



Electrical Current Creates a Magnetic Field

Hands-on Exploration of Electricity

Time

20 Minutes

Materials and Preparation

- Two pencils
- 16d (penny) nail. Try to get the biggest one you can with the most iron content.
- 3 – D-cell batteries (1 ½ volts ea.)
- Sheet of paper
- Iron filings
- 5 ft. enameled copper wire (uninsulated)
- Masking tape or electrical tape
- Metric ruler

Key Question

What is the relationship between electricity and magnetism?

What effects could electricity and magnetism have on the space station?

Overview

Electrical power is the most critical system on the space station.

Electricity is supplied to the space station through batteries or solar panels that are charged by the sun. Without a continuous supply of electricity, life support and communication systems would shut down.

Part One – Setting-up the Exploration

Take great care in constructing this exploration. Wrap the wire on the nail carefully and neatly, in even coils and in several levels. Be precise with all measurements and observations.

PROCEDURE FOR PART ONE

- 1** Wrap 4 feet of the wire around a nail. Be sure to leave $\frac{3}{4}$ inch of the nail on each end exposed. There should be 6 inches of the wire free at both ends.
- 2** Lay wire-wrapped nail on table. Place two pencils at top and bottom of nail to form an “H.”
- 3** Using tape, attach 2 D-cell batteries together to form one, 3-volt power source. Make sure the positive end of one battery is attached to the negative end of the other battery.
- 4** Using tape, attach the two wire leads from the nail to either end of the two D-cell battery power source.
- 5** Take a sheet of paper and make sure that it extends past the edges of all sides of the “H” by $\frac{1}{2}$ inch. Cut the paper if necessary.
- 6** Place the paper on the “H.”
- 7** Sprinkle iron filings carefully and slowly onto the paper above the nail. Begin sprinkling the filings on the paper over the nail and gradually expand your circle of sprinkles farther and farther from the nail.

CLOSURE QUESTIONS FOR PART ONE

1. What happens to the iron filings you are sprinkling on the paper?
2. Why do the iron filings at the outer edges of the paper react differently than those closer to the nail?

Part Two: Exploring the magnetic effect of various electrical currents.

You have three power sources: 1 D-cell, 2 D-cells, and 3 D-Cells taped together.

How does the magnetic field change when different power sources are used to create an electrical current?

PROCEDURE FOR PART TWO

- 1 Make a careful drawing of the magnetic field produced when using the 2 D-cells. Measure the width of the field, the length, and the distance between the magnetic field lines.
- 2 Change the power source. First, use 1 D-cell battery. Then attach 3 D-cell batteries together. Make careful drawings and measurements of each magnetic field.

Data Analysis

What conclusions can you make regarding the relationship between an electrical power source and current flowing through a wire? What conclusions can you make regarding the relationship between the electrical power source and the magnetic field produced by the electrical current?

CLOSURE QUESTIONS FOR PART TWO

1. How could a solar storm or a coronal mass ejection affect the electrical power sources aboard the space station? Explain how magnetism is a part of this.
2. What would your technical advice be for the astronauts if an electrical crisis should occur? Keep in mind that electricity is needed for the computer control systems, communication systems, and life support systems on board.