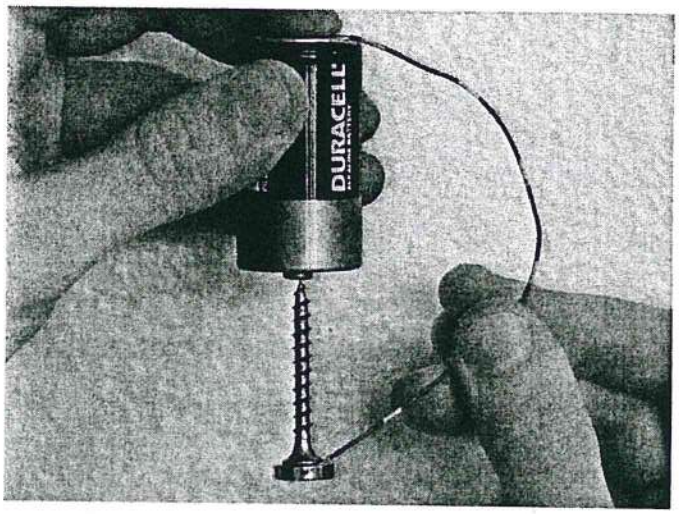
Homopolar Motor

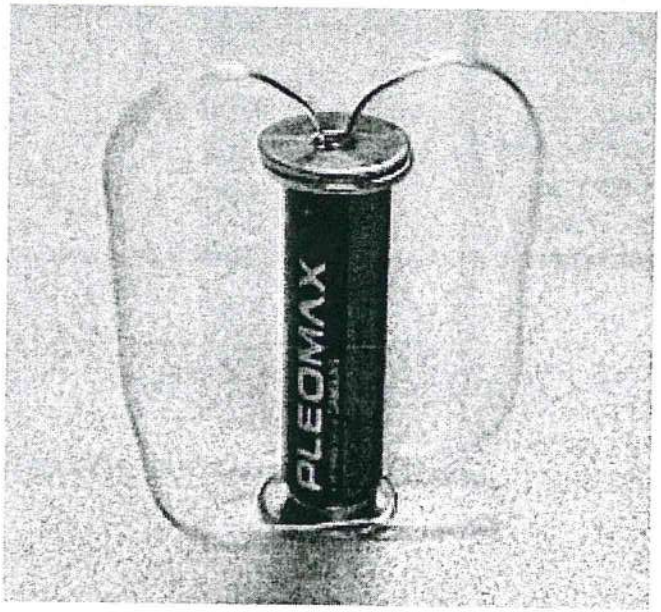
Materials:

AA battery
Neodymium magnet
Copper wire
Steel wood screw

Version 1:



Version 2:



Can you figure out the right-hand rule for each version?

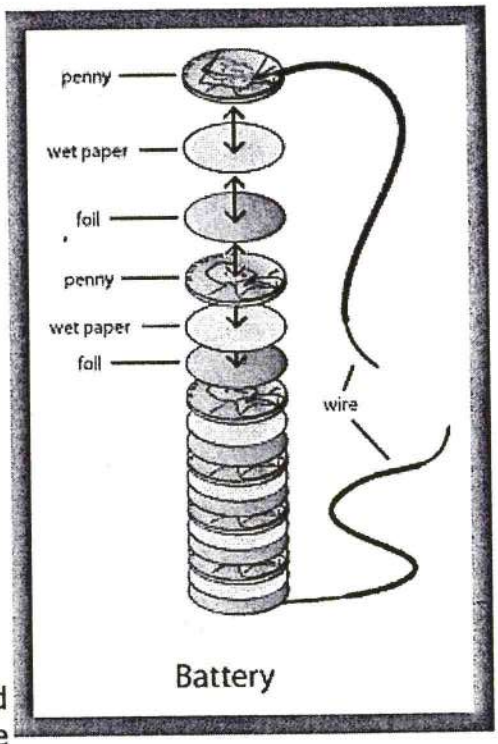
Make a Battery

Some kinds of batteries produce electricity by a chemical reaction between two different metals (electrodes) immersed in acid (electrolyte). Figure out how to make your own batteries in case the limited supply on the island runs out.

You'll need:

- two wires with the ends stripped off
- aluminum foil
- scissors
- small bowl
- warm water
- salt
- tape
- 6 pennies (copper coins)
- paper towels
- 1.5 volt penlight light bulb or LED
- a paper plate

What you do:
Partially dissolve 1 tablespoon of salt in 1 cup of warm water. Some salt should still be evident in the bottom of the bowl. Place a penny on the aluminum foil and draw around it. Repeat five times. Do the same thing with the paper towel. Cut out the circles. You should have six foil circles and six paper ones. Tape the end of one wire to a foil circle. Dip a paper circle in the warm, salty water. Place the foil circle with the wire on the plate, and put a wet paper circle and a penny on top of it. Using all the foil, pennies, and paper circles, build alternate layers. Then tape the other end of the wire to the last coin and put it on top. This is your battery.



Battery

Test the battery with the light bulb. Attach the end of one wire to the metal terminal end of the light bulb. Wrap the end of the other wire around the metal shaft of the light bulb. Can you see the bulb light up?

Activity adapted from Neil Ardley. 101 Great Science Experiments. *Dorling Kindersley, 1993. For instructions on creating a similar battery, see http://www.exploratorium.edu/snacks/hand_battery.html.*

Building a Spinning Coil Motor

Think and Wonder

Imagine a motor that works even when you do not turn the switch on and off. How does it work? Where does the electricity go? In this lesson, you will build a motor that runs automatically. Try to discover how to make it work.

Materials

For you

- 1 student notebook
- 2 pieces of #20 bare copper wire, each 20 cm long
- 2 rubber bands, No. 16
- 1 plastic cup and lid
- 2 alligator clips
- 1 battery and battery holder
- 1 switch
- 3 pieces of #22 coated hook-up wire, each 20 cm long
- 1 piece of #28 enameled copper wire, 65 cm long
- 1 piece of sandpaper, 5-cm square
- 1 flexible magnet, 25 x 20 x 5 mm, with a 5-mm hole in the center

Find Out for Yourself

1. Think about the hardest physical work you have ever done—not school work, but the kind of work that makes you sweat and makes your muscles tired.

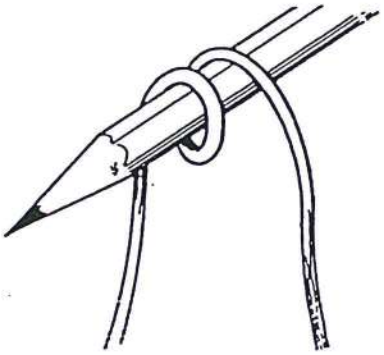
   Listen to the hard work that other students in your class have done. How could a motor be used to help you do this hard work? What else are motors used for?

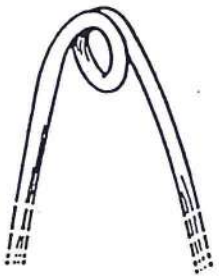
2. When you get your materials, you can begin to build a motor using the directions on pgs. 47 through 49. Remember that this motor will run by itself. Take some time to try to figure out how the electricity gets switched on and off automatically.

Student Instructions for Building a Motor

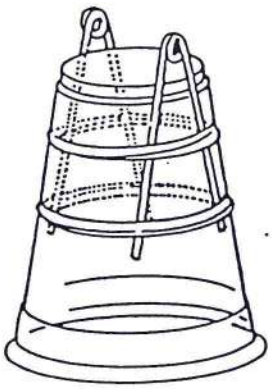
Use the directions and the pictures on these two pages to build an electric motor. If the motor does not work, try changing one thing at a time until it operates. That way, you will know what the trouble was. As you learned in Lesson 5, this kind of problem-solving is sometimes called **troubleshooting.**

1. Start by making a loop in the middle of each of the two bare copper wires. Wrap them around a pencil, then slide the loop off the pencil.

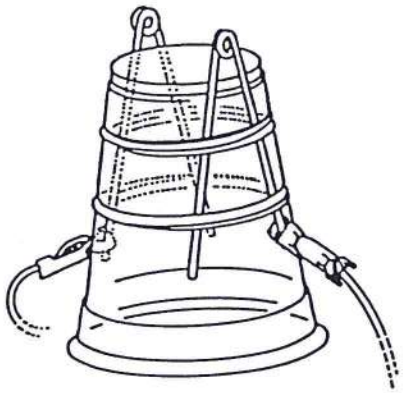




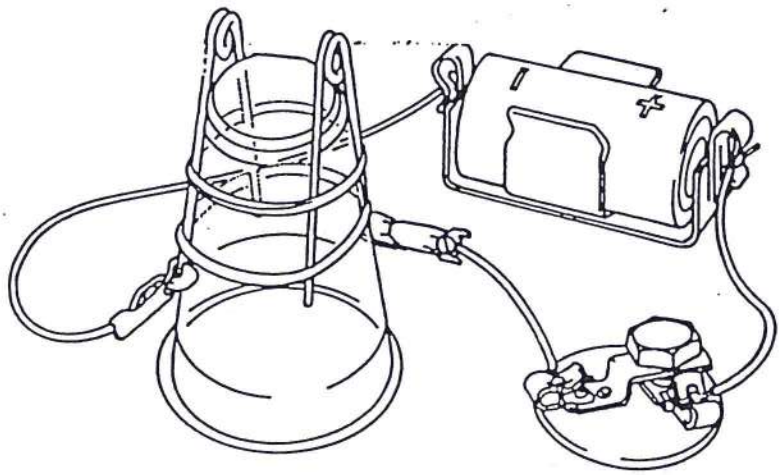
2. Use the two rubber bands to attach the bare copper wires to the plastic cup.



3. Clamp an alligator clip to one end of each of the bare copper wires.

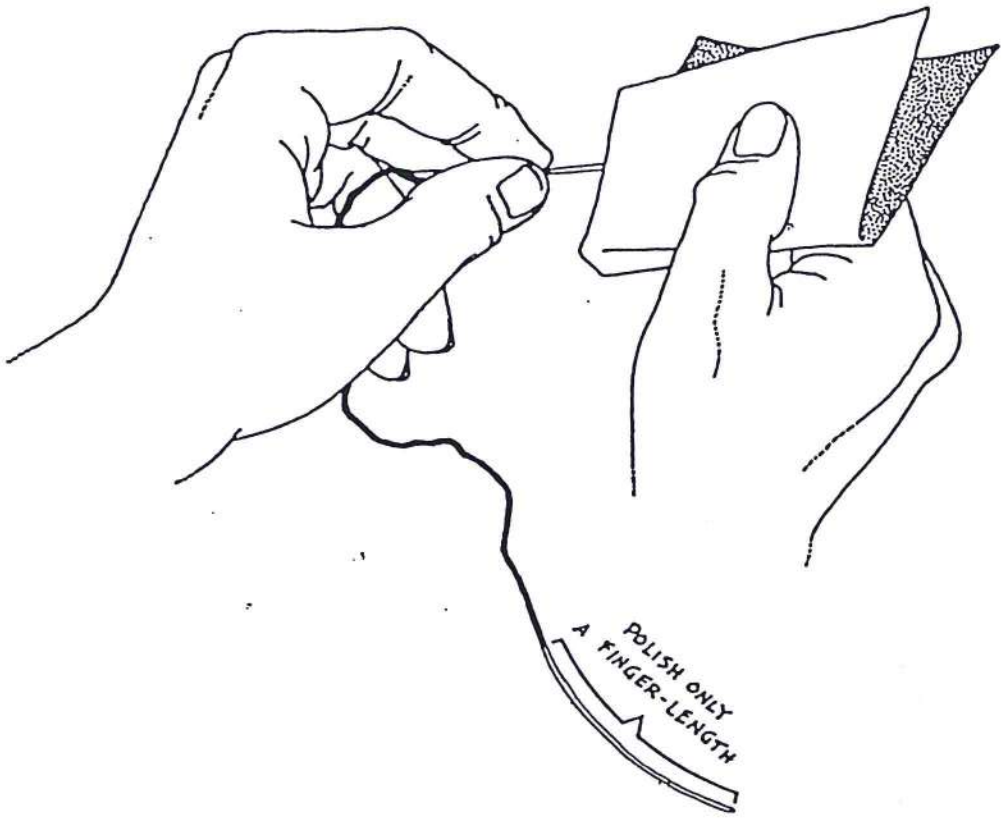


4. Hook up the rest of the circuit by connecting the battery and the switch to the alligator clips with the three pieces of #22 wire.

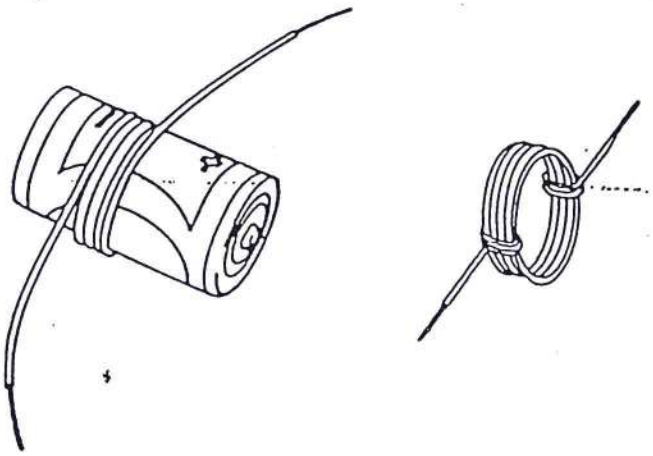


5. Next, begin to make the moving coil from the #28 wire. The wire has a thin coating of insulation on it called enamel, so you will need to sand off the insulation at the ends. This is so that the electricity can flow from the bare copper wire through the thin wire to the other bare copper wire.

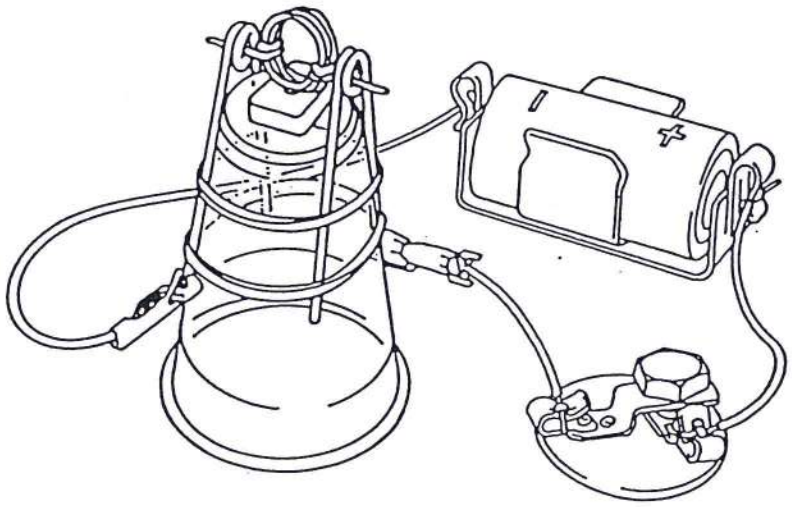
   Sand about one finger-length of insulation gently off each end of the wire. You can do this by folding the sandpaper in half and pulling the ends of the wire carefully between the two sides of the sandpaper.



6. Now, wrap the wire around the battery several times. Leave the bare ends sticking out of the coil. Slip the coiled wire off the battery. Wrap the bare ends three or four times around the coil, to hold it in a circular shape. Then bend the ends of the wire so that they stick straight out on opposite sides of the coil.



7. Next, place the ends of the coil through the loops in the bare wire on each side of the cup. If necessary, bend the coil and adjust the loops so that the coil can spin freely, without hitting anything.



8. Place a magnet on the top of the inverted cup, underneath the coil. Turn the switch on and blow gently on the coil to help it get started.

If the coil will not spin continuously, try putting the magnet somewhere else, turning it over, or bending a few wires a little.

3. Now that you have found out how to make the motor work, think about the questions below. Write your ideas in your notebook.
   - How is the electricity switched on and off automatically?
   - Where do you think the electricity flows in this circuit? Draw a picture in your notebook to help you explain.
   - Do you think the coil is magnetic? Why do you think that?
   - How can you make the coil spin faster or change direction? Try out your ideas!
   - How does this motor compare to the spinning compass motor? How are they alike? How are they different?
4. Talk to other students about what you are seeing.
5. As you dismantle your motor, think about what each part does and how the parts work together. In the next lesson, you will be taking apart a different kind of motor that someone else put together.