

Activity 2 - Electromagnets

TEACHER'S GUIDE

This activity is commonly performed in science classes, starting in 5th grade and extending through college! It relies on the amazing fact, discovered over 100 years ago by Hans Oersted, that if you let an electric current flow through a copper wire, it will generate a magnetic field strong enough to deflect a compass needle or pick up bits of iron.

Knowing about the properties of electromagnets is a crucial underpinning for understanding how magnetic fields are generated in nature, in the surface of the Sun, and in the interior of Earth. In preparation for this activity, or as a follow-up, please review with your students the relevant topics in your Earth Science or Physical Science textbook.

GOALS

- 1) Students will see that, when the electrical current is “turned on,” the needle of the compass placed close to the wire will suddenly point parallel to the pencil.
- 2) Students will see that the more loops of wire they wind around the pencil, the more paper clips they can pick up.
- 3) The more batteries they place “in series,” the more current will flow through the wire, and again, the stronger will be the magnetic field.

MATERIALS

- Thin insulated wire
- pencil
- battery
- compass
- paper clips

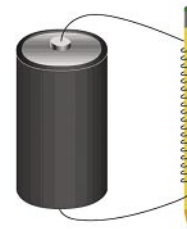


Figure B - Electromagnet made by using a battery, a pencil and thin, insulated wire.

This activity is quite straightforward and considered a “classic” experiment in electromagnetism, and one which students have usually performed at least once by eighth grade. Consult your Physical Science or Earth Science textbook for detailed plans on how to set up the experiment. **Note: We use a pencil rather than a nail because a nail isn’t relevant to the electromagnetism phenomenon. You will need to wrap more turns of wire around a pencil, however, in order to achieve a useable magnetic field.**

For THEMIS, we want students to understand, through this hands-on experiment, that magnetic fields can be produced by flowing currents or charged particles (electricity!). We also want them to understand that magnetic fields can be manipulated in strength in one of two easy ways:

1. They can control how much current flows in the wire by using several batteries in series to increase the current flowing in the wire around the pencil.
2. They can increase the magnetic field of the electromagnet by increasing the number of loops of wire wrapped around the pencil.

They can measure the strength of the electro-magnet by counting the number of paper clips the nail can pick up.

PROCEDURE

1. Have the students control how much current flows in the wire by trying different numbers of batteries, in series, to change the current flowing in the wire around the pencil. Have the students keep a lab book and record how many paper clips the electromagnet can pick up with each battery configuration.
2. Next have students change the magnetic field of the pencil by changing the number of loops of wire wrapped around the pencil. Again have the students record their observations in their lab book. The number of paper clips the pencil with coils can pick up indicates the strength of the electromagnet.
3. In Part A we defined the polarity of one of the bar magnets as “N.” Using this same bar magnet, explore the magnetic field of the electromagnet and determine which end is “N” and which end is “S.” Then reverse the current direction and repeat this experiment. Ask the students to describe what happens and why. They should note that the polarity depends on the direction of the current flow!

VOCABULARY

Current – A flow of charged particles through a conducting material or through space. These charged particles can be electrons, protons or ions.

Magnetic field – A condition in the space surrounding some objects that causes charged or metallic bodies brought close by to experience the force of magnetism.

RELATED WEB ACTIVITIES

1. Exploring Magnetism – Activity 2
<http://cse.ssl.berkeley.edu/exploringmagnetism/>
2. Electricity and Magnetism (IMAGE)
<http://image.gsfc.nasa.gov/poetry/activity/l4.htm>

A Simple Electromagnet

