specifically within the context of government schools.

What we look for: We welcome contributions from practicing teachers, teacher educators, and researchers that emerge from classroom practice and offer students direct experiences in observing, reasoning with evidence, and testing textbook claims.

We publish work that:

1) Is guided by grade-appropriate textbooks: Focuses on themes, topics, or questions in the latest NCERT EVS and science textbooks (freely available at: https://ncert.nic.in/textbook.php), reflecting their specific scope, complexity, and level of abstraction.
2) Aligns with the national curriculum: Supports teachers in meeting the curricular goals and competencies defined in the NCF-SE 2023 (freely available at: https://ncert.nic.in/pdf/NCFSE-2023-August_2023.pdf).
3) Is rooted in practice: Has been tried, reflected on, or refined through actual classroom or workshop experience.
4) Is adaptable: Shows how ideas can be contextualised in different classroom conditions, time constraints, and learning levels.
5) Prioritizes accessibility: Uses materials that are inexpensive and locally available, ensuring that activities and approaches are inclusive and easy to implement in all classroom settings.
6) Respects teacher agency: Invites teachers to think, decide, and respond to students rather than follow fixed steps mechanically.

What is not a good fit? To ensure your submission meets our needs, please avoid:

1) Abstract discussion: General opinions or policy commentary without grounding in classroom practice.
2) Rote learning: A focus on memorizing facts and definitions rather than conceptual understanding.
3) Prescriptive manuals: Step-by-step instructions that leave no room for teacher or student inquiry.
4) Expensive requirements: Experiments that depend on formal laboratory spaces or costly instruments.

How to submit: You may submit a brief pitch (approx. 200 words) or a complete draft (800–1500 words). Your submission should have:

- Simple language: Use clear, non-academic prose. Tell us why these ideas matter to you.
- Links to the textbook and curriculum: Explicitly state how your work supports NCERT content and aligns with NCF-SE 2023 goals.
- A brief bio: A short paragraph (< 50 words) about your background in science education and your areas of interest.
- Images: Of a resolution (> 300 dpi) with captions and credits. Note: Please avoid front-facing images of children where possible. Written permission from guardians is required to publish images of students.

Publication terms:

- Originality: We have zero tolerance for plagiarism. Submissions must be your original work. If previously published, include a permission letter from the original publisher.
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- Translation: Azim Premji University retains the right to translate and disseminate your work (currently published in English, Hindi, and Kannada).
- Republication: If you republish your work elsewhere, please acknowledge that it first appeared in i wonder...

Submit your pitches and drafts to: iwonder@apu.edu.in We welcome submissions in English, Hindi, or Kannada throughout the year.

FEEDBACK FROM READERS

We see every issue of i wonder… as an experiment in collective learning. While we try our best to ensure that our articles and resources are rigorous, practical, and contextual, the real test of these ideas is when you put them into practice. The following feedback comes from peers who have done just that—each offering a unique window into how these ideas live and breathe in diverse settings. As you read, which of these possibilities or challenges resonate with your own practice as an EVS or science teacher?

"During my school visits to GPS Naudiyal Gaon and GPS Ghurdauri, I integrated several resources from these issues into classroom transactions. For instance, the 'Empty' Tumbler activity ('Activity sheet I: Is an empty tumbler empty of matter?') from the August 2025 issue was excellent for helping students visualize that air occupies space. In the December 2025 issue, the Birdwatching Guidelines ('Why introduce students to birdwatching?') and Soil Exploration ('Exploring soil: The foundation of soil') activities were particularly effective in connecting students with their immediate surroundings. These resources helped shift the classroom from rote learning to an inquiry-based approach, where students felt like young scientists investigating everyday phenomena. They were particularly excited about making the Pinhole Camera ('Making and using pinhole camera models'), which made the concept of rectilinear propagation of light tangible and clear. The content in both issues [Aug 2025 and Dec 2025] is pedagogically very strong and aligns well with NCF-SE 2023. One suggestion is to include a dedicated 'Common Misconceptions' box for every major topic to help teachers identify and address students' preconceived notions. Also, providing more 'Low-cost/No-cost TLM' ideas specifically designed for resource-constrained rural schools would further enhance the magazine's utility in the field."—Hrishab Jardhari, Pauri, Uttarakhand.

"I haven't used these magazines in class yet, but they gave me great ideas for my Grade VII science lessons. For example, I will use the article on metals and nonmetals to make a practical worksheet. Students will use an observation table to classify real objects and answer "how" and "why" they made their choices."—Basayya Swami, Azim Premji School, Kalaburagi, Karnataka.

"While working with students of Grades VI to VIII on the topic of growth of living organisms and adolescence, I observed that many students hold several myths and misconceptions regarding menstruation... Although I have not yet directly used this particular article ('Using science to support students in navigating adolescence') in my classroom, reading it provided me with valuable insights and a structured approach to address such myths in the future. The article helped me understand how common beliefs can be questioned and corrected using a scientific perspective. It encourages open conversation, which is very important while dealing with sensitive topics like menstruation. The [resources are] helpful as [they] present myths and facts in a simple, student-friendly format, making it easier to initiate discussions. The "Why" column gives clear scientific reasoning, which can help students develop logical thinking. I also shared this article with teachers so that they can use it as a supportive resource during classroom discussions."—Priyanka Joshi, Azim Premji Foundation, Pithoragarh, Uttarakhand.

"The activity on air and water ('Activity sheet I: Is an empty tumbler empty of air?') was used during a classroom science session with upper primary students as part of an experiential learning approach. Students were encouraged to observe, predict, and explain the behaviour of air in water. The activity was first demonstrated by inverting a tumbler in water without tilting it, and students were asked to observe whether bubbles appeared. The tumbler was then tilted slightly to help them notice the change. Students later worked in small groups to perform the activity themselves, discuss their observations, and respond to the guided questions provided in the resource. Through this process, students developed a clear understanding that air occupies space and prevents water from entering the tumbler when it is held straight. When the tumbler is tilted, air escapes in the form of bubbles, allowing water to enter. The "Think about" questions supported deeper reasoning and helped students connect their observations with concepts such as air pressure and displacement. For teachers, the resource provided a structured way to conduct the lesson using an inquiry-based approach instead of direct explanation. It supported effective questioning and encouraged active participation. For students, the activity made learning engaging, hands-on,

and helped in building conceptual clarity around the presence and properties of air. Overall, the resource contributed to strengthening observation skills, critical thinking, and conceptual understanding, while also supporting interactive classroom practices."—Archana Thapliyal, Azim Premji Foundation, Dehradun, Uttarakhand.

"I have had the opportunity to use resources from the first ('Does an 'empty' tumbler contain air?') and second ('Does air add weight to an inflated balloon?') articles of i wonder... Hindi, Issue 13 (August 2025) in my classroom practice and teacher discussions. These articles explore how abstract ideas about air as matter can be made visible through simple classroom activities, such as using an empty tumbler or an inflated balloon. I used them while teaching Grade VI students the chapter on materials and their properties. I conducted a hands-on activity suggested in the article ('Activity sheet I: Is an empty tumbler empty of matter?'), where students inverted an "empty" glass in water to observe trapped air. The discussion questions from the article were used to encourage students to explain their observations in their own words. Students who earlier believed that air is "nothing" began to understand that it occupies space and has physical properties. The activity built strong links between daily experiences and scientific concepts, making learning more meaningful. Both issues are highly relevant and useful for classroom practice, especially in helping teachers connect science concepts with students' everyday experiences. The activities on air and properties of matter are engaging. It would be helpful to include a short "common student misconceptions" section after each article to support teachers further. Here are some suggestions or ideas that we could plan in future: (a) Include short video links or QR codes demonstrating experiments for teachers who may be new to activity-based teaching. (b) Featuring short reflections from practicing teachers who have tried the activities in classrooms could inspire wider adoption. (c) Exploring interdisciplinary links (science with social science/ mathematics or language classrooms) could further enrich classroom use."—Aayushi Jain, Azim Premji Foundation, Dhar, Madhya Pradesh.

"The article 'When do 'floating' and 'sinking' surprise us?' was discussed in a couple of classrooms and in a workshop as well. When the topic was introduced, everyone felt that they knew all about it, but when the list used in the article was discussed at length, then the discussion remained immensely interactive and engaging."—Mukesh Sati, Azim Premji Foundation, Champawat, Uttarakhand.

"I have used one activity in my classroom as part of assessment. The activity sheet for metal and non-metal ('Activity sheet: Are these everyday objects made of metals or nonmetals?') in Grade VII. I wanted to assess (i) the curricular goal: Explore the world of matter and its constituents, properties, and behaviour and (ii) the learning outcome: Categorises materials based on metallic and non-metallic properties such as lustrous, conductivity, sonorous, malleability, and ductility. This activity sheet was used as home assignment, in which students had to classify household things under three categories metal, non-metal and neither. Students had to write the reason for classification. The activity helped me understand the skill of students to classify material as metal and non-metal. It also helped me understand how students are applying physical properties of metals and non-metals... I am planning to repeat this activity with the same students when they get to Grade VIII. There I will discuss elements and compounds by taking reference of this example, to enhance the understanding of students about metal and non-metal. An online library can be made where articles can be segregated as per its subject (physics, chemistry, biology, and The World Around Us)"—Saumy Srivastava, Udham Singh Nagar, Uttarakhand.

"The use of the thermometer activity in the classroom supported experiential learning, helping children develop a clearer and more concrete understanding of the concept."—Vinutha KB, Mandya, Karnataka.

"While teaching acids, bases and indicators the students read the article ('Exploring natural acid-base indicators: Teaching experiences') themselves and tried to make the indicators that were mentioned in the article (those that were available other than the common ones). They enjoyed learning how to make the indicators and how they help in identifying the acidic and basic substances."—Prachi Panthari, Azim Premji School, Uttarkashi, Uttarakhand.

"Articles from these two issues have provided direct support for my classroom work and teacher workshops alike. I found the piece on 'Adolescence' particularly useful when integrated with the lesson on 'Reproduction in Animals.' Furthermore, the articles on Metals and Non-metals, Thermometers, Natural Indicators, and the experiment showing how air increases a balloon's weight are excellent resources that any teacher can implement directly in their classroom. A single article references different grade levels. I understand but teachers find it confusing."—Imran, Azim Premji Foundation, Chittorgarh, Rajasthan.

Every classroom offers a different story. Did an activity draw out a new question in your classroom? Did a pedagogical insight change a staffroom discussion? Whether an idea confirmed a long-held belief, sparked a disagreement, or inspired a new way to use a simple material, share your experience with us (iwonder@apu.edu.in). Tell us what worked, what did not, and what you would like to see next. Your reflections help us refine what we publish and how we support your journey.

WHAT'S INSIDE?

Every issue has content to support your professional journey as an EVS or science schoolteacher. The content in this issue has been reorganized into new sections. Each section focuses on the rigour and reasoning behind a different aspect of your teaching practice.

Articles (Support for Professional Learning from Practice):

- **Experiences (Textbook Ideas in Real Classrooms):** What do you do when students finish an activity, but remain unsure what it means? How do you respond when their explanations differ from the textbook? Here are stories that stay close to how teaching choices unfolded in class and made students' ideas visible. Read how teachers paused, asked questions, looked closely at how students responded, and redesigned instruction. See how students' understanding shifted when asked to predict outcomes, check claims, compare results, and explain their reasoning. Also, do share experiences from your own classroom—the 'messiness' of learning matters more than the 'perfection' of your results.

- **Perspectives (Realities Shaping Learning Spaces):** How do curricular policies and assessment designs shape science learning in the classroom? How do community beliefs or school realities influence science teaching? Here are articles that focus on the broader principles that shape classroom instruction and what students learn to value in science. Read how teachers interpret curriculum in practice, design assessments that build scientific skills, and promote inquiry with simple materials. See how science classrooms engage with social realities such as health, nutrition, and community dialogue. Also, do share how policy or community realities shape your practice—thoughtful reflection matters more than definitive solutions.

- **Explorations (Retracing Ideas in the Classroom):** How did scientists arrive at the textbook ideas students are asked to accept? What do students learn when they test a claim rather than simply read about it? Here, the evidence and reasoning behind textbook ideas are examined and opened to exploration through real-world questions. Read pieces on how scientific understanding evolved and how it can be investigated in classrooms today. See how the process of science connects what scientists do with how students can learn to think like scientists. Also, do share your explorations of ideas from the EVS and science curriculum—the tentativeness of your approach is more important than the completeness of your conclusions.

- **Extensions (Learning Materials Beyond the Textbook):** How does a teaching-learning material (TLM) extend a curricular idea beyond the textbook? How might you adapt it for diverse learners and contexts? Here are introductions to materials that make textbook knowledge more tangible and reshape it to reflect students' experiences and social realities.

Read how they connect science to students' worlds and widen who feels represented within it. See how their diverse formats support learners with varied language backgrounds and attention spans. Also, do share material you have worked with (whether a children's story, YouTube video, low-cost science kit, podcast, community science project, or online app)—the emphasis is on reflection, not promotion.

- **Readers' Voices (Refining and reshaping i wonder… in diverse contexts):** What understanding of textbook concepts emerged from using an i wonder… piece? We examine how teachers carry these ideas into classrooms and workshops, adapting them to match their time constraints, language requirements, accessibility to materials, and institutional routines. Also, do add your voice by sharing how you used an i wonder… piece with students or teachers—the emphasis is on conceptual insights, shifts in interactions, and contextual realities; not on endorsements or formal research.

Resources (Support for Practical, Inexpensive Classroom Inquiry):

- **Classroom (For Students to Observe, Question, and Explain):** How can our everyday surroundings become sites for scientific investigation? What do students understand differently when they test, measure, or build themselves? Here are student-facing resources for direct use in EVS and science classrooms. See how simple and inexpensive materials are used to explore familiar contexts—the natural world or built structures. Read how students are invited to observe, question and document patterns, gather and compare evidence, or explain their reasoning. Also, do share an activity sheet, field guide, or poster that helped your students investigate everyday phenomena—conceptual clarity and thoughtful design matter more than specialised equipment.
- **Staffroom (For Teachers to Plan, Reflect, and Refine):** What pedagogical decisions can help ensure that an activity builds students' conceptual understanding? How do we approach socially-contested scientific questions in the classroom with care and rigour? Here are teacher-facing resources for planning and reflection across EVS and science themes. See how they model careful questioning, unpack key concepts, anticipate common misconceptions, and suggest ways to structure inquiry. Read how they support thoughtful teaching in everyday contexts with limited resources and diverse learners. Also, do share a resource to help other teachers strengthen conceptual clarity or navigate sensitive classroom dialogue—pedagogical reasoning and classroom insight matter more than formal research.

Join the conversation!

Share your questions with authors in our free, live, online discussions. Could not make it to the live session? Catch up here:

- How do children know the Earth is not flat? Exploring mental models and evidence with Anand Narayanan and Amol Anandrao Kate. Watch here: https://www.youtube.com/watch?v=gMKyAZuu4tY.
- Why Science Matters: A deep dive into the purpose of science education with Anil Kumar Challa, Reeteka Sud, and Vinay Suram. *Watch here: https://www.youtube.com/watch?v=KeJIBY1IqpM.*
- Plants and Pollinators: Let's Explore! Investigating local ecology with Meenakshi and Radha Gopalan. *Watch here: https://www.youtube.com/watch?v=cqYu1zwmLX0&t=9s.*
- Exploring Motion through a Balloon's Flight: Simple physics in action with Anish Mokashi and Vinay Suram. *Watch here: https://www.youtube.com/watch?v=NgIRXGDpnfw.*

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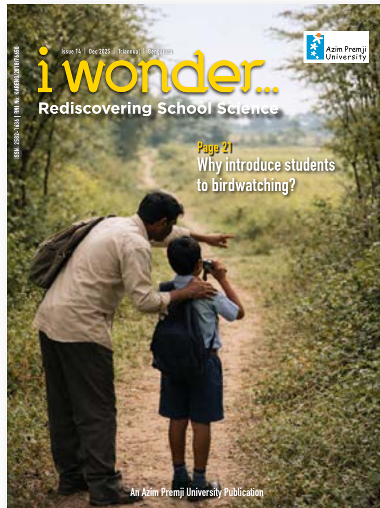

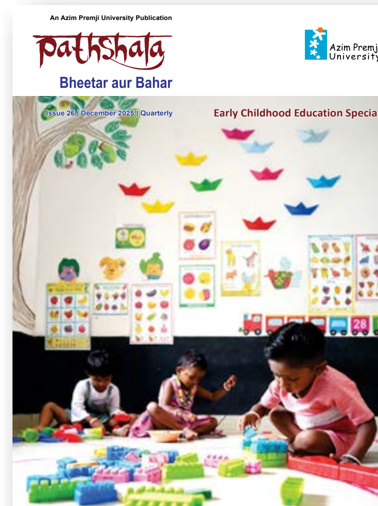

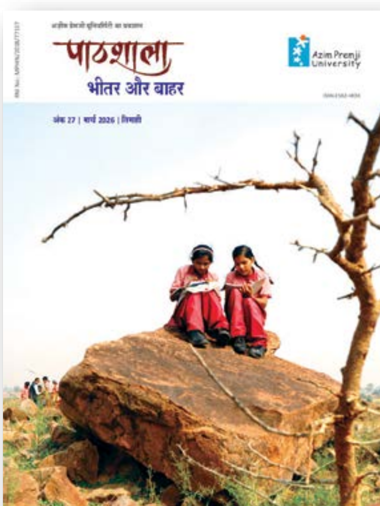

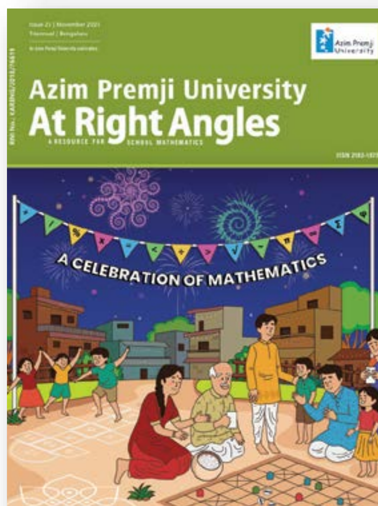

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