National MagLab STEM Lesson Plan: How a Magnet Stopped a War (Elementary School)

Lesson Objectives:

Student will be able to:

- Relate that electric current creates a magnetic field.
- Investigate ways to change the strength of an electromagnet.
- Describe items that engineers have designed using electromagnets.

Next Generation Science Standard:

- SC.5.P.10.2 Investigate and explain that energy has the ability to create motion or cause change.
- SC.5.P.10.4 Investigate and explain that electrical energy can be transformed into heat, light, and sound energy, as well as energy of motion.

STEM Rationale for Lesson:

Students will engage in a structured learning process that allows them to build a deep understanding of electromagnets through guided research and hands-on exploration. This process will involve investigating the principles of electromagnetism, such as how electric currents generate magnetic fields, and how these fields can be controlled and manipulated. Through activities like building simple electromagnets, experimenting with variables (such as the number of wire coils or the strength of the current), and observing their effects, students will connect theoretical concepts to practical applications.

The structured research will include analyzing scientific resources, understanding key terminology, and applying their knowledge to real-world problems, such as how electromagnets are used in everyday devices like motors, medical equipment (such as MRI machines), or in industrial settings. This method of learning will not only enhance their grasp of the topic but also develop their skills in scientific inquiry, critical thinking, and problem-solving. By the end of the exploration, students will have constructed a

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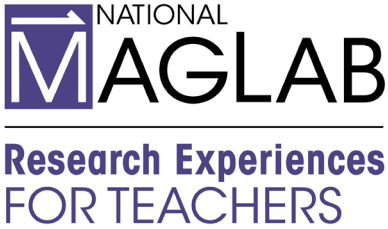
STEM Lesson Plan:



well-rounded understanding of how electromagnets work and their significance in modern technology.

Time: This lesson will take place over two days (60 minutes each day).

Materials:

- Research articles on Electromagnets https://science.howstuffworks.com/electromagnet.htm
- Electromagnet Lab Sheet
- Electromagnet Graphic Organizer
- Text “How an Electromagnet Stopped a War” from Foss Science Stories, Magnetism and Electricity
- D batteries (2 for each group)
- Paper Clips
- Iron nail for each group
- Thin electrical wire (cut in two-foot lengths) without insulation on the ends for each group

Previous Knowledge:

Students have actively constructed series circuits, giving them hands-on experience with the flow of electricity in a closed loop. Through these activities, they have developed a solid understanding of how electrical components—such as batteries, wires, and light bulbs—connect to create a functioning circuit. They have also learned the difference between static electricity, which involves the build-up of electric charge on surfaces, and current electricity, which refers to the continuous flow of charge through a conductor. This foundational knowledge of electric currents and circuitry serves as a basis for understanding more complex electrical systems.

Additionally, students have engaged in experiments with various materials to classify objects as conductors or insulators. By testing materials like metals, plastics, and wood, they have explored which materials allow electricity to flow through them (conductors) and which prevent the flow of electricity (insulators). This classification process has enhanced their understanding of electrical properties and the practical

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applications of different materials in electrical systems. The combination of constructing circuits and investigating conductors and insulators has provided students with a comprehensive understanding of basic electrical principles, setting the stage for further exploration of concepts like electromagnetism and circuit design.

Lesson Instructions:

Session 1:

1. Warm-Up (5 minutes): Begin by asking the class, "What does the term electromagnet make you think of?" Have students discuss their thoughts with a shoulder partner for 30 seconds. Call on a few students to share their ideas with the class. Show a short video of a junkyard electromagnet at work. Lead a class discussion on what was happening in the video and how the electromagnet was used.
2. Mini Lesson (10 minutes): Explain to students that they will be learning about electromagnetism and its principles before constructing their own electromagnets. Distribute graphic organizers to students to structure their thinking. Instruct students to fill in the "What I Know" and "What I Want to Know" sections of the organizer regarding electromagnets.
3. Research and Exploration (15 minutes): Provide students with printed articles about electromagnets, discussing their everyday uses and historical significance, including how an electromagnet once helped stop a war. Guide students as they read and fill in their graphic organizers with new information in the "What I Know" section.
4. Class Discussion and Sharing (5-10 minutes): Allow students to share their research findings and discuss the various uses of electromagnets in daily life.
5. Video Demonstrations (10-15 minutes): Show two short videos demonstrating how to create an electromagnet. Pause between key points in the videos to give students time to jot down notes or observations in their graphic organizers.

By the end of this procedure, students will have developed a foundational understanding of electromagnets, which will help prepare them for constructing their own in the next activity.

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STEM Lesson Plan:

Session 2:

1. Review (10 minutes): Begin the session by having students share interesting facts they learned about electromagnets during the previous session. Briefly recap key points, then explain that in today's session, students will work in teams to create their own electromagnet and explore ways to increase its strength.
2. Active Engagement & Exploration (30 minutes):
    a. Discussion (5 minutes): Instruct students to discuss with their shoulder partner how they think they can build an electromagnet and identify what materials they would need.
    b. Materials Overview (5 minutes): Show students the materials counter, explaining the items available for building their electromagnet, such as wire, nails, batteries, and paper clips.
    c. Planning (5 minutes): Give teams 5 minutes to discuss and plan their electromagnet design and how they will approach the building process.
    d. Building (15 minutes): Allow students to collect their materials and begin constructing their electromagnets. Circulate around the room to answer questions, offer guidance, and prompt critical thinking.
3. Data Recording and Experimentation (20 minutes): Distribute lab sheets to each team to record their data and observations. Instruct students to test their electromagnet by seeing how many paper clips they can attract. Have them experiment with different variables (such as number of coils or strength of the battery) and record their results. Ensure students answer the guiding questions on their lab sheets as they progress.
4. Conclusion (5 minutes): Reconvene as a class to briefly discuss their findings. Encourage teams to share how they increased the strength of their electromagnets and what they learned during the process.

By the end of this session, students will have successfully created an electromagnet and explored ways to enhance its magnetic strength through experimentation.

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STEM Lesson Plan:

Build an Electromagnet Lab Sheet

Research Experiences FOR TEACHERS

Name: _____ Date: _____

Data:

Number of times coils are wrapped	Strength of the magnetic field
Trial 1: 15 coils	
Trial 2: 30 coils	
Trial 3: 45 coils	

1. Which trial attracted and held the most paperclips? _____
2. Why do you think that is? _____

   _____
3. What could you do to make your electromagnet stronger?

   1. _____
   2. _____
   3. _____
4. Explain how the electromagnet is different from a traditional magnet?

   _____

   _____
5. List one reason an electromagnet is used over a traditional magnet.

   _____

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STEM Lesson Plan:

Electromagnet Graphic Organizer

PART ONE: You can include facts and sketches.	What do you think you know about electromagnets?
PART TWO:	What do you want to know about electromagnets?
PART THREE:	Read about Michael Faraday and then add information about electromagnets here:

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STEM Lesson Plan:

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Research Experiences FOR TEACHERS

PART FOUR:	Read about how electromagnetism stopped a wat. What did you learn about electromagnetism?
PART FIVE:	Watch the two videos and add more facts.
PART SIX:	Describe with a scientific drawing and full sentences what an electromagnet is, how to make one, and how it can be used.

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