# Build It: Electric Motor

| THE BASICS | THE TOOLBOX |
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|  Grade Level: K-12  Estimated Time: 45 min. | • 1 D-cell (1.5 volt) battery<br>• 12 inches of thin (30-gauge wire) with varnish insulation<br>• 2 paper clips<br>• Tape<br>• Doughnut- or disk-shaped magnet<br>• Nail file or emery board |

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| **EDUCATION STANDARDS** | **Physical Science Content Standard:**<br>Reinforce the concept that electricity and magnetism can be used to create motion. |
| **SAFETY CONCERNS** | 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. |
| **FOR KIDS WITH DISABILITIES** | Visually- and mobility-impaired students may need to work with a partner. |

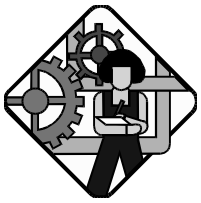
## What To Do

**Educational Objective:**

To build a simple electric motor. To learn how magnetism and electricity work together to create motion in motors.

**What to Do:**

- Gather the materials and build a motor yourself. It takes a little practice to get it moving, so it's important that you try it yourself ahead of time.
- To save time, you can cut the wire into 12-inch lengths.
- **Store magnets, batteries, and wire separately!**



**Questions to Ask Students As They Do This Activity:**

- Is there anything in the motor that is magnetic **besides** the doughnut magnet?
- Do you have to use insulated wire? Why?
- Why are we using such a thin wire here?
- Why is the wire coiled?
- Why do you scratch off the insulation at the ends?
- How is the motor similar to the electromagnet?

**Why It Happens:**

The insulated wire forces the electricity to pass through all the coils of the wire. As in the electromagnet, this makes a temporary magnet out of the coils. It will be a magnet as long as electricity is flowing through the coils. If non-insulated wire is used, the electricity would take the shortest path open to it and would not go around and around the coils.

As in the other electromagnet, when an electron moves down a wire, it creates a weak magnetic field around the wire. By coiling the wire, we strengthen the magnetic field because we add up the effect of lots of electrons all moving around the coil in the same direction and all creating tiny fields. The more rounds of coiled wire, the stronger the field.

When this temporary magnetic field comes in contact with the magnetic field from the doughnut magnet, the attraction or repulsion is enough to push the thin wire coil around. The push/pull is just like bringing two doughnut magnets together… you can feel it! It's that alternating push/pull that keeps the motor going around and around. If we want to make a more powerful motor, we can use more coils of wire (most industrial motors have hundreds) and stronger magnets.

## Web Sites

- **Simple Electric Motor**
  http://www.simplemotor.com (Grades 4-12)
- **Beakman's Electric Motor**
  http://fly.hiwaay.net/~palmer/motor.html (In English and Spanish; Grades 4-12)

## Software

- **Physics Explorer**
  LOGAL Software, Inc., 1999
  (Grades 9-12)
- **Electrical Currents and Magnetism**
  AIMS Multimedia, 1996
  (Grades 6-10)

## Reading Room

- Friedhoffer, Robert. **Magnetism and Electricity**. Watts, 1992. (Grades 5-12)
- Oxlade, Chris. **Electricity and Magnetism**. Heinemann Library, 2000. (Grades 1-4)
- Wong, Ovid. **Experimenting with Electricity and Magnetism**. Watts, 1993. (Grades 9 and up.)

## Career Connections

Small motors and magnets are important parts of many kinds of medical equipment. People who design these sophisticated pieces of equipment are called biomedical engineers.

# BUILD IT: ELECTRIC MOTOR ACTIVITY SHEET

If you have built a simple electric circuit with a battery, a bulb, and aluminum foil and have built an electromagnet, then you already know how to put together all the pieces of a simple electric motor. Let's find out how electricity and magnetism work together to run all of the motors we use every day!

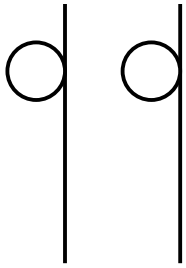
1. Gather your materials. You'll need a 12-inch piece of thin wire, 2 paper clips, a nail file or emery board, some tape, and a magnet.

2. Make a coil of wire by loosely wrapping the wire around one of your fingers or your thumb at least three times. Leave an inch of wire loose at each end of the coil. See diagram below.

3. To fasten the coil, thread both ends of the wire through the center hole of the coil three times.

4. The wire has a coating on it that acts as insulation. You need to strip ½ inch of coating off each end of the wire. Use the nail file top rub off the coating. If you place a piece of white paper under the wire, you should be able to see the coating come off. **Don't rub too hard or you will break the wire!** Make sure all of the coating is off on all sides of the two ends. Lay the coil aside.

5. Straighten the two paper clips and make a loop in each as shown by wrapping the end of the paper clip around an ink pen or pencil. The loops should be near the end of the paper clip as shown here:



6. Tape or hold one paper clip to each end of the battery so that the loops stick up at the same height and the bottoms of the paper clips touch the metal ends of the battery.

7. Place the coil of wire so that the ends stick through the loops in the paper clips and the coil is above the battery (see picture). Then place the magnet on the battery underneath the coils, and fidget with the position of the magnet until the coil spins. You just built an electric motor!