Workshop 7.
The Lure of Magnetism

What is the difference between a permanent magnet and an electromagnet? In this workshop, fourth-grade students build an electromagnet by winding a wire around a rivet and attaching the ends to battery terminals. The students first predict how many washers they can pick up with the help of their electromagnet and then perform the experiment to test their predictions. After the number of washers is recorded and the results are discussed, the students engage in a group discussion about practical uses for electromagnets.

On-Site Activities and Timeline

Getting Ready

30 minutes

Share What You Learned

For homework, you used a string of paper clips to investigate the pick-up power of a magnet. Take a few minutes to discuss your observations with the group or a partner.

A Penny for Your Thoughts on the 10-Cent Experiment

In the Workshop 6 video, you saw an experiment involving four ring magnets on a pencil. Perhaps you even tried it. When the pencil was held horizontally, the four magnets were equally spaced, but when held vertically, the bottom magnets were closer together than the top ones. Write down how you think the results would change if we used three magnets rather than four. What would happen if we used five? What would happen if the experiment could be done on the Moon? Share your ideas with the other participants.

Building an Electromagnet

Materials:

A 1.5-volt battery

A 2-inch or longer nail

1 yard of thin insulated wire (remove any insulation from the ends)

A box of paper clips

Instructions:

Do this activity with a partner.

1. Wind the wire tightly around the nail so that you have 25 turns, leaving enough wire free at each end to connect it to the battery.
2. Connect one end of the wire to the top terminal of the battery (the positive [+] terminal) and one to the bottom of the battery (the negative [-] terminal).
3. See how many paper clips you can pick up with the nail and record the number in the table to the right.
4. Now add five more turns of wire and again see how many paper clips you can pick up. Again, record the number.
5. Repeat this process until you have 50 turns of wire around the nail.
6. Is there a relationship between the number of turns of wire and the number of paper clips your electromagnet can lift?

Number of turns	Number of paper clips
25	
30	
35	
40	
45	
50	

On-Site Activities and Timeline, cont'd.

Watch the Workshop Video

60 minutes

As you watch the video, look for the "10-Cent Experiment." You may want to try it yourself at home. Instructions can be found on page 55.

Going Further

30 minutes

How Many Forces Can You Find?

During the past few sessions you have been learning how to use arrows to represent forces on objects. Working on your own or with a partner, draw arrows to represent the force acting on the ball in each situation below.

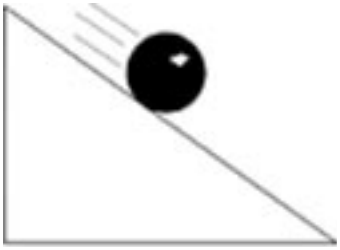
1. A ball sits on a table.

2. A ball is dropped.

3. A ball is thrown up in the air.

4. A ball rolls across a table.

5. A ball rolls down a ramp.



6. A ball hangs from a string.

To check your answers, go to the *Science in Focus: Force and Motion* Web site at:

http://www.learner.org/channel/workshops/force

For Next Time

Homework Assignment

Electromagnetism in the Real World

For this assignment, select any device that uses electromagnetism and design a poster to help others understand how it works. Your poster should fit on one piece of poster board and may include pictures, text, drawings of the device, or anything else that will help others to understand how it works.

At the start of the next workshop, you and your colleagues will hold a "poster session," and you will have the opportunity to share what you have learned. The poster should give enough detail so that even students in your class would understand how your device works.

Here are some examples of devices that use electromagnetism:

An MRI machine

An airport metal detector

A ground metal detector (treasure finder)

A credit card scanner

A junk yard scrap metal sorter

A telephone

A stereo speaker

A video tape player

A computer hard drive

A doorbell

Site Leaders: Remember to bring copies of participants' completed questionnaires from Workshop 1 to the next (final) workshop.

For Next Time, cont'd.

The 10-Cent Experiment

Materials:

Five identical rubber bands

Two paper clips

A ruler

A set of keys (or other object that can act as a weight)

Instructions:

1. Hang the keys from a paper clip on a single rubber band and measure the length of stretch of the band.
2. Connect two rubber bands chain-style (end-to-end), and hang the keys from the chain. Measure the length of stretch of the rubber bands.
3. Finally, hang the keys on two rubber bands placed side by side (so as to create a single, two-strand band). Again, measure the length of the stretch.

Questions:

How did the amount of stretch differ with the different arrangements of rubber bands?

Why?

Notes