

STEM Education for Innovation: Experimento India

Teacher's Manual: Basics of Energy

Manual at a glance

This manual is made to help teachers use the Basics of Energy OERs using the Inquiry-Based Learning approach in classrooms.

Sr. No.	Topic / Concept	Description
1	Introduction	Overview of the package and pedagogical approach
2	OER types included in the package	Overview of resource types (videos, reading material, stories, surveys, questions)
3	How to conduct this package in the classroom?	General guidelines before, during and after the lesson along with safety instructions/precautions
4	Lesson plans	Instructions and detailed lesson plans for each concept/resource

Lesson plans

Sr. No.	Topic / Concept	Resource Name Learning Outcome	Time Required	Textbook Link
4.1	Work and Energy	Energy: Our Invisible Companion Understand what energy is, why it's essential, its different sources and forms, and how it depends on position, motion, and force.	30 min (video + discussion)	NCERT Class-6 Chapter-11 Nature's Treasures Class 9, Chapter 10 Work and Energy





Sr. No.	Topic / Concept	Resource Name Learning Outcome	Time Required	Textbook Link
4.2		Did you work today? Understand what energy is, why it's essential, its different sources and forms, and how it depends on position, motion, and force.	30 min (video + discussion)	NCERT Class 9, Chapter 10 Work and Energy
4.3	Sources of Energy- Renewable and Non- renewable	Renewable Energy: Infinite Sources of Energy Harnessing Solar Energy: Making a Simple Solar Cooker	30–40 min (Reading material) 40–45 min (Reading	NCERT Class-6 Chapter-11 Nature's Treasures
		Learn about various renewable energy sources and their environmental benefits, understand real-life	material + hands-on activity)	
4.4		Non-renewable Energy: Limited Sources of Energy Learn about various non-renewable energy sources and understand why their use should be limited.	30–40 min (Reading material)	
4.5		What if the Sun Disappears? Understand the Sun's role as Earth's primary energy source and its impact on heat, light, seasons, the water cycle, and life processes like photosynthesis and the food chain.	30 min (video + discussion)	





Sr. No.	Topic / Concept	Resource Name Learning Outcome	Time Required	Textbook Link
4.6	Potential and Kinetic Energy	From Rest to Motion: Energy Everywhere! Understand that energy exists in different forms, can transform from one form to another, and relate potential and kinetic energy to reallife examples.	30 min (video + discussion)	NCERT Class 9, Chapter 10 Work and Energy
4.7	Law of Conservation of Energy	The Mystery of Energy Understand that energy cannot be created or destroyed, only transformed, and learn to explain the Law of Conservation of Energy.	30 min (video + discussion)	
4.8	Online game on Energy	Kaun banega Energy Champion Learn to identify different sources and forms of energy and reflect on your understanding of energy and its conservation.	30 min (Online quiz like KBC)	





1. Introduction

Energy is everywhere, from the food we eat to the electricity that lights our homes, and even the Sun that gives life to our planet. Yet, most children think of it as an invisible force without understanding how and why it is so important. This series is designed to help upper primary students (Class 6-8) explore the fascinating world of Energy. Through experiments, activities, hands-on explorations, and stories students will learn about energy and its role in work, the different sources and forms of energy, the Law of Conservation of Energy, and the Sun as the primary source of energy for the earth.

This teacher's manual has been designed to support educators of class 6th–8th in using the digital open educational resources (OERs) based on Energy in their classrooms. The OERs can also be used flexibly by parents at home or by students themselves for self-learning. Each resource is self-explanatory and aligned with the NCERT curriculum.

The Basics of Energy OERs are built on inquiry-based learning and constructivist pedagogy. Instead of being passive recipients of information, children actively explore, ask questions, investigate, and build their own understanding. This method encourages curiosity and critical thinking, which are vital for learners to develop independent thinking.

In the inquiry-based model, teachers act as facilitators who guide students to explore real-world problems, gather evidence, and make connections. For example, instead of telling students the principles of evaporation, a teacher might encourage them to design a simple experiment to observe how water disappears under different conditions. This approach not only deepens content knowledge but also develops problem-solving and research skills.

The constructivist approach emphasizes that learners construct knowledge from their experiences. Middle school students bring prior knowledge, beliefs, and everyday experiences into the classroom and teachers build on these foundations. Group work, discussions, projects, and hands-on activities are used to help children learn collaboratively and deepen understanding. This makes learning meaningful and long-lasting.



Together, these approaches help to create classrooms where children are active participants, confident learners, and capable problem-solvers, skills that are essential not only for academic success but also for life beyond school.

There are several methodologies to implement Inquiry-based learning and the Constructivist approach in the classrooms. Here, we are using a 'Five E methodology'. This manual provides practical and easy-to-follow lesson plans for classroom teaching. It has the following 5 steps:



This manual provides teachers with ready-to-use lesson plans, activity instructions, materials lists, guiding questions, and Learning Outcomes for each OER, so classroom teaching becomes easier, more engaging, and directly supportive of curriculum.



2. OER types included in the package

This package provides a variety of Open Educational Resources (OERs) designed to engage children in learning through observation, inquiry, and hands-on activities. The resources include:



a. Videos

- Short and engaging videos explaining key concepts related to the topic
- Can be shown in class or shared for students to watch in groups or at home



b. Reading material

- Simple, illustrated content to explain the core concepts
- Includes real-life examples and applications for better understanding and to encourage discussion



c. Audio Stories

- Short and engaging audio narratives explaining key concepts related to the topic
- Include real-life examples and prompts for critical thinking



d. Suggested research questions

- Thought-provoking prompts are included in the resources
- Can be used for class discussions, homework, or small projects to extend learning

3. How to conduct this package in the classroom?

a. Before the activity



Form student groups: Divide the class into small groups (4–5 students) to encourage teamwork and peer learning.



Assign roles: Give responsibilities such as material collector, recorder, presenter, or timekeeper.



Share materials list in advance: Provide a simple materials list (low-cost/everyday items) so students can bring them from home.





Set up the classroom: Arrange equipment such as a projector/blackboard for videos, or prepare printouts/handouts for reading material and worksheets.

b. During the activity



Introduce the Resource: Show the video, distribute reading material, or explain the task clearly.



Group Work: Ask students to watch, read, or perform the activity in their groups, noting key observations.



Guide Exploration: Circulate among groups, prompt with guiding questions, and encourage them to compare findings.



Record Observations: Remind students to use survey forms or worksheets where provided, or ask them to record observations in the tables given in the particular resource.

c. After the activity



Discussion & Reflection: Facilitate a short group/class discussion where students share their conclusions. Highlight how the concept connects to real-life problems and solutions.



Connect to Key Concepts: Summarize the scientific ideas, clarify misconceptions, and link to textbook content.



Ask questions: Use the suggested research prompts in the resources to spark further thinking and discussion.



Feedback & Motivation: Appreciate student efforts and encourage them to explore the concept independently.



Homework/Extension (Optional): Assign follow-up tasks such as simple research, a 1-day observation, or creating a poster/action plan.





4. Lesson plans

4.1 Energy: Our Invisible Companion





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Understand what energy is and why it is essential for all actions
- Learn to recognize the different sources and forms of energy around us
- Understand how energy depends on factors like position, motion, and force
- Learn to appreciate the value of energy and develop awareness about saving it

Materials:

- Video: Energy: Our Invisible Companion
- Notebook and pencil for observations and reflections





5E Lesson plan



Engage

Show students the opening visuals from the video till 0.36 minutes: A moving boat, a runner, clothes drying, and a house lighting up.

Ask thought provoking questions:

• Why did the boat stop? How did it start again? Why did the runner get tired?

Let children discuss their ideas in pairs or small groups.



Show the whole video to the students and, wherever questions are asked, take a short pause and let them respond or guess the answers.

Encourage children to make predictions and test them.

Let them discuss observations with peers and think about what factors affect energy (force, position, speed, mass).



Explain

Definition of energy: Energy is the ability to do work. It gives us the power to run, cook, learn, and live.

Discuss the invisible nature of energy:

- We cannot see energy but we can experience and see the effects of energy on things around us
- Explain sources and forms of energy using examples from the video
- Introduce basic concepts:
- Magnitude of energy depends on many factors like speed, mass, position, size etc.







Ask students to look around and identify more examples of natural energy.

Pose reflective questions:

- Will a football and a tennis ball have the same energy if they are both lying on the ground at the same place?
- Which one has more energy? An aeroplane flying in the sky or a car travelling at 100km/h on the road? And why?

Discuss the importance of energy conservation:

- Imagine a world without energy: no light, no warmth, no cooking. How would life be then?
- Encourage students to think about ways to save energy and wise use of energy



Oral or written reflection questions:

- Give two examples of energy you saw in the video
- Explain why energy is called our invisible companion
- What factors affect the energy of an object?
- Why is it important to save energy for the future?

Activity:

Draw or list at least five sources of energy around your home or school and classify them as natural or man-made.

Homework:

Observe one activity at home and identify the energy source used. Write 3-4 sentences describing it.





4.2 Did You Work Today?





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Understand the scientific definition of work
- Learn the two essential conditions for work to take place: application of force and displacement of an object
- Understand how to analyze everyday activities to determine whether work is being done
- Learn to develop critical thinking and inquiry skills through observation, discussion, and reflection

Materials:

- Video resource: Did You Work Today?
- Notebook and pencil for students
- Chalkboard/whiteboard for drawing examples



5E Lesson plan



Engage

Begin by asking:

- Did you work today? What did you do?
- · Let students share examples of their daily activities

Show the video till 0.17 minutes and Ask:

• What is common in all these activities?

Guide students to recognize the concept of "work" in their examples. Show video from 0.18 minutes to 0.31 minutes and ask curiosity-provoking questions:

- Climbing stairs-can this be called work?
- Can running a race be called work?
- If yes, why? If not, why not?



Show video (from 0.32 minutes to 1.04 minutes) examples of lifting a bucket, pushing/pulling a cart, and climbing stairs.

Encourage students to discuss in small groups:

- In each example, is work being done? Why or why not?
- Let them observe and note which actions involve displacement and which do not?

Ask students to give their own examples of work and non-work from their daily lives.



Explain

Show the explanation part (from 1.05 minutes till end) and let students discuss the scientific definition of work:

- Work is done when a force is applied to an object and it is displaced
- Standing still uses energy but involves no displacement, so no work is done
- Walking involves displacement, so work is done

Revisit initial examples in the video and analyze: lifting bucket, pushing cart, climbing stairs.

Highlight the two essential conditions for work: force applied and displacement.

Encourage students to explain these points in front of the class. If needed, you can explain further.







Pose problem-solving and thought experiments:

- A wrestler tries to knock down a wall but it doesn't fall. Was any work done? Why?
- A bird sits on a moving train. Who is doing work-the bird or the train?
 Why?
- Encourage students to discuss in pairs or small groups and explain their reasoning

Let students think and answer these questions. If needed, you can explain further.

Ask students to reflect on their own activities:

• Think of all the work you did today. Did you meet both conditions for work?



Ask students quick oral questions:

- Can work be done without displacement?
- Give one example of work you did today
- Why is energy necessary for work?
- Would you have done any work if you studied for an exam?
- If you travelled to school in a bus, would it be work?

Assign written reflection in notebooks:

• List three activities from your day and indicate whether work was done or not, with reasoning

Optional homework:

 Observe family members doing household tasks and note which actions involve work according to the scientific definition





4.3 Renewable Energy sources:





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- To learn about various renewable energy sources and their environmental benefits
- To understand real-life applications of solar energy
- Learn to develop inquiry, observation, and analytical skills through hands-on experiments

Resources:

- Informative Document: Renewable Energy: Infinite Sources of Energy
- Activity Document: Harnessing Solar Energy: Making a Simple Solar Cooker

Materials:

- Cardboard box (15–20 cm height)
- Black chart paper or black paint
- Transparency sheets or transparent glass pane
- 3 steel containers with lids (5–10 cm height)
- 50 g rice
- Old newspapers
- Scissors, cellotape
- Scale/ruler, pencil
- Sunlight



5E Lesson plan



Day-1

Begin with thought-provoking questions:

- Why is the government encouraging the use of solar energy and electric vehicles?
- Are there sources of energy that will never run out?
- Why are solar lights, electric bikes, and cars becoming popular?

Show images of solar panels, wind turbines, hydroelectric dams, and tidal energy setups.

Ask students:

- What do all these have in common?
- Guide them to the idea of renewable energy



Day-1

Let the students read the document and then discussrenewable energy and its sources:

- solar
- wind
- hydroelectric
- geothermal
- biomass
- tidal

Let students share examples of each from daily life.

Ask:

- Which of these can provide energy without harming the environment?
- Do you think all these are infinite sources of energy?



Explain

Day-1

Explain: The renewal energy source, characteristics and benefits of renewable energy:

- Continuous availability
- Environmentally friendly
- Reduces dependency on fossil fuels

Mention examples of real-life applications of solar panels, windmills and hydroelectric dams for generating electricity.

If needed, you can explain further. Use diagrams or videos to reinforce the concepts and clarify students' questions.







Day-2

Introduce the hands-on activity: making a simple solar cooker.

Adjust the solar cooker for maximum sunlight exposure.



Discuss:

- In which container did the rice cook fastest? Why?
- What is the role of black paint?
- How can this activity help us to understand renewable energy?
- Explore possible improvements and other applications of solar energy

Ask students to Observe rice at 20 min, 40 min, 1 hour, 2 hours, and record

• Is solar energy a good alternative to electrical energy?



Day-2

Ask reflection and assessment questions:

- Name at least three renewable energy sources and explain their benefits
- Why is solar energy considered sustainable?
- In the solar cooker activity, which container heated first and why?
- Suggest modifications to make the solar cooker more efficient
- How can we reduce dependency on non-renewable energy in daily life?

Homework:

Draw a diagram of the solar cooker, showing sunlight entering and heating the container. Label all parts.





4.4 Non-renewable Energy: Limited Sources of Energy





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn about various sources of non-renewable energy
- Understand why we should limit the use of non-renewable energy resources

Materials:

 Blackboard/Chart to note down key points (heat, light, photosynthesis, water cycle, fuels, energy, life)

5E Lesson plan



Begin with a few simple, relatable questions to spark curiosity:

- Where do petrol and diesel come from?
- Why does the Government encourage us to use public transport instead of private vehicles?
- Why are we told to switch off vehicle engines at red lights?







Let the students read the document and then discuss:

- Non-renewable energy and its sources
- Fossil Fuels
- Nuclear Energy

Then ask: How do we get wax for candles? Let students answer.

Now connect this to coal, petrol, and diesel: once used, they cannot be quickly replaced.

Next, ask students to list the fuels and energy sources they see around them. Help them sort these into two groups: renewable and non-renewable.



After Reading the document let students explain:

- Non-renewable energy sources
- Fossil Fuels Nuclear Energy

Everyday connections:

- The LPG (Liquid Petroleum Gas) in your kitchen comes from fossil fuels
- Electricity in many Indian homes comes from coal
- Some electricity in India also comes from nuclear power stations

If needed, you can explain further. Use diagrams or videos to reinforce the concepts and clarify students' questions.



Ask students:

- What will happen when all fossil fuels are exhausted?
- Can we run buses and trains without petrol or diesel?

Do a quick thought exercise:

Imagine you are in a place where there will be no electricity for one whole week, and there is also no transport facility. What will you do in such a situation to survive?

This shows how dependent we are on non-renewable sources.

Also, encourage the children to think: if we want to reduce our dependence on fossil fuels, what should we do?









End the session with a few reflective questions:

- Why are fossil fuels called non-renewable?
- How are they harmful to the environment?
- What will you do to prepare for a situation when these resources are exhausted?
- Why should we use renewable energy instead of non-renewable energy?
- Can you give two examples of non-renewable energy used in your home or community?

Students can answer orally, in groups, or write in notebooks.





4.5 What if the Sun Disappears?





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Understand the importance of the Sun as the primary source of energy for Earth
- Learn the role of the Sun in providing heat and light, causing winds and seasons, and sustaining the water cycle
- Learn to connect sunlight with photosynthesis, oxygen production, and the food chain
- Learn about how the Sun plays a role in generating fossil fuels on Earth
- Learn to imagine and critically think about the consequences of the Sun disappearing

Materials:

 Blackboard/Chart to note down key points (heat, light, photosynthesis, water cycle, fuels, energy, life)





5E Lesson plan



Begin by playing/narrating the story- 'What if the Sun Disappears?'

Pause at 1.09 minutes after Bunty's dream:

- What do you think will happen if the Sun really disappears?
- Allow students to freely imagine and share their thoughts

Tell them:

• Today, we will explore why the Sun is so important for us and our planet



Play the whole story and let students brainstorm in groups:

Where and how do we use sunlight in our daily life?

Record their answers (drying clothes, light for doing work in houses, fields etc, solar panels, farming, etc.).

Ask:

• What will happen to rivers, plants, or animals if the Sun disappears?



Let students explain the key points from the story:

- The Sun gives light → helps us to see
- Sun gives heat → keeps Earth warm and livable
- Sun causes winds and seasons
- Sun powers the water cycle (evaporation, clouds, rain)
- Sun enables photosynthesis in plants → food + oxygen
- Explain how the Sun also has a role in the formation of fossil fuels which provide us with energy
- Sun provides renewable energy (solar panels and wind energy for generating electricity)

If needed, you can explain further Use simple analogies: Without the Sun, Earth would be like a giant freezer in complete darkness.







Discussion prompt:

- If the Sun disappears, which would we lose first-light, food, or oxygen?
- Why?

Critical thinking:

Are there any life forms that can survive without sunlight? (link to deep-sea creatures, cave organisms, etc.).

Extension:

• How do you think the world will cope with this situation?



Evaluate

Quick oral quiz:

- Name 3 natural processes that depend on sunlight
- What is photosynthesis, and why is it important?
- How is coal connected to the Sun?
- What will happen to the water cycle if the Sun disappears?

Written activity:

• Draw and label 5 ways the Sun supports life on Earth

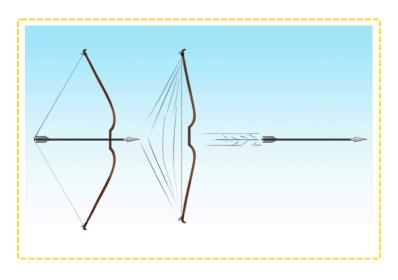
Homework:

• Write a short paragraph- A day without the Sun in my village





4.6 From Rest to Motion: Energy Everywhere!





Learning objectives:

By the end of this lesson, students can:

- Understand that energy exists in different forms
- Learn to observe how energy changes from one form to another
- Learn to connect real-life examples with the concepts of potential and kinetic energy

Materials:

- Rubber band, a ball, slingshot, spring
- Blackboard and chalk/marker
- Video resource

5E Lesson plan



Engage

Play the first clip (till 0.09 minutes):

- What will happen if I let this car go? Pause. Let students predict.
- Show the car rolling down the ramp (0.10 minutes -0.42 minutes)

Ask:

- Why did it move on the ramp?
- Why did it stop moving on a flat surface?

Trigger curiosity:

Does the position of the car affect its movement?

Build excitement:

Let's see what happens with two cars on ramps of different heights.





Students watch (0.26 minutes-1.16 minutes) and compare two cars, one from a high ramp, one from a low ramp

Discuss observations:

- Which car goes farther and faster and why?
- Drop two balls from the same height, then from different heights, and observe depressions in sand

Ask guiding questions:

- What do you notice when the balls are dropped from the same height?
- What changes when the height is different?
- Students record their observations



Show the complete video and ask students to explain and Kinetic and potential energy:

- Energy in a body due to its Position (height) is Potential Energy
- Energy in a body due to its Motion IS Kinetic Energy
- Explain word origins for Potential and Kinetic and their meanings

Connect with real-life:

- Explain the basis of how a slingshot works
- Why does a car consume more fuel to move at a faster speed?

Apply the concept with examples:

- Which has more potential energy: a stretched rubber band or a normal rubber band?
- Which has more kinetic energy: a fast bowler's ball or a spinner's?
- What kind of energy is stored in food, coal, petrol, and batteries?



Small group activity:

Give each group a rubber band or toy car. Ask them to demonstrate how stored energy changes into motion.

- What is the relationship between compression of a spring and its movement?
- Does the amount of compression affect its movement?

Link back to the big idea: Energy can change forms but is never lost.







Quick oral check:

- Define Potential Energy in your own words
- Define Kinetic Energy in your own words

Written exercise:

Draw and label a situation where PE changes to KE. (Example: A stone falling from a height, slingshot, spring).

Question prompts:

- Why did the car on the higher ramp move faster?
- Why do fast bowlers deliver more energy through their ball than spinners?

Give two real-life examples of potential energy.





4.8 The Mystery of Energy





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Understand that energy cannot be created or destroyed but only changes from one form to another
- Learn to explore how energy transforms in everyday life
- Learn to understand and explain the Law of Conservation of Energy
- Learn to connect energy transformations back to the Sun as the primary source of energy

Materials:

- Video: Mystery of Energy!
- Blackboard/Chart for energy transformation chains
- Student notebooks



5E Lesson plan



Engage

Begin with two puzzling questions from the video till 0.24 minutes:

- 1. We provided energy to the swing, but after some time, it stopped. Where did its energy go?
- 2. When wood burns, where does the heat energy go?

Encourage students to think and share their guesses.

Tell them:

Today, we'll explore the mystery of energy!



Explore

Play the video clip showing (0.25 minutes-1.18 minutes) a ball being dropped from a height.

Pause at the point where it bounces. Ask:

Why does each bounce become smaller?

Let students discuss in pairs or write their hypothesis.

Demonstration:

- Teacher performs an activity with a ball
- Ask students to observe sound, and height of bounces



Explain

Play the entire video. Then students explain:

- Why does each bounce become smaller and at last the ball stops bouncing
- Potential energy at the top → Kinetic energy as it falls
- On hitting the ground → some energy changes into sound, some into heat (friction with ground/air) and some is transmitted to the ground
- Each bounce is smaller because part of the energy is transformed into other energy forms
- Total Energy = Potential Energy + Kinetic Energy + Sound Energy + Heat Energy

Introduce the Law of Conservation of Energy:

- Energy can neither be created nor destroyed; it only transforms from one form to another
- If needed, you can explain further







Ask students to draw an energy chain:

E.g.: Sunlight → Plants → Food → Human → Lifting ball →Dropping ball—---> Ball bouncing → Sound + Heat + Kinetic + Potential.

Ask:

- If energy cannot be destroyed, why should we save energy? (lead to discussion on resources, efficiency, sustainability)
- Extend with more real-life examples: bulb glowing, car running, athlete running etc.



Evaluate

Quick oral/written questions:

- What happens to the energy of a ball after it stops bouncing?
- State the Law of Conservation of Energy
- Trace the energy chain in food you ate this morning
- Why is the Sun called the primary source of energy?

Homework: Write any 2 examples of energy transformation from daily life and explain in 3-4 sentences.





4.9 Kaun banega Energy Champion





Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn to recall and identify different sources and forms of energy
- Learn to reflect on your understanding and assess your own knowledge about energy and its conservation