

## INSTRUCTIONAL GUIDE

## Contents

- 10 pieces of solid copper wire
- 10 AA batteries
- 30 washers
- 10 Small Neodymium magnets



## Introduction

This simple Homopolar Motor shows how moving charges (an electric current) experience a force when they move through a magnetic field. When the wire is in place, current flows from the battery's positive terminal, through the wire, radially through the magnet, and into the battery's negative terminal.

The direction of the force is perpendicular to both the direction of the current and the direction of the magnetic field, as demonstrated by the Left-Hand Rule.

- The magnetic field is vertical, relative to the table.
- The current is radially inward at the lower point of contact, toward the center of the battery.
- The resulting force on the current-carrying wire is tangential. The tangential force, or torque, causes the wire to rotate.

Note that only one connection to the magnet is necessary for the motion to occur. Creating two connections doubles the resulting force, creating a faster spin. Try bending the wire into different shapes, such as a spiral that rests one end on the positive terminal and curls around the battery. Prolonged use may cause battery to overheat.

## Assembly

1. Attach one magnet to the negative terminal of the battery. Attach one of the washers to the magnet. This washer will act as a support base for your motor.
2. Referring to the picture, prepare the shape of the wire. Make a sharp bend in the middle of the length of wire. Bending it in half will create a balance point in the wire.
3. Next, on both sides of the sharp bend in the wire, create a curved bend resembling a capital M with curved arches.



4. Prepare the wire to sit atop the battery and be able to rotate by straightening out both of the long length sides of the copper wire, keeping the newly formed arches curved. Having both of these two sides the same length will allow the wire to hang equally alongside the battery in step 6. The wire will hang longer than the length of the battery.
5. Fit the wire to the battery by placing the sharp bend created on step 3 on the center of the positive end of the battery. Bend an arch into each wire length at the point where the wire is at the magnet and washer base. These bends of the wire should help point the wire in the direction of the base (negative terminal of the battery). Set the wire aside.



6. Referring to the picture, place the other 2 washers on the positive terminal of the battery (the top of your motor). These will help center the copper wire.
7. Place the wire on top of the washers, using the sharp bend from step 3 to balance the wire on the battery.
8. Adjust the bends in the ends of the wires to allow the wire ends to just brush up against the magnet at the base. Make sure one end is on one side of the magnet and the other end is on the opposite side of the magnet. Your wire should start rotating as your motor starts working!

## Related Products

**World's Simplest Motor (P8-8300)** By building and observing a motor that converts electrical energy into motion, students discover and explore first-hand several key properties of electricity and magnetism.

**Lenz's Law Apparatus (P8-8400)** Experience the fundamental principle behind electric motors with this demonstration. Drop the strongly magnetized plug through the copper pipe, and induced currents cause it to fall very slowly.

**Electromagnetic Flashlight (P6-6052)** Shake the Electromagnetic Flashlight 40 times and see it light up an ultra-bright LED bulb. The flashlight is perfect for backpacking, emergency kits, the kitchen drawer or just to shed some light on how magnets can be used to produce electricity.