Lesson Title	Electricity and Magnetism
Length of Lesson	1 class period (50 min)
Created By	Charles Vaughan
Subject	General Science
Grade Level	8
State Standards	2d
DOK Level	DOK 2 (Construct, Compare, Make Observations)
DOK Application	Describe the cause/effect of a particular event. Identify patterns in events or behavior.
National Standards	Grades 5-8: B: Physical Science
Graduate Research Element	My research involves volatiles and ionized gasses emitted from comets. These ionized particles are easily influenced by charged particles and magnetic fields emanated from the sun.

Student Learning Goal:

MS 8th Grade:
2d (Physical Science): Relate how electrical energy transfers through electric circuits, generators, and power grids, including the importance of contributions from Mississippi companies.

National Standards for Grades 5-8:
B: Physical Science:

- TRANSFER OF ENERGY. Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
- TRANSFER OF ENERGY. Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.

Materials Needed (supplies, hand-outs, resources):
Every student/table needs the following:

- Refrigerator magnets
- One large iron nail
- Insulated copper wire
- ~20 paperclips
- Compass
- Alligator clip wires
- Small colored stickers
- Two rubber bands
- One large 6-volt battery (lantern battery)

- One size D battery
- Sandpaper and scissors for cutting and stripping wires
- Needle nose pliers
- Numerous other metals (aluminum, copper, zinc, steel, etc.)
- Handout (File name: INSPIRE_Vaughan_11_15_12_Handout.doc)

Lesson Performance Task/Assessment:
This lesson will have three parts:

(1) Students will learn what kinds of materials are affected by magnets. This part of the lesson will illustrate how all magnets have poles. They will also learn how the strength of a magnet is finite.

(2) Students will build an electromagnet using copper wire, a large lantern battery, and an iron nail. They will investigate the strength of this magnet and consider what parameters will make the magnet stronger. Using a compass, they will also determine if this electromagnet has poles similar to the common refrigerator magnets.

(3) Students will construct a crude electric motor. They will have to explain the relationship between electricity and magnetism for this part of the lesson. This construction can be somewhat challenging for students, and it may be necessary for the instructor to cut/sand the copper wire beforehand if time is short.

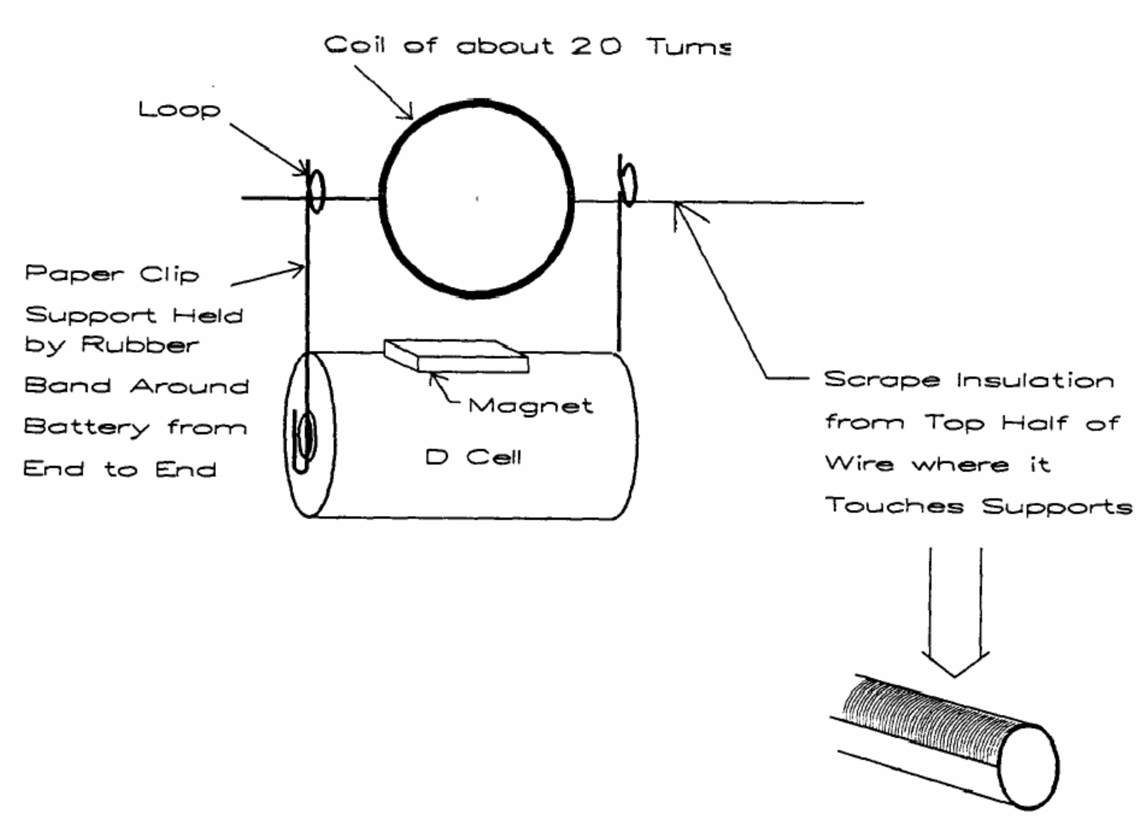
Lesson Relevance to Performance Task and Students:
Electricity and magnetism are critical areas of study for modern technology. Many of our devices - from automobiles to computers - would not function without a very solid understanding of the relationship between these two phenomena.

Anticipatory Set/Capture Interest:
"You have probably heard that there is a relationship between electricity and magnetism, but you have probably never seen this. Did you know that an electric current can produce a magnetic field, and that a magnetic field can produce an electric current under the right circumstances?"

Guided Practice:
Much of this lesson is performed independently by the students, but it is necessary for the instructor to show how to construct the materials for parts 2 and 3.

For part 2, show how to make the electromagnet. Cut off ~50 cm of copper wire. Scrape insulation off the ends to expose the copper metal. Wrap the wire around the nail at least 20 times, leaving enough loose wire at both ends for an easy connection. Now connect the loose ends of the wire to the alligator clips, and then connect these clips to the 6-volt lantern battery. Do not leave this battery connected for more than 30 seconds at a time. The wires and battery can heat up excessively. Please emphasize this to your students.

Part 3 is difficult to construct. First, tightly wind a coil of wire around the D battery at least 20 times to get a coil that's about 2 inches in diameter. Remove the coil, keeping it tightly bundled. Take the two ends of wire and point them in opposite directions. Scrape the insulation off only the top side of each end of the wire using sandpaper (refer to the diagram below). Now attach two bent paper clips to the ends of the D battery, using a rubber band to hold them in place. Cradle the coil of wire by its two loose ends in the paper clips. Place a small stack of magnets between the coil and the battery. If this is constructed well, the coil will spin and accelerate when assembled (you may have to give it a slight flick to get it started).



Independent Practice:
Students should follow the handout and answer questions for this lesson.
(File name: INSPIRE_Vaughan_11_15_12_Handout.doc)

Remediation and/or Enrichment:
Remediation – IEP

Enrichment – If materials are available, have students check the current or voltage coming from their electric motor. Is the current constant or alternating? Is there a relationship between current, voltage, and the speed at which the coil spins?

Check(s) for Understanding:
Students should be able to qualitatively notice the relationship between electricity and magnetism. All magnets, both static and electric, will have poles. A moving current will create a magnetic field, and an electric motor requires both a magnetic field and an electric current to operate.

Closure:
- Do household magnets have poles? What about electromagnets? How can you tell?
- What kinds of materials are affected by magnets? Even if an object is not attracted to a magnet, does a magnetic field still pass through it?
- How could you make your electromagnet stronger? What would make the electric motor spin faster?

Possible Alternate Subject Integrations:
Physics

Teacher Notes:
Many of the ideas and questions in this lesson were incorporated from a similar lesson taught in Physical Science at Mississippi State University.

Source: http://physics.msstate.edu/labs/