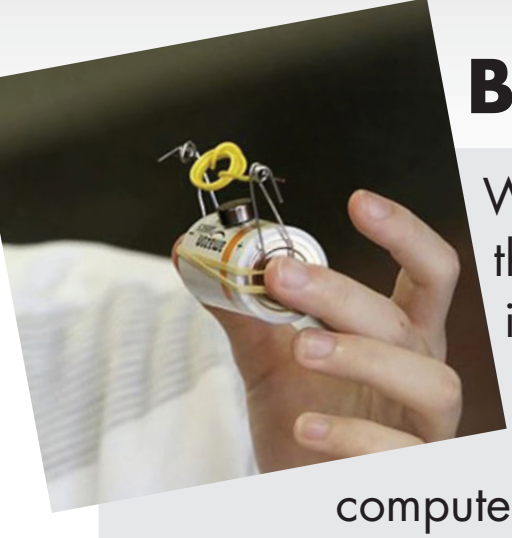


BUILDING A SIMPLE MOTOR

When you think of a motor, you may immediately think of a car, but you actually encounter motors in your home every day. If you put on clean clothes that were washed in the washing machine, ate food from the fridge, or used a computer, you used an **electric motor**.

Energy comes in many forms. Electric energy can be converted into useful work or mechanical energy by machines calledlectric motors. Electric motors work due to **electromagnetic interactions**: when two magnetic fields push or pull each other to create motor rotation—one field created by a permanent magnet and one field caused by electrons flowing through a wire, creating a magnetic field around the wire.

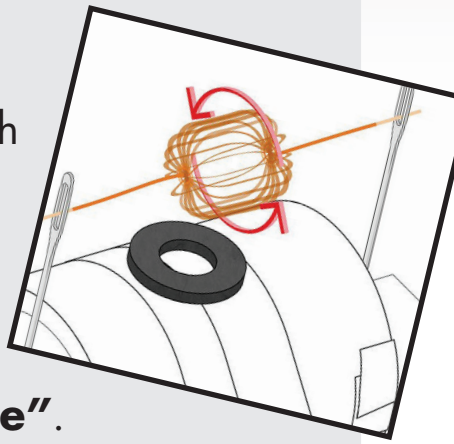
In this STEM activity, you will make your own simple electric motor.

MATERIALS

- 1 strand insulated copper wire with ends exposed about 1 inch —the **"electromagnet"**
- 1 black permanent marker
- 1 small disc magnet—the **"permanent magnet"**
- 1 D-cell battery
- 1 large rubber band
- 2 large paper clips

1 Make loops with copper wire.

Starting in the center of the insulated copper wire, wrap both ends around the permanent marker to make 4.5-inch loops. Carefully slide the marker out of the wire loops.



2 Make a bundle with the wire.

Wrap each end of the insulated copper wire around the wire loop, extending in a straight line on each side of the bundle to form the axle. This is called the **"armature"**.

3 Insulate one side of the wire.

Hold the wire bundle you have made so that it would be flat against a wall rather than a table (see FIGURE 1 below). Color the bare end of the wire that faces you with permanent marker. Leave the bottom side of the wire bare.

4 Form the loops.

Carefully bend one end of the paperclip around the Tootsie Pop stick to form a small loop. Repeat with the second paperclip.

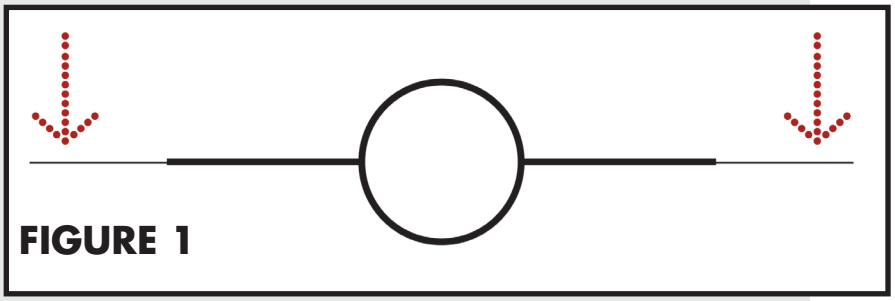


FIGURE 1

5 Assemble the motor (PART 1).

Wrap the rubber band around the length of the D-cell battery. Insert the paperclips on each end of the battery so that one paperclip is touching each terminal. They should be held in place securely by the rubber band with the small loops at the top.

6 Assemble the motor (PART 2).

Set the magnet on top of the battery, in the center. Position the copper wire armature in the paperclip loops with the shiny side of the wire touching the loops. Make sure the armature does not touch the magnet.

7 Watch your motor in action!

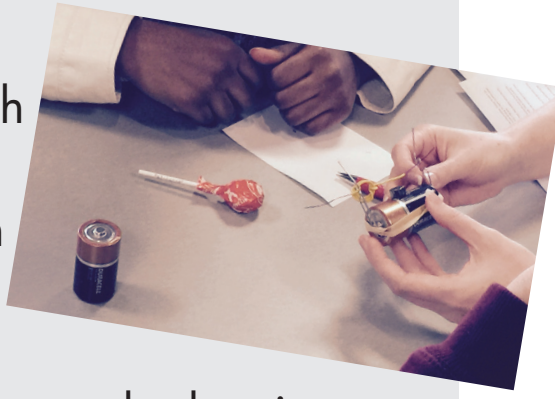
FYI: The more secure your paperclips are to the battery terminals and the straighter and more level the wire bundle ends are, the faster your motor will run. If your motor does not start immediately, try helping it by spinning the armature.

DID YOU KNOW...

You used **technology** to assist you in building a simple electric motor.

You used **math** to determine the supplies needed.

You used **engineering** skills to construct the motor.



You used **science** to create an electric current that flowed from the battery through your circuit to the wire coil, creating an electromagentic interaction. The magnet in your motor attracted one side of the coil and repelled the other, changing electrical energy to mechanical energy. With a big enough electric motor, the spinning can be used to power something, like turn a wheel.

As a follow-up activity, study how simple changes affect the motor's rotation. Make predictions, test them, and record your results.

THE MOTOR EFFECT

Magnetism. Magnetism is a force that exerts a push or pull. Magnets have two poles: a north and a south pole. Like poles repel. Opposite poles attact.

Electromagentism. Electromagnetism describes the relationship between electricity and magnetism. It is also used to describe how a magnetic field is created by the flowing of electric current. When an electrical current flows through a wire, it generates a magnetic field. This is an important concept in electricity. The magnetic field can be increased by coiling the wire, which allows more current to flow through a smaller distance and increases the magnetic field.

The motor effect. Today, you built a simple electric motor using a coil of wire that was free to rotate between two opposite magnetic poles. When an electric current flowed through the coil, the coil experienced a force and moved. This is called the motor effect.