TRB 5:3 - Activity 4: Electricity and Magnets

Summary

Either through a "hands-on" activity or a classroom demonstration, students will make a small motor to see the use of magnets.

Materials

- Home survey sheet for students
- 5 small disk magnets
- 2 large paper clips
- A Styrofoam cup
- A solid enameled or insulated 20-gauge copper wire (about 2 ft. long)
- A battery or power supply (2 or 3 D cells or a 6-volt lantern work best)
- 2 electrical lead wires with alligator clips at both ends (available at Radio Shack)
- Wire stripper (if you used insulated wire); Sandpaper (if you used enameled wire)
- A black, permanent marking pen
- A battery holder (if using D cells)

Additional Resources:
Books:
Magnetism by John Woodruff
Physics for Kids:49 Experiments with Electricity and Magnetism by Robert W.Wood
Science Projects about Electricity and Magnets by Robert Gardner

Background for Teachers

Electric motors are everywhere. In your house, nearly every mechanical movement that you see around you is caused by an AC or DC electric motor. An electric motor is all about magnets and magnetism. These small motors use magnetism to create motion. Due to the fundamental law of all magnets that opposites attract and likes repel, these forces create rotational motion inside an electric motor, thus producing the force that is necessary for driving the machine attached to the motor.

Intended Learning Outcomes

4-Communicate effectively using science language and reasoning.

Instructional Procedures

Invitation to Learn:
The day before the lesson is to be presented, give all students a magnet survey sheet and have them look for magnets in use in their homes. Have them check each room in the house looking for magnets. Don 't give them too much information before sending them on the “search.” The next day, make a list on the board or chart paper of all the places the students found magnets in use. Tell the students that magnets are found in nearly every small appliance motor (i.e. can openers, blow dryers, hand drills, etc.) Discuss other places they might find magnets. Tell the students that they will be making a small motor to see the use of the magnets. (This may also be done as a demonstration if supplies are limited.)
Instructional Procedures:

Wind the copper wire into a coil about 1 inch in diameter. Make four or five loops. Wrap the ends of the wire around the coil a couple of times on opposite sides to hold the coil together. Leave 2 inches of wire projecting from each side of the coil and cut off any extra wire.

If you are using insulated wire, strip the insulation off the ends of the wire projecting from the

coil. If you are using enameled wire, use the sandpaper to remove the enamel. Color one of the projecting wire ends black on one side with the marking pen. (If the coil is held in a vertical plane, color the top half of one of the wires black.)

Turn the cup upside down and place two magnets on top of it in the center. Attach three more magnets inside the cup, directly beneath the original magnets. This creates a stronger magnetic field and holds the top magnets in place.

Unfold one end of each paper clip and tape them to opposite sides of the cup, with their unfolded ends down. Rest the ends of the coil in the cradles formed by the paper clips. (Make sure the end painted black is UP.) Adjust the height of the clips so that when the coil spins, it clears the magnets by about 1/16 inch. Adjust the coil and the clips until the coil stays balanced and centered while spinning. Good balance is essential in getting the motor to operate well.

If you are using a battery, put it in a battery holder. Use the clip leads to connect the battery or power source to the paper clips. Connect one terminal of the battery to one paper clip and the other terminal to the other paper clip.

Give the coil a spin to start it turning. If it doesn't keep spinning on its own, check to make sure the coil assembly is well balanced when spinning, that the enamel has been thoroughly scraped off, that the projected end has been painted black, and that the coils and magnets are close together, but will not hit each other. You may have to adjust the distance of the cradles. Keep making minor adjustments until the motor works. Patience will be rewarded.

Conclusion: Current flowing through the wire coil creates an electromagnet. One face of the coil becomes a North pole, the other a South Pole. The permanent magnet attracts its opposite pole on the coil and repels its like pole, causing the coil to spin.

Extensions

Have the students return home with their magnet surveys and add to their lists the many uses of magnets.

Put the students in research teams and have them report on the way magnets are used in such things as Maglev trains, doorbells, Magna Doodles, stereo speakers, video and cassette tapes and transformers. Use the web site mentioned below called “How Stuff Works ” as a great reference.

Assessment Plan

The students will be able to name at least 10 common household items that use magnets.

The students, using a small motor diagram, will be able to tell how the motor works and why it is capable of generating power.

Bibliography

This lesson is part of the Fifth Grade Science Teacher Resource Book (TRB3) http://www.usoe.org/curr/science/core/5th/TRB5/. The TRB3 is designed to be your textbook in teaching science curriculum to your students. This book covers all the objectives of each standard and benchmark. If taught efficiently, a student should do well on the End-of-Level (CRT) tests. The TRB3 is designed for teachers who know very little about science, as well as for teachers who have a broad understanding of science.

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