Three Nations ENERGY
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ELECTRIC
Vehicle ACTIVITY

BEAKMAN Electric Motor

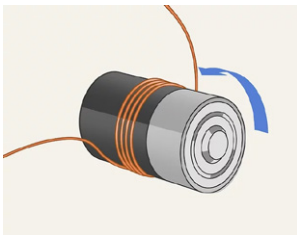
Discover how electric car motors work

Part 1 - Making the Wire Coil

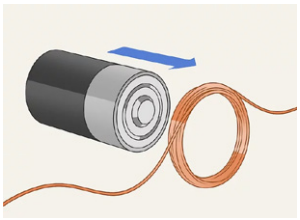
Step 1 Gather all of your materials:

- copper wire *(anything from 24 to 28 gauge will do) with no insulation (you can remove insulation with wire strippers or a blade)*
- small magnet
- electrical tape
- D battery
- two paper clips
- permanent marker

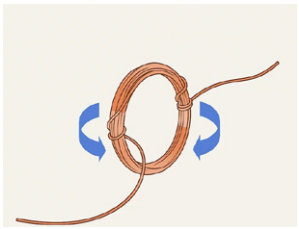
Step 2 Take the D battery or any other cylindrical object and wrap your wire around it at least 7 to 10 times with 5 cm of wire sticking out from each end. Keep the coil tight as you wrap the wire around the battery.



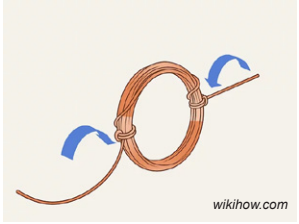
Step 3 Remove the coil of wire and be careful not to let the wire unravel.



Step 4 Wrap each end of the wire around the coil several times to hold the shape of the coil. Make sure to leave at least 5 cm) of wire extending out of each end of the coil.

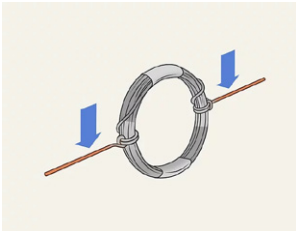


Step 5 Tie a knot around the coil with each loose end of wire. These knots just ensure the coil doesn't unravel.

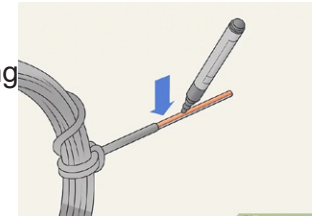


Part 2 - Assembling the Motor

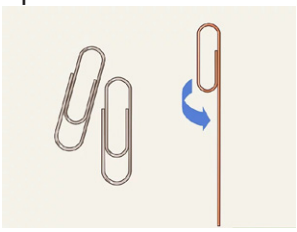
Step 1 Pull the wire ends so they are pointed straight out from either side of the loop(5 cm). Work any small bends out of the wire that is extended so they are more or less completely straight.



Step 2 Hold the coil in one hand so the loop is standing upright and the wires are extending out to either side. Then use a permanent marker to color in just the top of the wire extending out from either side. Leave the bottom side uncolored.

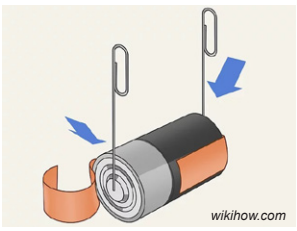


Step 3 Take your paper clips and unfold the ends of them so they are straight. Leave the remaining loop of the paper clip intact. The paper clips should now each look like a loop with a long arm extending from it.

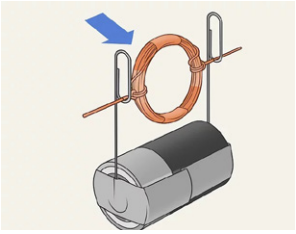


Step 4 Lay the battery on its side. Place the extended end of one paper clip against the positive side of the D battery and secure it in place with a piece of tape. Use the other paper clip to do the same to the negative side.
(Make sure both paperclips are pointed in the same direction.)

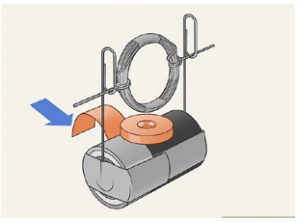
(Add some tape to the bottom of the battery to keep it from rolling.)



Step 5 Insert the wire from one side of the coil into one of the paper clips, and then slide the other end through the other paper clip.
If the paper clips are too far apart, bend them inward so they can hold the coil.

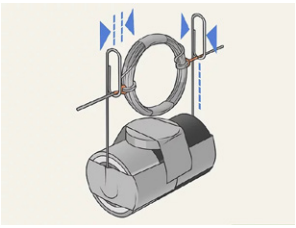


Step 6 Place a piece of tape over your magnet and stick it onto the battery centered beneath the coil.

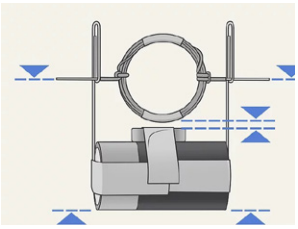


Part 3 - Make It Run Smoothly

Step 1 Adjust anything that prevents the coil from spinning.



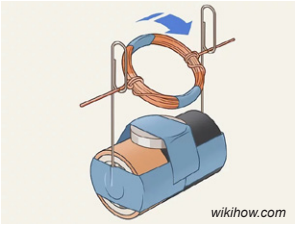
Step 2 Adjust the balance by moving the paperclips to make the motor spin freely. You may need to experiment a bit with the placement and positioning of the paper clips to hold the coil in place. 3



Step 3 Give the coil a little spin if it doesn't start on its own. Repeat adjusting as needed.

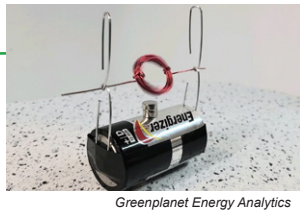
If the motor doesn't start spinning when you nudge it in one direction, try nudging it in the opposite direction.

You have made a Beakman electric motor!



HOW IT WORKS

An electric motor uses the attracting and repelling properties of magnets to create motion.



Greenplanet Energy Analytics

An electric motor contains two magnets;

- **permanent magnet** (also called a fixed or static magnet)
- temporary magnet, also called an **electromagnet**.

A *permanent* magnet is surrounded by a magnetic field (a north pole and a south pole) all the time.

The electromagnet creates a magnetic field (a north pole and a south pole) only when electric current is flowing through a wire (*"temporary"*).

The strength of the electromagnet's magnetic field can be increased by forming the wire into multiple loops. (This increases the current through the wire). Such loops of electrical wire are often called a **coil**.

To make an electric motor, the electromagnet (the temporary magnet) is placed on an axle so it can spin freely.

It is then positioned within the magnetic field of a permanent magnet.

When a current is passed through the electromagnet, the temporary magnetic field interacts with the permanent magnetic field to create attractive and repelling forces.

These forces push the electromagnet, which freely spins on its axle, and an electric motor is born.

(Note: As the wire of your coil spins, the part with the marker interrupts the electricity so the electromagnets switches off for a second. This on/off allows the coil to keep spinning.)

Source: This article was adapted from WikiHow:

https://www.wikihow.com/Build-a-Motor

Videos

Build a Simple Electric Motor - Science Buddies
Build a simple electric motor with just a battery, magnet, paper clips, and coil of wire in this fun science experiment!
https://youtu.be/WI0pGk0MMhg

How does an Electric Motor work? (DC Motor) - Jared Owen
Electric motors can seem very mysterious! How do they use electricity to start rotating? Let's break it down step by step to understand how it works. Topics covered in this video: circuits, current, magnets, electromagnets, armature, commutator, brushes, stator, and rotor. This video only covers DC motors.
https://youtu.be/CWuIQ1ZSE3c

TEACHER RESOURCE

EV - Curriculum Connections

Overview

These hands-on activities are a great opportunity to demonstrate how electric cars work and how solar electricity is produced.

This is a great complementary exercise for exploring society's impact on the environment in regards to greenhouse gases.

Science Grade 7

Unit A: Interactions and Ecosystems (Social and Environmental Emphasis)

1. Investigate and describe relationships between humans and their environments, and identify related issues and scientific questions.

4. Describe the relationships among knowledge, decisions and actions in maintaining life-supporting environments

Unit D: Structures and Forces (Science and Technology Emphasis)

1. Describe and interpret different types of structures encountered in everyday objects, buildings, plants and animals; and identify materials from which they are made.

2. Investigate and analyze forces within structures, and forces applied to them.

3. Investigate and analyze the properties of materials used in structures.

4. Demonstrate and describe processes used in developing, evaluating and improving structures that will meet human needs with a margin of safety.

Science Grade 8

Unit D: Mechanical Systems (Science and Technology Emphasis)

1. Illustrate the development of science and technology by describing, comparing and interpreting mechanical devices that have been improved over time.

2. Analyze machines by describing the structures and functions of the overall system, the subsystems and the component parts.

3. Investigate and describe the transmission of force and energy between parts of a mechanical system.

4. Analyze the social and environmental contexts of science and technology, as they apply to the development of mechanical devices.

Science Grade 9

Unit D: Electrical Principles and Technologies

1. Investigate and interpret the use of devices to convert various forms of energy to electrical energy, and electrical energy to other forms of energy.

- Construct, use and evaluate devices for transforming mechanical energy into electrical energy and for transforming electrical energy into mechanical energy.

2. Describe technologies for transfer and control of electrical energy.

- Investigate toys, models and household appliances; and draw circuit diagrams to show the flow of electricity through them (e.g., safely dismantle discarded devices, such as heating devices or motorized toys, and draw diagrams to show the loads, conductors and switching mechanisms).

All curriculum connections were derived from:

https://education.alberta.ca/media/159711/elemsci.pdf