

Lesson Title: **Electro-magnets**

Grade level: **4**

Discipline Focus: **Electricity, Circuits, Conductors**

Length of lesson: **50 min.**

Stage 1 – Desired Results			
<p>Content Standard(s): 4.2.3.2.2 Construct a simple electrical circuit using wires, batteries and light bulbs. 4.2.3.2.3 Demonstrate how an electric current can produce a magnetic force.</p>			
<p>Student Understanding (Unit Goals):</p> <ul style="list-style-type: none"> Continued conceptual development of circuit construction Electricity and magnetism are 2 different parts of the same force. 	<p>Essential Question(s):</p> <ul style="list-style-type: none"> What variable(s) affect the strength of an electro-magnet? 		
<p>Student objectives (outcomes): Students will be able to:</p> <ul style="list-style-type: none"> 1) build an electro magnet circuit 2) change the design to make a stronger magnet. 			
Stage 2 – Assessment Evidence			
<p>Performance Task(s):</p> <ul style="list-style-type: none"> Build an electro magnet and alter its strength. 	<p>Other Evidence:</p> <ul style="list-style-type: none"> Science notebook 		
Stage 3 – Learning Plan			
<p>Learning Activity:</p> <table style="width: 100%; border: none;"> <tr> <td style="vertical-align: top;"> <p>Materials: Circuit Kit including</p> <ul style="list-style-type: none"> 2 switches (single) 1 rivet 2 switches (double) 1 motor 2 battery cases 1 long wire 2 batteries 2 lights 12 wires </td> <td style="vertical-align: top; padding-left: 20px;"> <p>Not in Kit</p> <ul style="list-style-type: none"> Plastic Cup W/ paper clips Bar Magnet (optional) Student Notebook 1 bag of conductors and Insulators (about 10 Science Notebooks items) Ruler </td> </tr> </table>		<p>Materials: Circuit Kit including</p> <ul style="list-style-type: none"> 2 switches (single) 1 rivet 2 switches (double) 1 motor 2 battery cases 1 long wire 2 batteries 2 lights 12 wires 	<p>Not in Kit</p> <ul style="list-style-type: none"> Plastic Cup W/ paper clips Bar Magnet (optional) Student Notebook 1 bag of conductors and Insulators (about 10 Science Notebooks items) Ruler
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Stage 3 – Learning Plan

Procedure:

- 1) Student groups will receive a bag of materials listed above.
- 2) Explain to students that we will be using electricity to make a magnet.
- 3) To begin, students should make a simple circuit including 1 battery, 1 light and 1 switch.
- 4) Students will remove the wires that connect the light to the circuit as well as the light itself. Open (turn off) switch and have students take out the metal rivet and long red wire. Hold the wire with about a 6" wire tail on one side and then with the long end of the wire wrap the rivet with 10 more turns. When wire is wound students may tie a single knot using both ends of the wire so it will stay together.
- 5) Have students close the switch and place one end of the magnet into the cup of paper clips and determine how many you are able to pick up.

Safety Note: Make certain students only have switch closed for about 10 seconds at a time. If it is on too long batteries will heat up.

- 6) At this time, students should be roughing out a data table for data collection. This should not be a final table right now. Students should record number of paper clips picked up by the magnet with 10 turns of the wire.
- 7) Now we want to make the magnet so it is capable of picking up at least 10 paperclips at a time. Students have all the tools they need. They can try anything to alter the circuit and make the magnet stronger. Students should collect data with every test that they perform.
- 8) Students should call teacher over when they achieve this goal of picking up > 10 paper clips.
- 9) When students find a solution they should begin to write a report including:
 - 1) Title of lab,
 - 2) State the problem,
 - 3) List the different things that you attempted and whether they worked or not,
 - 4) A neat, well-organized data table of every test you attempted,
 - 5) Conclusion stating what you learned about the variable(s) that affects the strength of a magnet to allow you to pick up > 10 paper clips and what variable(s) that do not seem to have a significant effect on the strength of an electro-magnet.
- 10) When students complete the experiment they should collect all tools and return them to their bag.
- 11) Discuss with students after lab write ups are turned in the variables that affect the strength of a electro-magnet.

Extension:

1) Students create a magnet that is capable of picking up 15 – 20 clips every time. Discuss with students the idea of how strong to build a magnet. If it needs to pick up 15-20 paper clips every time should it be built to pick up more. If we over build the strength of the magnet what are the benefits and drawback of building a stronger magnet (you can certainly get into cost, customer satisfaction etc.).