Three Nations ENERGY
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ELECTRIC Vehicle ACTIVITY

SIMPLE Electric Motor

Discover how electric car motors work - Part 2

Electric motors need electromagnets to work.
Let's see how to make a super simple motor.

This demonstrates how you can change electricity and magnetism into mechanical energy (motion).

Materials

- 3 - 5 strong rare earth magnets, disk shaped, about 12 mm x 3 mm
- A 1.5 V battery (AA works well)
- Approximately 35 cm (14 in) rigid, copper wire (two if you want to experiment)
- pliers

Procedure

Warning! Disconnect the battery when not in use. The wire may become hot and catch fire.

Warning! Keep magnets away from electronics like phones. They will damage them.

Watch the Instruction Video (optional):

Electric motor - The Experiment Archive

https://www.youtube.com/watch?v=L2iO4zlSFc0

Or Use the Following Steps:

Greenplanet Energy Analytics

Step 1 Start by folding the wire in half and pinch the end with the pliers. This gives you a point to balance the wire on when it spins.

Step 2 Continue to bend it into a rough heart shape as shown.

Step 3 Attach the magnets to the negative terminal of the battery.

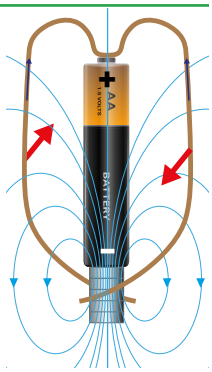
Step 4 Balance the copper wire on the positive terminal of the battery. You may have to adjust the bend so it balances.

Step 5 Be sure the wire ends are in contact with the magnets but not with each other.

Step 6 Adjust the position of the wire until it starts to spin.


Greenplanet Energy Analytics

Explanation



You have just built a machine that can make something move with the help of an electric current - an electric motor.

The electric current going through the copper wire creates a magnetic field. This interacts with the field from the magnets. This creates a force that pushes on the copper wire and causes it to move in one direction so it begins to spin.

This type of electric motor is different from the ones in electric cars and most other electric appliances because the direction of the current is always the same. The standard electric motors are a bit more complex and have an electric current that changes direction back and forth while it runs.

This shows how simple and energy efficient an electric motor can be. This is why electric cars run on less energy and save money in the long run, not to mention, helping the environment.

Questions

Copy and answer these on a separate sheet.

1. This activity demonstrates how you can change electricity and magnetism into _____energy.

2. The machine you have made is called an electric _____.

3. A magnetic field is created when the _____ goes through the copper wire.

4. The field from the magnet interacts with this causing a force that pushes so the wire begins to _____.

5. This simple motor is different from the one in electric cars because the electric current direction does not _____.

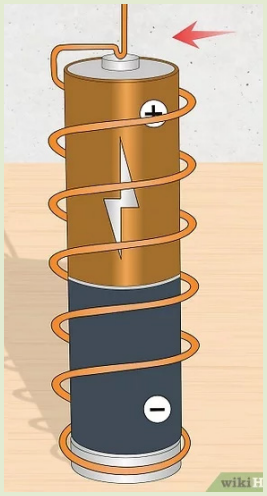
6. This demonstration shows how simple electric motors are and that makes them energy _____.

7. BONUS What happens if you flip the magnets over and run the motor again? _____.

CHALLENGE

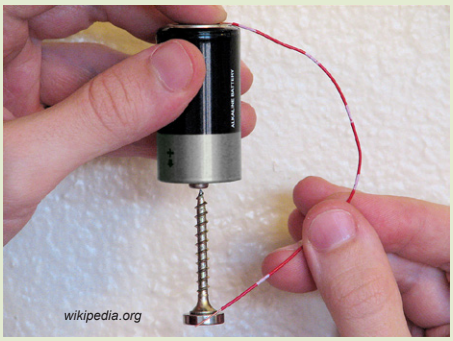
Experiment

You can turn this demonstration into an experiment. To do that, try answering one of the following questions. The answer to the question will be your hypothesis. Then test the hypothesis by designing and doing an experiment.



wikihow.com

- **What other shapes of the copper wire are possible?**
- What other kinds of batteries are possible?
- What happens if you use more magnets?



wikipedia.org

Try a different design:

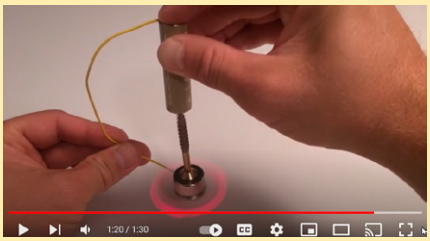
Check out the internet for more ideas and test them out.

For Fun

Check out this Flashy Electric Motor

See the Video:

https://www.youtube.com/watch?v=Atzqu54wS1Y



Visit the website:

https://www.experimentarchive.com/experiments/flashy-electric-motor/

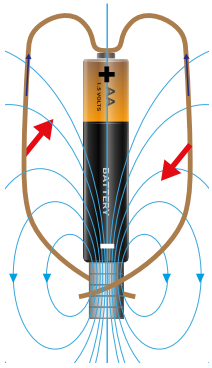
TEACHER RESOURCE

SIMPLE ELECTRIC MOTOR ACTIVITY

Teacher Notes

This activity is Part 2 of the exploration into how electric vehicles (EVs) work. It will help the students understand why EVs are more energy efficient than internal combustion engine (ICE) vehicles, Student will construct a simple motor and see how electric motors need less moving parts than ICEs.

This is a homopolar motor - a direct current (DC) electric motor which produces constant circular motion.



This device is easy to create - a permanent magnet is attached to one terminal of a DC power supply, in this case a AA battery. A conducting wire connects the other terminal to the magnet, thus completing the circuit. This wire should be free to rotate while always maintaining contact with both the terminal and magnet.

The current (I) flowing through the wire will produce a magnetic field. This field will interact with the magnetic field (B) produced by the permanent magnet, and a Lorentz force (F) will be exerted perpendicular to the directions of I and B. As you look at the diagram, the force on the left section of the wire is acting into the screen and the force on the right section is coming out of the screen. As the wire can move freely, these forces cause the wire to rotate in a clockwise motion. Because the polarities of the magnetic fields do not change (hence the name homopolar), the direction of the force will not change and the wire will rotate in a constant circular motion.

BONUS

By flipping the magnets over, you change the direction of the poles (north and south) of the permanent magnets under the battery. This causes the wire to spin in the opposite direction.

Resources

Science Buddies - How to Make a Homopolar Motor

https://www.sciencebuddies.org/stem-activities/how-to-make-a-homopolar-motor

They also have a video:

https://www.youtube.com/watch?v=0DwHz0zRIGM

WikiHow - How to Make a Homopolar Motor

https://www.wikihow.com/Make-a-Homopolar-Motor

Answer Key

1. mechanical
2. motor
3. electricity
4. spin
5. change
6. efficient
7. BONUS It spins in the opposite direction

Check out this learning resource and MORE at 3ne.ca/learning

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