Investigation Three – Fun with Electromagnets

Standard III Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and material made of iron.	**Standard III**
Objective 1 Investigate and compare the behavior of magnetism using magnets.	Objective 1
Intended Learning Outcomes 1. Use science process and thinking skills. 3. Understand science concepts and principles.	

Background Information

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. Today you can have groups or individuals make temporary magnets.

Pre-Assessment/Invitation to Learn

Dump some paper clips on the table. Ask one of the students to volunteer to gently touch a nail to the pile of paper clips. 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 paper clips. 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.

Materials
- Paper clips
- Magnet
- Nail

Instructional Procedure

This may be done as a class demonstration, or each student could make his/her own electromagnet.

1. Using the insulated 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.
2. 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 paper clips.
3. Unhook the battery and demonstrate what happens to the paper clips.
4. Now slip the nail out from the copper wire wraps and see what the Nail will do when it touches the pile of paper clips.

Materials
- 16 penny nails (the hardware symbol is 16d nails)
- Paper clips
- Two D cell batteries
- Bar magnet or other permanent magnets
- Roll of #22 insulated copper wire (or bell wire)

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. When the wires are disconnected from the battery, the nail is no longer a magnet. It is only a temporary magnet.

Curriculum Extensions

Science –

- 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. (ILO 1)
- 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. (ILOs 2, 5)

Assessment Suggestions

- 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.

Reference to Assessment Section

	Multiple Choice	Constructed Response	Performance Test
Unit Test	4		Which is Stronger?

Resources

Books:

- Woodruff, Magnetism
- Siepak, Karen Lee. Magnets and Electricity.
- Wood, Robert W. Physics for Kids: 49 Experiments with Electricity and Magnetism.
- Bockneck, Jonathon. Science of Magets. Milwaukee, Wisconsin: Garth Stevens Publishing

Web sites:

- www.howstuffworks.com/electromagnet2
- www.execpc.com/~rhoadley.magtrain
- www.ee.umd.edu/~taylor/frame1
- http://nyelab.kcts.org/
- www.sciencepage.org