



Build It: Electromagnet!

<p>THE BASICS</p>	<p>THE TOOLBOX</p>	<p>EDUCATION STANDARDS</p>	<p>Physical Science Content Standard: Understanding that electricity can form a magnetic field that can be used to create a temporary magnet.</p>
<p> Grade Level: K-12</p>	<ul style="list-style-type: none"> • 3" long iron or steel bolt • 22-gauge insulated wire (24" long) • 2 D-cell batteries • 2-3 alligator clips or tape 	<p>SAFETY CONCERNS</p>	<p>Be careful in handling sharp ends of cut wires. Make sure students remember what a short circuit is and that short circuited wires can become warm.</p>
<p> Estimated Time: 45 min.</p>	<ul style="list-style-type: none"> • 20 paper clips & other magnetic objects • Wire cutter 	<p>FOR KIDS WITH DISABILITIES</p>	<p>Visually- and mobility-impaired students may need to work with a partner. Hearing-impaired students should have no trouble performing this activity.</p>



Educational Objective:

To learn how to construct and use an electromagnet. To learn that electromagnets are temporary magnets and work only when electricity passes through the coil of wire.

What to Do:

- Before doing this activity, students should have built simple electric circuits with batteries and flashlight bulbs.
- Build an electromagnet and try it yourself so you can help students in wrapping the wire coil. To save time, you can pre-strip the ends of the wire for each pair of students. You can use a wire stripper, scissors, or a sharp knife to remove the insulation.
- Do not dismantle the electromagnets until you are finished with electromagnet activities, but be sure they are disconnected from the batteries at the end of your class.
- When you are finished with electromagnet activities, unwrap the wires and be sure the electromagnets are not connected to the batteries.
- Students can label their electromagnets with tape and use them over and over.

Questions to Ask Students As They Do This Activity:

- What is traveling through the wires? Where does the electricity come from?
- Is an electromagnet a temporary magnet or a permanent magnet? Why is it a temporary magnet?
- How can you measure the strength of your electromagnet? How can you make your electromagnet stronger?

Why It Happens:

When an electric current flows through a wire, a magnetic field is produced around it. The field produced by a single wire is very weak. To increase it, we wind the wire into a tight coil. This concentrates the magnetic field, especially if we put an iron bar in the center of the field. The poles of the magnet are at either end of the coiled wire (therefore, at the end of the iron bolt.)

There are two ways to increase the strength of an electromagnet. One is by adding more length to the wire (more coils). The other is by increasing the amount of electricity going through the wire. By increasing these two things, engineers have developed very powerful electromagnets such as the enormous ones used in junkyards to lift large piles of metal.

WEB SITES

- **Magnetic Fields**
<http://www-spod.gsfc.nasa.gov/Education/wmfield.html> (Grades 9-12)
- **Moving Electrons**
<http://www.lbl.gov/MicroWorlds/teachers/movingelectrons.pdf>
(Grades 4-12 – requires Adobe Acrobat Reader)

SOFTWARE

- **Electrical Currents and Magnetism**
AIMS Multimedia, 1996.
(Grades 6-10)
- **Tomorrow’s Promise Physics**
CompassLearning (formerly Jostens Learning), 1997.
(Grades 7-12)

READING ROOM

- Gardner, Robert. **Science Fair Projects About Electricity and Magnets**. Enslow, 1994. (Grades 2-6)
- Kerrod, Robin. **Electricity and Magnetism**. Marshall Cavendish, 1994. (Grades 2-6)
- Oxlade, Chris. **Electricity and Magnetism**. Heinemann Library, 2000. (Grades 1-4)

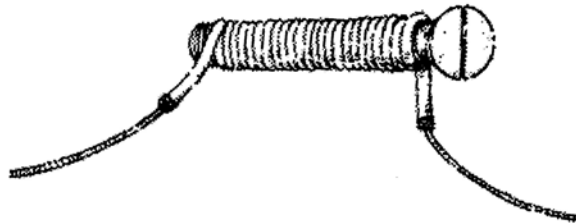
Career Connections

Many kinds of magnets are made of special ceramic materials that are made permanently magnetic by electric currents through a process similar to the one demonstrated in this activity. Individuals who do this job are called ceramic engineers.

BUILD IT: ELECTROMAGNET ACTIVITY SHEET

You can make a temporary magnet by stroking a piece of iron or steel (such as a needle) along a permanent magnet. There is another way that uses electricity to make a temporary magnet, called an electromagnet. Let's build one!

1. Work with a partner. You'll need an iron or steel bolt, 24 inches of insulated wire, 2 D-cell batteries with holders, alligator clips or tape to hold the wire connections together, and some paper clips or other magnetic items.
2. Wrap the wire in a **tight, even coil** around the bolt. Leave 3 or 4 inches of wire loose at each end. Keep wrapping the wire until you get to the end of the bolt. There may be as many as 3 or 4 layers of wire all the way up and down the bolt. Your electromagnet should look something like this:



3. Attach one end of the wire to the positive (+) end of one of your batteries. Attach the other end of the wire to the negative end (-) of your battery pack.
4. Try to pick up one of the paper clips with your electromagnet. What happens? Now, unhook one of the wires from the battery. Will your electromagnet pick up a paper clip now? What do you need flowing through the wire to make the iron bolt act like a magnet?
5. How many paper clips will your electromagnet hold? Can you hang clips on both ends of the bolt? Why?
6. How can you make your electromagnet stronger? Try adding more batteries to your battery pack. Make sure all the batteries "face" the same direction in the circuit. Now, how many paper clips will your electromagnet hold?
7. How is the strength of the electromagnet affected by the increase in electricity traveling through the wire?