How Strong Is Your Magnet?

THE BASICS	THE TOOLBOX
 Grade Level: K-8  Estimated Time: 30 min.	For each 2 students: • Bar magnet • Clothespin • Masking tape • Manila folder • 12 oz. plastic or paper cup • 20 paper clips • Data sheet • Pencil

EDUCATION STANDARDS	**Physical Science Content Standard:** Understanding properties of magnets, that magnets exert a magnetic field, and how distance affects the strength of that field.
SAFETY CONCERNS	There are no specific safety considerations other than making sure students do not put paper clips into their mouths.
FOR KIDS WITH DISABILITIES	Students with vision or mobility impairments may need to work with a partner.

What To Do

Educational Objective:

To experimentally measure the strength of a magnet and graph how the strength changes as the distance from the magnet increases, and as a barrier (masking tape) is built between the magnet and an iron object.

Materials Preparation:

- Make copies of the data sheet for each pair of students.
- Make a large graph on newsprint paper or a chalkboard. After the students conduct the activity, you will need to average students' findings and graph the class findings. The x-axis (horizontal) is for the distance from the magnet (that is, the number of layers of tape beginning with zero); the y-axis (vertical) is for the strength of the magnet (number of paper clips it can hold).
- Cut the tape for each pair of students. One long strip will be used to tape the clothespin to the cup. Then, cut 21 one-inch (2.5 cm) pieces (small enough to fit on the magnet). Stick them to a smooth manila folder and have students number them from 1 to 21.

Questions to Ask Students As They Do This Activity:

- How many paper clips can the magnet hold without any masking tape?

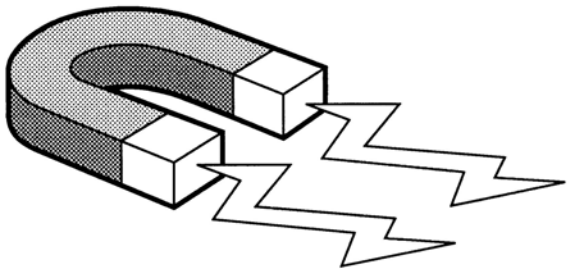
- As you begin adding layers of tape, what happens? Why?
- Is the masking tape a magnet? How do you know? If not, why are the paper clips attracted to it?
- What happens to the strength of the magnet as you add more layers of tape? Why?
- Is the magnetic attraction blocked by the tape, or is it just that the tape adds distance between the magnet and the paper clip?
- What does the graph tell us?

Why It Happens:

A magnetic field is often mentioned when talking about magnets. This field is produced by the motion of charged particles. For example, electrons flowing through a wire will produce a magnetic field surrounding the wire, and create a temporary magnet. Permanent magnets are made of ferromagnetic metals, such as iron, cobalt, and nickel that respond very strongly to magnetic fields. Their magnetic properties are caused by the spin and orbital movements of their electrons.

A magnetic field (the pull of the magnet) will pass through materials like tape with almost no effect. The tape does not block the attraction of the magnet for the paper clip. Rather, each piece of tape removes the paper clip from the surface of the magnet by one more small increment of distance, equal to the thickness of the tape. The tape is just a convenient way to move the clip and the magnet farther apart. The distance between the magnet and the clips, not the tape lessens the attraction of the magnet. As you move farther from the magnet's pole, the field becomes weaker and weaker.

You can show that the strength of the magnetic field decreases the farther you move from the magnet by a simple demonstration. Tie one end of a thread to a paper clip and tape the other end to the surface of a table. Hold a magnet above the paper clip. You can hold the clip up in the air (and keep the string taut) as long as the magnet is fairly close to the paper clip. If you move the magnet too far away for the clip, the strength of the magnetic field decreases, and the paper clip falls.



Web Sites

- **Background Information for Magnets**
  http://www.science-tech.nmstc.ca/english/schoolzone/Info_Magnets.cfm#force
  (Grades 5-8)
- **Magnets**
  http://www.physics4kids.com/files/elec_magnets.html
  (Grades 3-12)

Software

- **Bumptz Science Carnival**
  Theatrix/Sanctuary Woods, 1995.
  (Grades 1-5)
- **Electrical Currents and Magnetism**
  AIMS Multimedia, 1996.
  (Grades 6-10)

Reading Room

- Vecchione, Glen. **Magnet Science**. Sterling, 1995. (Grades 5-8)
- Wee, Patricia Hachten. **Science Fair Projects for Elementary Schools: Step by Step**. Scarecrow Press, 1998. (Grades 2-5)
- Woodruff, John. **Magnetism**. Raintree Steck-Vaughn, 1998. (Grades 3-6)

Career Connections

An applications engineer figures out ways to apply technology to practical uses, such as using a very strong magnet to lift and move wrecked cars in a junkyard.

HOW STRONG IS YOUR MAGNET? ACTIVITY SHEET

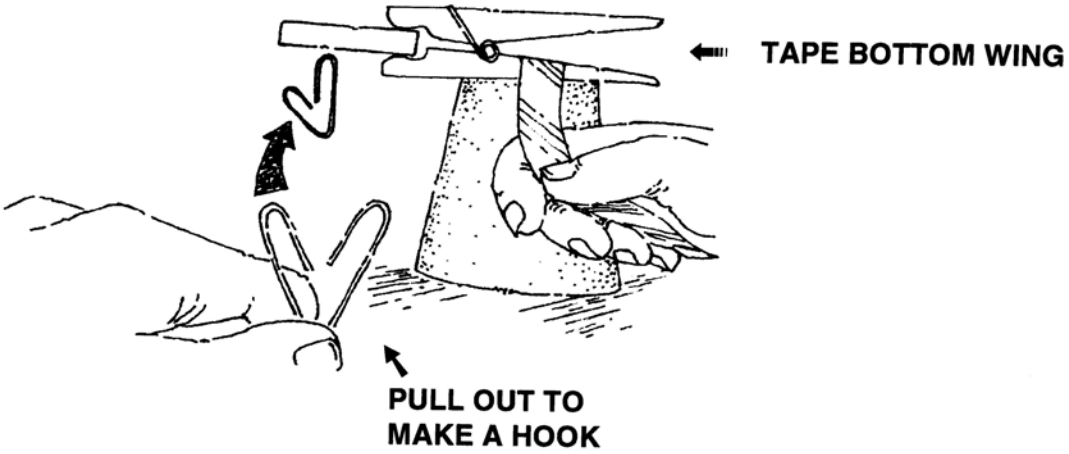
Can your small magnet attract a paper clip from across the room? From across your desk? How can you find out how strong your magnet is? This experiment will help you find out!

For this experiment, you will need:

- Magnet
- Clothespin
- Masking tape
  (1 long piece & 21 short pieces)
- Paper cup
- 20 paper clips
- Data sheet
- Pencil

1. Work with a partner. Number your small pieces of tape from 1 to 21.

2. Clamp your magnet in the clothespin. Tape it to the bottom of the cup as shown in the drawing.

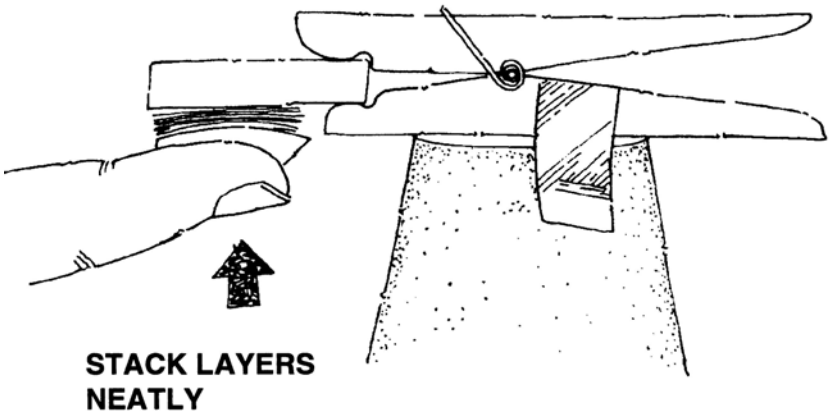


3. Pull out one end of a paper clip to form a hook. Touch the hook to the magnet. It should stick to one pole of your magnet.

4. Take turns with your partner and carefully add paper clips to the hook, one by one. Count the total number of paper clips that you can hang onto the hook before the weight becomes too much for the magnet to hold and the paper clips fall.

5. Write this number of paper clips on your data sheet on the line for *zero pieces of tape*.

6. Next, stick three pieces of masking tape (labeled #1, #2, and #3) on the bottom of your magnet. See the picture below. Now repeat your experiment and see how many paper clips you can hang on the hook. Make sure the hook touches the tape, not the magnet itself. Write your findings on your data sheet.



7. Add three more pieces of tape and repeat your experiment. Mark your findings on your data sheet.

8. Keep adding pieces of tape, three at a time, repeat the experiment, and write down what you find. As you add more and more layers of tape, what do you notice about the number of paper clips you can add to the hook? Is the magnet able to hold more or fewer paper clips? Do you think the tape is causing this? Why?

9. Use your findings to help your leader and class complete a graph that describes the results of your experiment.

How Strong Is Your Magnet?
Data Sheet

How Many Layers of Tape?	How Many Paper Clips?
0	
3	
6	
9	
12	
15	
18	
21	