STEM Education for Innovation: Experimento India

Teacher's Manual: Magnetism

Manual at a glance

This manual is made to help teachers use the Magnetism 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	Discovery of Magnets	Mysterious Stone Understand the story of the first human encounter with a magnet, learn about magnetic energy and its properties.	30 min (Audio story)	NCERT Class-6, Chapter-4, Exploring Magnet.

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Sr. No.	Topic / Concept	Resource Name Learning Outcome	Time Required	Textbook Link
4.2	Magnetic and non-magnetic substances	Magnet and its Friends Identify and understand which objects are magnetic and which are non-magnetic.	30–40 min (Reading material + hands-on activity)	NCERT Class-6 Chapter-4 Exploring Magnet 
4.3	Properties of Magnets	Make your own magnet Understand how a magnetic material can be magnetised, and establish the concept of permanent and temporary magnets.	30–40 min (Reading material + hands-on activity)	
4.4		Magnet: Attraction and Repulsion Understand the properties of a magnet to attract and repel other magnets and magnetic materials.	30–40 min (video + hands-on activity)	NCERT Class-6 Chapter-4 Exploring Magnet 
4.5		Magnetic Field lines Understand what is meant by a magnetic field and how to visualize it.	30–40 min (video + hands-on activity)	NCERT Class-10 Chapter-12 Magnetic Effects of Electric Current 

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Sr. No.	Topic / Concept	Resource Name Learning Outcome	Time Required	Textbook Link
4.6	Properties of Magnets	Electromagnet Understand how we can make a magnet with the help of electricity and learn about the uses of electromagnets.	30–40 min (video + hands-on activity)	NCERT Class-8 Chapter-4 Electricity: Magnetic and Heating Effects 
4.7		Full Magnet or Half? Understand what happens when a magnet breaks. Will each piece remain a complete magnet?	30–40 min (Reading material + hands-on activity)	NCERT Class-6 Chapter-4 Exploring Magnet 
4.8	Earth as a Magnet	Earth is a Magnet Understand why all freely suspended magnets or a compass always align in the North-South direction. Learn why the Earth behaves as a magnet.	30 min (video + discussion)	NCERT Class-6 Chapter-4 Exploring Magnet 
4.9	Magnetic shielding	Magnetic shielding Learn the concept of magnetic shielding, understand where it is used, and why it is important in daily life.	30–40 min (video + hands-on activity)	

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1. Introduction

Magnets are all around us, from the compass that shows us direction to the magnets used in our toys, appliances, and electronic devices. Yet, for many children, magnets are just objects that attract or repel, without understanding the science behind them. This series is designed to help upper primary students (Class 6–8) to explore the fascinating world of Magnetism. Students can learn concepts and applications related to Magnetism through hands-on activities, experiments, and stories.

This teacher's manual has been designed to support educators of class 6th–8th in using the open educational resources (OERs) based on Magnetism 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 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.

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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, and 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 OERs designed to engage students 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.

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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 Guiding 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.

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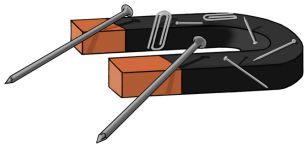
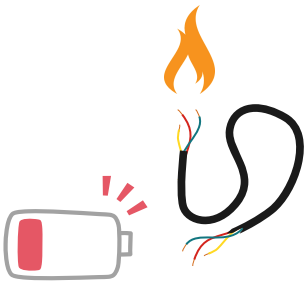
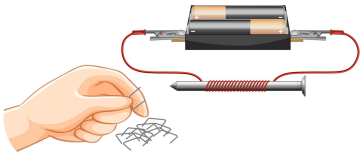
Record observations: Remind students to use survey forms or worksheets where provided, or ask them to record observations in the tables given in the particular resource.

Safety instructions

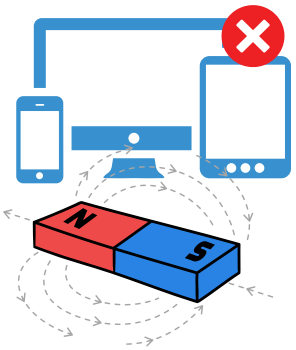
1. General precautions

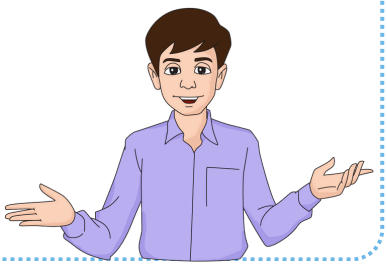






- Do not drop the magnets
- Keep sharp objects like needles or pins away from the magnet
- Ensure adult supervision when handling strong magnets or cutting objects like cycle spokes
- Keep magnets away from electronic devices such as mobile phones and computers
- Always disconnect the wires from the battery or cell when experiments are not being performed. This will prevent the draining of the battery or cell, and the wires will not become hot.
- Use a battery or cell of 9 volts or less when conducting electrical experiments
- Do not throw discharged cells in the waste. Segregate them as e-waste (electronic waste). Hand-over this e-waste to an organization or agency for its safe disposal.





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4. Lesson plans

4.1 Mysterious Stones

Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn about the historical discovery of magnets
- Learn that magnetism is a natural force, not magic
- Learn to observe carefully and ask meaningful questions
- Understand how storytelling can be connected to scientific inquiry

Materials:

- Audio story
- Notebook and pencil for each student
- Small magnets and metal objects (optional, for demonstration)
- Chart or board for discussion points

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5E Lesson plan

 **Engage**	Ask the students: • Imagine you placed an object somewhere and it got stuck. • Why do you think it may have happened? • Could it be magic, or something else? Why or why not? Let the students share their answers and ideas. Then, play the audio story for them.
 **Explore**	Let the students listen to the story till 2.16 minutes. Encourage students to think about: • Why did the stick and shoes stick to the stone? Was this really a miracle? Let the students discuss in groups and guess the answer.
 **Explain**	Let the students listen to the explanation part of the story. This allows students to understand that Magnetism is a natural force, not magic. Discuss: • About Lodestones • Magnets attract materials like iron but not wood/leather • Connect the story to how observations and curiosity led to scientific discoveries
 **Elaborate**	Ask students to identify examples of magnets in daily life: refrigerator magnets, compasses, electric motors, toys, etc. Challenge them to think creatively: If you had a magnet, what experiments would you try at home?
 **Evaluate**	Oral reflection: Ask students to summarize the story and explain why the stick and shoes were stuck to the stone.

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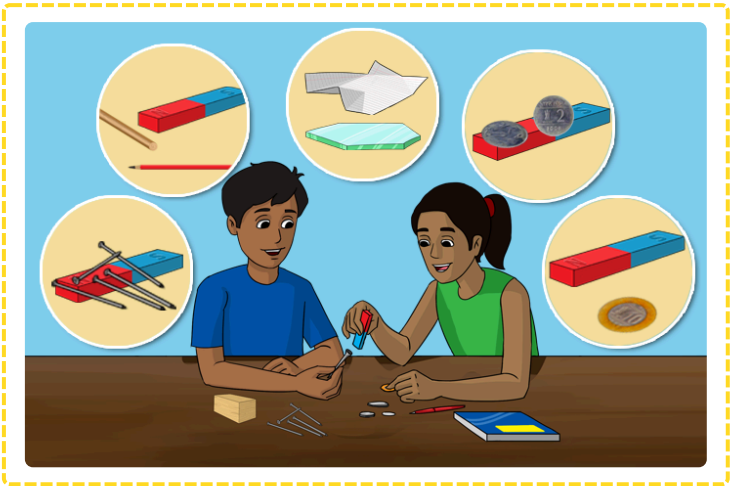
4.2 Magnet and its Friends



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Learning objectives:

By the end of this lesson, students can:

- Learn to identify and classify materials as magnetic or non-magnetic through direct testing
- Understand the composition of magnetic materials
- Learn to observe patterns in material properties and ask questions about them
- Understand how to record observations and reason based on evidence

Materials:

- A magnet
- Notebook and pen
- Various objects: wood, small stone, soil, Iron nails, Stainless-steel spoon, Copper wire, Aluminium, Brass, different coins, plastic, paper, glass
- Optional: Additional objects from the classroom or home

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5E Lesson plan

Engage	Ask: • Have you seen a magnet? What do you think it can do? • Show an image of a magnet with iron pins attached and ask: • What do you notice? Why do the pins stick? • Encourage students to guess which objects around them might stick to a magnet Spark curiosity: Do magnets attract everything or only some objects?
Explore	Provide each group with a magnet and the set of objects. Ask students to first predict which objects will stick and note their guesses in a table. Test these objects and more from your surroundings with the magnet, record observations in the notebook in the format shown in the resource. Facilitate small group discussions: Which objects were attracted? Which were not? Can you see a pattern?
Explain	Encourage students to identify patterns linked to their observations. Discuss the results with the class: • Objects that stick to magnets are magnetic materials. Many metals are magnetic, such as Iron, Nickel, Cobalt • Objects that do not stick are non-magnetic materials (wood, plastic, glass, Copper, Aluminium, paper, etc.) • Not all metals are magnetic; e.g., some coins or steel objects may or may not stick depending on their composition
Elaborate	• Challenge students to find compositions of metal objects that were not attracted by the magnet • Why do some coins stick and others don't? • Find other applications of magnets in transportation, telecommunications, power generation, medicines, etc.
Evaluate	• Oral reflection: Ask students to explain why certain objects stick to magnets and others do not • Ask students to list 5 magnetic and 5 non-magnetic material

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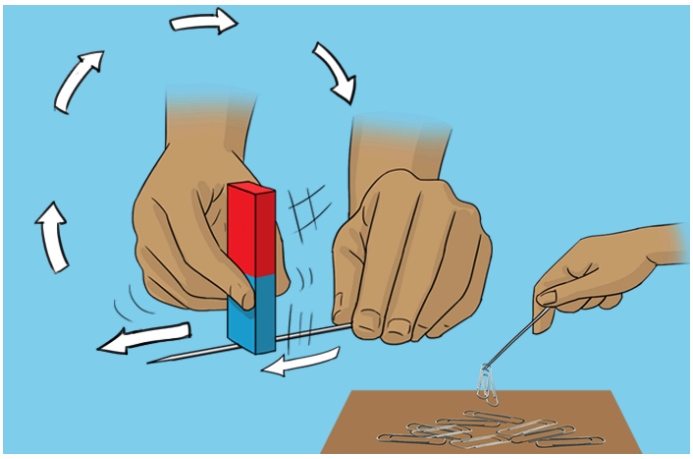
4.3 Make Your Own Magnet



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Learning objectives:

By the end of this lesson, students can:

- Understand how temporary magnets can be made using permanent magnets
- Learn about permanent and temporary magnets
- Understand what happens when a magnetic material is rubbed with a magnet
- Learn to record observations, draw inferences, and reason scientifically

Materials:

- Bar magnet
- Steel needle (not plastic-coated)
- Allpins
- Various magnetic and non-magnetic objects (Iron nails, coins, wood, plastic, Aluminium foil, metal ruler, rubber, etc.)
- Notebook and pen

5E Lesson plan

Engage

Show students a picture of a screwdriver attracting screws and ask:

- How do you think the screwdriver and screws attract each other?
- Is there something in them that makes this happen?

Encourage guesses and introduce the idea that a magnet may be involved.

Pose the question: Can we make our own magnet that works like this screwdriver?

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Explore	Ask students to read the instructions from the resource and perform the activity. Create a table as shown in the resource, in their notebooks to record observations.
Explain	Ask the students to carefully read the explanation provided in the resource and discuss the results recorded in their tables. Only magnetic materials (Iron, Nickel, Cobalt, some types of steel) can be magnetized. Non-magnetic materials (wood, plastic, Aluminium, rubber, etc.) cannot be magnetised. Explain the difference between permanent magnets (retain magnetic properties long-term, e.g., bar magnet) and temporary magnets (lose magnetism after a short time, e.g., needle, paper clip, screwdriver).
Elaborate	Tell the students to experiment by rubbing the needle 30/40/50 times to explore if rubbing affects magnetic strength. Ask students to think of ways temporary magnets could lose their magnetism (demagnetization by dropping, heating, or other methods). Pose questions: • Now that you understand how to make temporary magnets? • How do you think permanent magnets are made? Find out! Encourage students to explore and experiment with magnets of different shapes on their own.
Evaluate	Oral discussion: • Which materials can be magnetised? Which cannot? Students demonstrate creating a temporary magnet for the class and explain its properties, comparing it to a permanent magnet.

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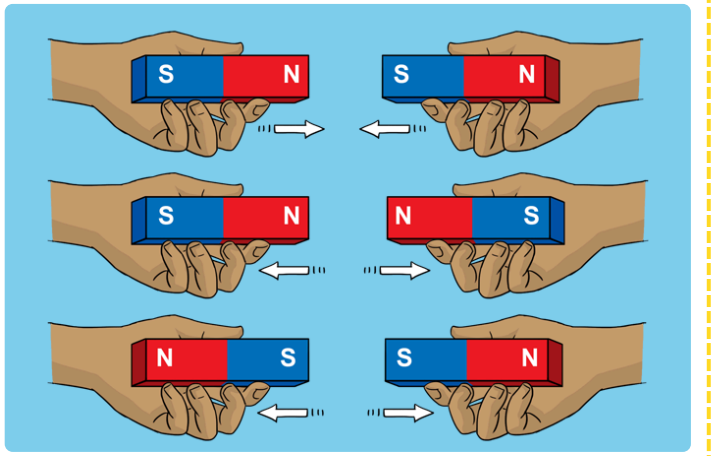
4.4 Attraction and Repulsion



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Learning objectives:

By the end of this lesson, students can:

- Understand that every magnet has two poles: North and South
- Understand the behavior of magnets: attraction and repulsion
- Learn to experiment, record observations, and draw conclusions

Materials:

- Bar magnet
- Three thin sewing needles
- Red, green, and blue thermocol balls
- Plastic tray/plate
- Water
- Notebook and pen

5E Lesson plan

Engage	Show students the video clip of the jumping frog. Ask: • Why do you think the frog is jumping? • Write your hypothesis in your notebook Replay the video and encourage students to focus on the movement of the frog and think about invisible forces causing it to jump.

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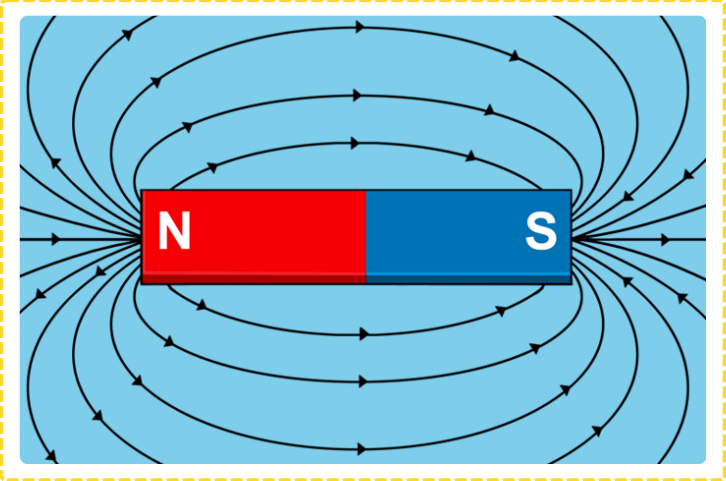
Explore	Show the video till the experimentation part. Ask students to perform the experiments, create and fill the observation table as shown in the video. Ask the students to find patterns from the observations.
Explain	Play the explanation part of the video and explain to the students when magnets attract and when they repel. Relate the experiment to the frog jumping in the video: • Explain that the frog jumped due to magnetic repulsion • Introduce the terms poles of a magnet- North Pole and South Pole Discuss the behaviour of poles: • Opposite poles attract (pull each other) • Like poles repel (push each other away) Encourage students to explain the behaviour of magnetized needles and the concepts of attraction and repulsion in front of the class.
Elaborate	Ask students to think about real-life applications of magnetic attraction and repulsion. Pose additional questions for inquiry: • In which geographic direction do the magnetized needles always come to rest? • Why do they always point that way?
Evaluate	Quick check- Oral Qs: • What happened when opposite poles of magnetized needles were brought close? • What happened when like poles were brought close? • Which poles attract and which repel? • Did the non-magnetized needle push any magnetized needle away? Written reflection- Students record in their notebooks: • Identification of poles of a magnetised needle • Difference between attraction and repulsion

4.5 Field Lines



Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn about the magnetic field of a magnet
- Learn to observe and visualize magnetic field lines using iron filings
- Understand how to identify regions of high and low magnetic field intensity

Materials:

- Bar magnet
- Iron filings
- White sheet of paper
- Pen or pencil
- Magnetic Compass (optional)

5E Lesson plan

Engage	Show students the video clip of the jumping frog. Ask: • Why do you think the frog is jumping? • Write your hypothesis in your notebook Replay the video and encourage students to focus on the movement of the frog and think about invisible forces causing it to jump.

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Explore	Show the experiment part of the video and guide groups to perform the experiments as shown. Encourage students to draw the patterns in their notebooks. Ask students to sprinkle iron filings on the paper further and further away from the magnet. Now ask a question. • Why do the field lines disappear beyond a certain point? • What does it tell us?
Explain	Play the explanation part of the video and discuss observations: The magnet's invisible force extends beyond its physical contours but within certain limits. Explain the concept of a magnetic field and magnetic field lines. Highlight that lines close together indicate stronger force, and lines far apart indicate weaker force. The lines disappear beyond a certain limit. Relate back to the floating kite example.
Elaborate	Pose questions: • Discuss real-life applications: security scanners, electronic devices, and everyday uses of magnets Assign activities: • Find other machines or devices that use magnets • Draw magnetic field lines of a bar magnet using a compass • Draw magnetic field lines for magnets of different shapes and compare patterns • Research magnetic field applications in transportation and medicine
Evaluate	• Why does one kite float and the other does not? • What does the density of field lines tell us? • Where is the magnetic field strongest? Where is it weakest? • Students submit notebook sketches of field lines and share observations

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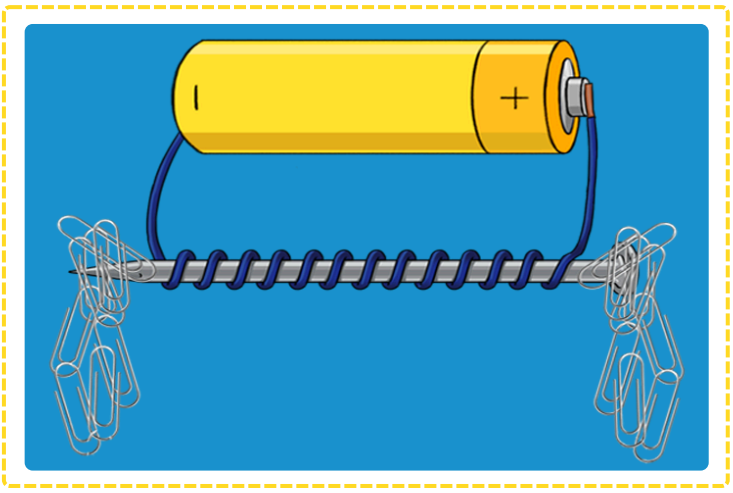
4.6 Electromagnet



Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn about the relationship between electricity and magnetism
- Learn about electromagnets and their properties
- Understand real-life applications of electromagnets in cranes, doorbells, and trains
- Learn about factors that affect the strength of an electromagnet

Materials:

- 10 cm Iron nail or wire
- ½ meter insulated wire
- 1.5 V cell
- Magnetic compass
- Some allpins
- Scissors/stripper
- Cellotape

5E Lesson plan

Engage

Show video clip:

- How is the crane lifting and dropping Iron filings?
- Why does a doorbell ring only when the switch is pressed?

Let the students discuss and try to guess the answers.
Encourage them to connect it with what they already know.

Teacher's Manual: Magnetism

Explore

- Play the experimentation part of the video and guide groups to perform the experiments as shown
- Ensure learners have all the required materials
- Ask students to conduct the experiment
- Repeat 2–3 times and observe
- Bring a compass near the current-carrying wire (without nail) and observe the deflection
- Ask students - Why does the needle deflect?

Explain

Play the explanation part of the video and discuss.

- Why does the compass needle deflect when brought near the current-carrying wire with and without the nail?
- Why does the nail behave like a magnet only when connected to the cell?

Explain:

- An electric current produces a magnetic field
- Iron nails strengthen the weak magnetic field and become temporary magnets
- Define electromagnet
- Relate to the crane and doorbell examples

Elaborate

Discuss applications: electric motors, Maglev trains, security devices, medical equipment.

- What if we use two cells instead of one?
- What if we increase the number of wire turns?
- How do we find the North and South poles of an electromagnet?
- Encourage students to try these variations at home or in the class

Research how a doorbell works with an electromagnet, or find 3 machines at home/school that use electromagnets.

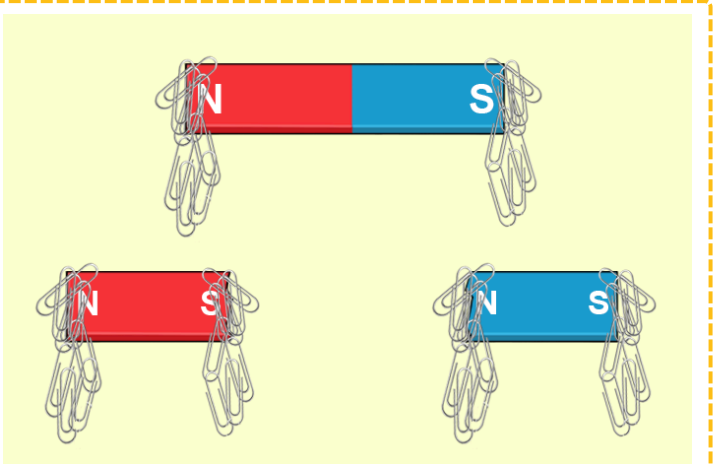
Evaluate

Ask:

- What is an electromagnet?
- Why do the magnetic properties disappear when the wire is disconnected?
- Where do you see electromagnets in daily life?

Homework:
Draw a circuit diagram of an electromagnet with nail, wire, and cell.

4.7 Full magnet or half?



Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Understand why each broken piece of a magnet behaves like a complete magnet

Materials:

- Bar magnet
- Cycle spoke
- Pliers
- Few allpins

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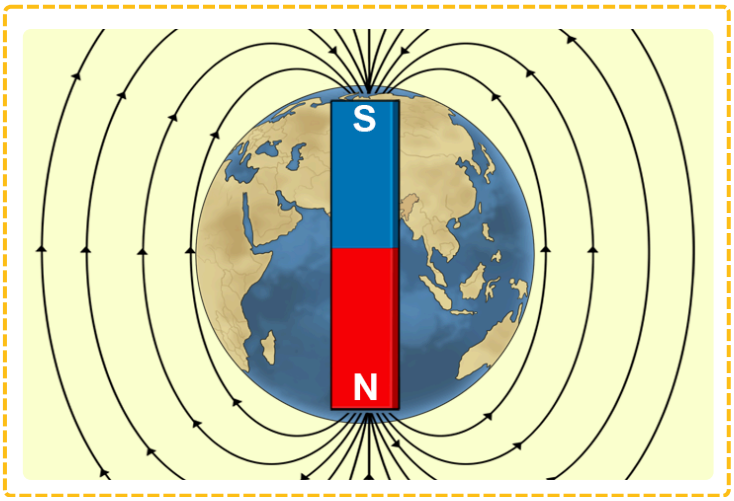
5E Lesson plan

 **Engage**	Show a bar magnet and ask: • What do N and S on a magnet represent? • What will happen if we cut this magnet into two pieces? Will each piece have only one pole, North or South? Ask students to write their hypothesis in their notebooks.
 **Explore**	Read the experimentation part of the resource and guide groups to perform the experiments step by step. Ensure that students have all the required materials. Instructions to students: • Be careful while using the pliers • Do not drop or throw the spoke on the ground
 **Explain**	Read the explanation part. Discuss: • Each magnet is made up of hundreds of tiny magnets • Hence, each broken piece behaves like a complete magnet, having both North and South poles and each piece exhibits all magnetic properties
 **Elaborate**	Encourage students to think: • What would happen if we break a horseshoe magnet or a ring magnet? • Draw a diagram showing North and South poles Can you find out if a magnet with only one pole exists?
 **Evaluate**	• What happens to the poles when a magnet is cut? • Where do pins stick to a magnet when the magnet is cut? Homework: Draw labelled diagrams showing the poles of a full bar magnet and its pieces.

4.8 Earth as a Magnet



Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn why a suspended bar magnet or compass needle always aligns in the North–South direction
- Understand why the Earth behaves like a giant magnet
- Learn the difference between geographic and magnetic poles
- Learn about the significance of Earth's magnetic field

Materials:

- Bar magnet
- Thread (to suspend the magnet)
- Magnetic compass
- Globe or a pictorial representation of a globe

5E Lesson plan

Engage

Suspend a bar magnet freely and/or show them a magnetic compass and let students observe how they align.

Ask:

- Which direction does the needle and the bar magnet point to?
- Why doesn't it point East–West?

Pose the puzzle:

- Why does it always align North–South?

Allow students to guess and note their hypotheses.

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Explore

Play the video. Focus on the layers of the Earth:

- Crust
- Mantle
- Outer core
- Inner core

Ask the students to find out the composition of the four layers.

Explain

Discuss the composition of four layers.
Let 1-2 groups explain in their own words.

- Outer core is made up of molten Iron and Nickel. The movement of this molten mixture due to the rotation of the earth generates an electric current. This electric current gives rise to a magnetic field.
- The inner core containing Iron and its compounds strengthens this magnetic field

Hence we can compare the Earth to a giant bar magnet with north and south poles. The magnetic poles are distinct from the geographic poles which are defined by the Earth's axis.

Elaborate

Extend the discussion:

- If compasses point north, can we reach the geographic North Pole using them?
- Find out: Importance of Earth's magnetic field in navigation, animal migration, protection from harmful solar radiation
- Connect with previous lesson about Electromagnets. The Earth's magnetic field is generated in a similar way.

Ask students to reflect:

- What would happen if Earth had no magnetic field?
- Why does the north end of a magnet point towards Earth's geographic north?

Evaluate

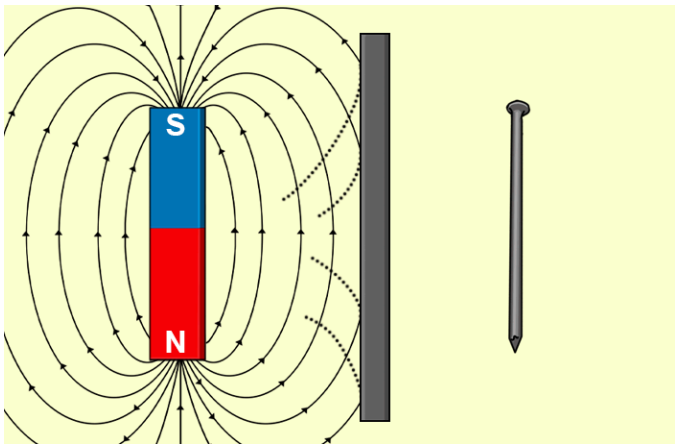
Questions:

- Why does a compass needle point North-South?
- What creates the magnetic field inside the Earth?
- Are the Earth's magnetic poles and geographic poles the same?

Homework: Draw a diagram of the Earth indicating the geographic and and magnetic poles.

Also show the alignment of a freely suspended bar magnet on Earth.

4.9 Magnetic Shielding



Scan or click the QR code to open the resource.

Learning objectives:

By the end of this lesson, students can:

- Learn about magnetic shielding and how it works
- Understand how different materials influence magnetic fields
- Learn about real-life applications of magnetic shielding
- Understand the difference between magnetic shielding and electrical insulation

Materials:

- 3–4 ring magnets
- Allpins
- Empty matchbox
- Steel ruler
- Plastic scale
- Wooden scale
- Iron strip
- Stainless steel spoon
- Scissors
- Other common objects (at least 10)

Teacher's Manual: Magnetism

5E Lesson plan

 **Engage**	Ask: • Have you ever looked inside a speaker? There's a metal plate and the magnet. • Do they have specific roles? Or is the plate just for support? Now, play the relevant part of the video. Show students a magnet attracting pins through a matchbox cover. Pose the question: Will the magnet still work if different materials are placed in between? Let students guess.
 **Explore**	Play the experiment part of the video. Guide groups to perform the experiments as shown. Ensure that all students have required materials. Ask students to create an observation table as shown and write their observations. Ask: • Which materials allowed the pins to stick to the magnet and which did not? Encourage them to try with at least 10 everyday objects of similar thickness. Discuss patterns: Do magnetic and non-magnetic materials behave differently?
 **Explain**	Play the explanation part of the video. Discuss: • Non-magnetic materials (wood, plastic) do not block the magnetic field; magnetic materials (Iron, steel) block or redirect it Introduce the concept: Magnetic shielding is a process of blocking or redirecting magnetic fields using magnets or magnetic materials. Clarify with analogy: It's like a wall that blocks magnetic forces.

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Elaborate	Extend discussion with real-world applications: • Phones use shielding to protect circuits • Speakers use it to prevent distortion in nearby screens • MRI machines require strong shielding to avoid interference in nearby devices • Satellites and laboratories also use magnetic shielding to reduce interference • Is magnetic shielding like electrical insulation? How are they similar or different? • Why aren't phones allowed in hospital MRI rooms? • Can you spot any other examples of shielding at home or school?
Evaluate	• What is magnetic shielding? • What type of material blocks a magnetic field? Give two real-life uses of magnetic shielding. Written task: Draw a simple diagram showing how a magnetic field is redirected when an Iron strip is placed between a magnet and allpins.