

at home *discoveries*

homopolar motor



Using a battery and some magnets, create a spinning motor and explore electromagnetic principles!

Materials:

- AA or AAA battery
- Neodymium magnets
- Copper wire

Directions:

1. Attach the magnets to the negative terminal of the battery (bottom side.)
2. Cut a piece of copper wire approx 10 inches long.
3. Create a notch in the middle of the wire that will rest on top of the positive terminal.
4. Bend wire into a rectangular shape, leaving enough wire at the ends to wrap loosely around the magnets. The wire should just touch the magnets connected to the bottom of the battery while resting on the positive terminal.



5. Balance the wire on the positive terminal while the battery rests upright on the magnets. The wire should begin spinning.. You may need to adjust the wire to get the right connection.

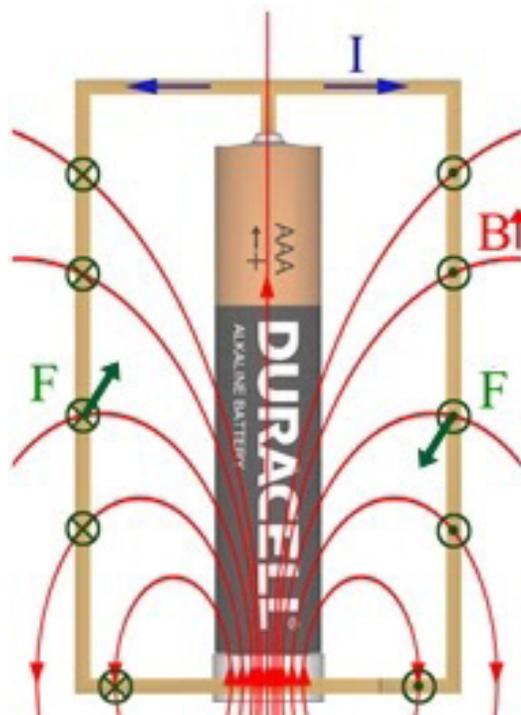
6. Get creative with your wire. Make different shapes and see if they can rotate balanced on the battery.



How it works

The flow of current (see below diagram) travels from the positive terminal of the battery to the battery connected to the negative terminal of the battery on the bottom.

Current flow creates an electromagnetic field that interacts with the magnetic field of the magnet. This electromagnetic field creates a force, called the Lorentz Force, that pushes the copper wire, causing the wire to rotate. Because current only flows in one direction (DC power), the force will push in the same direction (clockwise) every time.



Q&A

Q: Why do we need to use copper wire?

A: Copper has one of the lowest resistances of any metal (silver is the lowest). This allows the current to flow without causing the wire to heat up the wire to the point it will burn you. Additionally, more resistive wires (like a steel paperclip, for example) will adhere to the magnet and won't allow it to spin freely.

Q: Can I use a different type of magnet and still make the motor spin?

A: No. Unfortunately less powerful magnets, like the kind you might use for fridge magnets, don't provide enough of a field to get the motor moving.

Q: Why do we need the magnets? Why isn't the current flow enough of a force to move the wire?

A: In a homopolar motor we have the field created by the current through the wire, and the field created by the magnets connected to the base of the battery. The magnetic field, B in diagram on right, created by the current flow isn't enough to cause the wire to rotate. But when we combine it with the magnetic field of the magnet, the two forces interact to create rotation.

This same principle is used in DC motors. A current is applied to a coil of wire to create an electromagnetic field. This field interacts with a permanent magnet. That interaction creates rotation we use to do mechanical work.

Links

<https://learning-center.homesciencetools.com/article/make-spinning-wire-motor>

<https://www.magcraft.com/blog/what-is-a-homopolar-motor>

<https://courses.lumenlearning.com/physics/chapter/22-7-magnetic-force-on-a-current-carrying-conductor/>

<https://www.kjmagnetics.com/blog.asp?p=homopolar-motors>

