TRB 5:3 - Activity 3: Fun with Electromagnets

Summary

Students will construct an electromagnet and explain how it works.

Materials

16 penny nails (the hardware symbol is 16d nails)
straight pins or paper clips
AA, C, D cell batteries, as well as a 6-volt and 9-volt batteries
bar magnet or other permanent magnet
roll of #22 insulated copper wire (or bell wire)

Additional Resources:
Books:
Magnetism by John Woodruff
Magnets and Electricity by Karen Lee Siepak
Physics for Kid: 49 Experiments with Electricity and Magnetism by Robert W. Wood

Background for Teachers

An electromagnet is a temporary magnet formed when electric current flows through a wire or other conductor.Most electromagnets consist of a wire wound around an iron core.In 1820, Hans Oersted discovered that an electric current produces a magnetic field.In 1825, English electrician William Sturgeon showed that by adding an iron core, the coil's magnetic field is strengthened. In the late 1820s, American physicist Joseph Henry built the first practical electromagnet.

Instructional Procedures

Invitation to Learn:
Dump some straight pins or paper clips on the table. Ask one of the students to volunteer to gently touch a nail to the pile of pins. Ask the student if the nail is acting like a magnet. (It should not.) Next, have another student touch a bar magnet or similar permanent magnet to the pins. Ask the student if the bar is acting like a magnet. (Obviously, it should.) Tell the students that it is possible to make the nail act just like the bar magnet.
Instructional Procedures:
This may be done as a class demonstration, or each student could make his/her own electromagnet.

Using the copper wire, begin at the top of the nail, and wrap the wire around it. You will need a 6-inch wire tail at the top of the nail. Wrap the wire tightly trying hard not to leave spaces. When you get near the end of the nail, loop the wire under the previous loop and cut the wire so you have another 6-inch wire tail at the bottom of the nail.
Hook each tail to one of the terminals on the battery and have the students touch the electromagnet to the pile of pins or paper clips. The nail will now pick up several pins.
Unhook the battery and demonstrate what happens to the pins.
Now slip the nail out from the copper wire wraps and see what the nail will do when it touches the pile of pins.

Conclusion: When an electric current moves in one direction through a wire, a magnetic field is created around the wire. When the wire is wrapped around an object to form a coil, the magnetic field around each wire is aligned right next to the field of the adjacent wires. They all work together to form a much stronger, single magnetic field.

Extensions

Increasing/decreasing the amount of electric current moving through the nail will vary the strength of the magnetic field in the nail. Have the students experiment with the number of wraps around the nail and the battery power. Have them record the results in some sort of graphic organizer. Have the students try other variables like uniformity of the wrapping, wire thickness, etc. Warn the students that some wires may become hot when connected to the batteries.

Community involvement: Ask a local auto shop mechanic to come and show the students how starters work, and where the magnets are located. You could also ask someone familiar with sound equipment to demonstrate the use of magnets and electromagnets in stereo speakers.

Assessment Plan

Have each student construct an electromagnet and explain how it works. If materials are not available for all students, have them draw a picture of an electromagnet and explain how it works.

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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