

Lab

What You'll Do

- **Build** several electromagnets.
- **Determine** how many paper clips each electromagnet can lift.
- **Analyze** your results to identify the features of a strong electromagnet.

What You'll Need

batteries, D-cell (2)
battery holders (2)
electrical tape
metal rods (1 iron, 1 tin, 1 aluminum, and 1 nickel)
paper clips, small (1 box)
wire, extra-insulated
wire, insulated, thick, 1 m long
wire, insulated, thin, 1 m long
wire stripper

Safety



Making a Better Electromagnet

In a Quick Lab earlier in this chapter, you made an electromagnet by using batteries and a wire coil. In this lab, you will experiment with the characteristics that make an electromagnet stronger.

Asking a Question

What combination of various batteries, wires, and metal rods will make the strongest electromagnet?

Building an Electromagnet

- ➊ Review the basic steps in making an electromagnet by looking at the Quick Lab in Section 2.
- ➋ On a blank sheet of paper, prepare a data table like the one shown in this activity.
- ➌ Wind the thin wire around the thickest metal core. Carefully pull the core out of the center of the thin wire coil. Using the thick wire, repeat the steps above. You now have two wire coils that can be used to make electromagnets. **CAUTION:** Handle the wires only where they are insulated.

Forming and Testing a Hypothesis

- ➍ Think about the following, and predict the features that the strongest electromagnet would have.
 - a. Which metal rod would make the best core?
 - b. Which of the two wires would make a stronger electromagnet?
 - c. How many coils should the electromagnet have?
 - d. Should the batteries be connected in series or in parallel?



Sample Data Table: Differences in Electromagnets

Electromagnet number	Wire (thick or thin)	No. of coils	Core (iron, tin, alum., or nickel)	Batteries (series or parallel)	No. of paper clips lifted
1					
2					
3					
4					
5					
6					

Designing Your Experiment

- 5 With your lab partners, decide how you will determine the features that combine to make a strong electromagnet.
- 6 In your lab report, list each step you will perform in your experiment.

Performing Your Experiment

- 7 After your teacher approves your plan, carry out your experiment. You should test all four metal rods, both thicknesses of wire, and both battery connections (series and parallel). Count the number of coils of wire in each electromagnet that you build.
- 8 Record your results in your data table.

Analysis

1. **Explaining Events** Which wire made a stronger electromagnet: the thick wire or the thin wire? How can you explain this result?
2. **Explaining Events** Which metal cores made the strongest electromagnets? Why?
3. **Explaining Events** Could your electromagnet pick up more paper clips when the batteries were connected in series or when they were connected in parallel? Explain why.

Communicating Your Results

4. **Drawing Conclusions** What combination of wire, metal core, and battery connection made the strongest electromagnet?

Extension

Suppose someone tells you that your conclusion is invalid because each time you tested a magnet on the paper clips, the paper clips became more and more magnetized. How could you show that your conclusion is valid?