



# The World's Simplest Motor



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## Overview

What's going on when electric motors power devices like fans? Just what does it take to create such a motor, and what makes it go? Let's find out.

## Doing the activity

First, stick one of the flat ends of the neodymium magnet to the flat end of the nail (stay away from your computer, cell phone, wallet, and other items the neodymium magnet could damage). The nail will now be magnetized, so you can stick the sharp end of the nail to one end of the battery (you can start with either the positive or the negative end). Now, hold one end of the copper wire on the other end of the battery, and gently touch the free end of the wire to the magnet. What do you observe? **(Be careful; if you hold the wire in place for a while, it and the motor components will get hot!)**

*Note:* If nothing is happening, try fanning out the different strands of the wire to make a flat brush and holding it very gently against the magnet. Also, make sure the nail is hanging freely from its point; if the nail moves to the rim of the battery end, it tends to get stuck.

## What's happening

Electricity and magnetism are very closely linked. A flowing electric current will create a magnetic field (for more on magnetic fields, check out the *Magnetic Sleuth* activity). For electric current to flow, you need a full circuit (complete conducting path), and using the wire to connect one end of the battery to the magnet forms just such a circuit! The electric current flowing through the wire creates a magnetic field around the wire. The interaction of this magnetic field and the field of the neodymium magnet creates a force that makes the magnet and nail spin. As the magnet spins, electric energy in the current is being transformed into rotational kinetic energy in the magnet and nail, as well as into thermal energy. Even though electric motors can get pretty complicated, this is the basic principle on which they all function!

## Summing up

Motors, which are essential elements of daily life for most folks, rely on the fundamental connections between electricity and magnetism to work. If you flip the battery upside-down, what happens in your motor?

## For more information

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### Necessary materials:

- neodymium magnet\*
- AA battery
- steel nail
- copper wire

**\*Be careful with this magnet!** It's very strong, and can wipe credit cards, do bad things to cell phones, break if it "jumps" to a surface, etc.