Title: Pulling Through It All (Magnets)
Teacher: Dr. Leonard
Grade Level: 4th
Duration: 70 minutes (2 sessions)
Date: October 12, 2010

General Objective:
Students will investigate how magnets pull objects with a barrier between them.

Standard/Benchmark:
AAAS 4G: Without touching them, a magnet pulls on all things made of iron and either pushes or pulls on other magnets.
MT 2.3: Identify the basic characteristics of light, heat, motion, magnetism, electricity, and sound.
MT 1.3: Use data to describe and communicate the results of scientific investigations.

Learning Objectives
Concepts: Students will be able to...
- conclude that magnets do not need to touch objects in order to pull them.

Skills: Students will be able to...
- make predictions and compare them to their observations of a phenomenon.
- communicate their prediction, observations, and ideas in writing.

Instructional Procedures

Background information for teacher: Keep magnets away from computer disks, audio- and video cassettes, and credit cards, as magnets will “wipe” the information off them. Also keep magnets away from computer and TV screens and antique watches, as magnets can damage them.

Magnets must be treated with care or their magnetic effects can be destroyed. Do not allow them to be dropped, exposed to extreme heat, or stored with another magnet of the same type.

The science behind it: Magnetic forces act through most materials, although the magnetic interaction decreases with the thickness of the materials.

Engage: (15 min)

Pre-assessment (10 min): Complete the “Magnets in Water” pre-assessment (from Uncovering Student Ideas in Science, Vol 2) in their notebooks; have students share their ideas; tally the numbers of students who agreed with each of the people named in the assessment. This will be their prediction; they will actually test it at the end, in “Elaborate.”

Focusing event (5 min): The teacher demonstrates the “flying paperclip” (a paper clip attached to a string taped to the table is suspended in mid-air by a bar magnet). Ask questions like: Why is the paper clip suspended like this? What’s between the magnet and the paperclip? How many other things can you attach to a string and suspend with a magnet?
Driving question: Introduce driving question: What materials can a magnet pull through?

Explore: (20 min)
Demonstrate the procedure to the students by placing a magnet beneath a sheet of paper and placing a paper clip on top. When you move the magnet around underneath, the paperclip will move, too. Ask students to predict which element in the chart (attached) the magnet will pull through. Then provide groups of 3-4 students with materials and ask them to investigate the driving question. Students should try a sheet of construction paper, cardboard, plastic tumblers, glass jars, aluminum foil, a tin can, and a sheet of steel, such as the side of a filing cabinet drawer. During the exploration, move amongst students asking: Why do you think the magnet pulls through “this” but not “that”? Is there a material that the magnet pulls through better or easier? How do you explain that? If there is time and interest, students can test how a magnet pulls through items of their own choosing. Students will keep track of their results on the worksheet (attached) that they can paste into their notebooks.

Explain: (15 min)
Ask students what they discovered: What kinds of things did you find the magnet would pull through? What things would it not pull through? What can you conclude about a magnet’s pull? If necessary, ask them productive questions to get at the idea that magnets don’t need to touch an object to pull it.

Have them write their conclusion at the end of the worksheet. They should be able to conclude by essentially stating the learning objective: Magnets do not need to touch objects in order to pull them.

Elaborate: (20 min)
Return to the pre-assessment. Ask students if they would like to change their prediction, and have them explain why and how they would change it (write modified prediction in notebook). Allow student groups to test each idea on the pre-assessment about whether a magnet can pull paperclips under water. As they conduct the investigation, ask questions to extend their thinking: How is your initial idea changing? What evidence have you found that is causing you to change your idea? Why do you think the magnet and paperclip are behaving that way in water? Have them write a paragraph in their notebooks (at least 4-5 sentences), saying what they predicted, what they observed, and how their ideas have changed.

Evaluate:
Formative assessment (teacher, outside of class time): Use formative assessment checklists (attached) to evaluate (1) students’ conclusions about magnets on the worksheet, and (2) their paragraphs comparing their predictions to their observations.

Summative assessment (at the end of the unit, in class): Students design and carry out a new investigation to find out how magnets behave in different situations; judge, present, and justify their explanations to the class.
Materials & Resources

1. Used in creating this lesson

2. Required to teach the lesson
   - Bar magnet, paperclip, string, tape, sheet of paper (for teacher demonstrations)
   - 1 worksheet per student (attached)

1 of each of the following per group of 3-4 students (those items used only in Elaborate are marked with “X”):
   - Magnet (bar or horseshoe, etc.)
   - Sheet of construction paper
   - Piece of cardboard
   - Plastic tumbler
   - Glass jar
   - Sheet of aluminum foil
   - A “tin” can (from a canned food, washed out)
   - Access to a metal filing cabinet drawer
   - A half dozen paperclips
   - Bowl of water – X

Formative Assessment Checklists

1. Conclusion (on Worksheet)
   Did student identify that a magnet …
   can pull through most materials? Yes / No
does not need to touch an object to pull it? Yes / No

2. Paragraph on Predictions, Observations, Change in Ideas
   Does the paragraph include all elements:
   Prediction? Yes / No
   Observations? Yes / No
   How their ideas changed after the test? Yes / No
   Quality of student’s expression:
   - Clear and complete discussion; made connections between prediction, observation, and ideas
   - Partial discussion, or difficulty expressing ideas
   - Unclear discussion, or no connections made
Magnet Inquiry Pre-Assessment

Magnets in Water

Four friends were wondering if a magnet could pick up steel paper clips in water. This is what they said:

Nate: “I think magnets and paper clips need to be in air. If both the magnets and paper clips are in water, they won’t attract.”

Amy: “I think magnets need to be in the air, but it doesn’t matter if the paper clip is. Magnets can attract paper clips covered with water.

Steve: “I don’t think air makes a difference. I think magnets will attract paper clips when both are under water.”

Leah: “I don’t think air makes a difference. However, when magnets are in water, they work the opposite way. The paper clips will be repelled by the magnet.”

In your notebook, identify which friend you agree with and why. Explain your thinking about how magnets work.

What materials can a magnet pull through?

<table>
<thead>
<tr>
<th>Material</th>
<th>Prediction: Will the magnet pull through this?</th>
<th>Results: Did the magnet pull through this?</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>construction paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cardboard</td>
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<td>plastic tumbler</td>
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<td>glass jar</td>
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<tr>
<td>aluminum foil</td>
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<tr>
<td>a tin can</td>
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<td></td>
<td></td>
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<tr>
<td>steel (the side of a filing cabinet drawer)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

What can you conclude about a magnet’s pull?