3M Young Scientist Lab

Family Activity | Grades 3–5

Interaction at a Distance

OVERVIEW

Students come in contact with and use magnets every day. They often don't consider that there are different types of magnets and are made for different purposes. In this activity students explored magnetic strength and how combining magnets can increase it. Students measured this strength using a stack of index cards, graphed the data, and looked for a pattern in their data.

At home, students will extend their learning with their Parent/Guardian to find out what types of magnets they have in their house and test their strength and attraction at a distance.

OBJECTIVES

Students will be able to:

- discover various magnets around their home and test their strength.
- manipulate magnets so they attract and repel each other.
- test the magnetic strength by adding multiple magnets together.

BACKGROUND INFORMATION

Magnets provide a simple way to explore force with students. The power of a magnet is somewhat like magic to them and requires exploration to understand. When forces act on or between objects, they do so in two significantly different ways. The first type of interaction involves touching; one object has to touch another object. Examples of this include a broom sweeping dry cereal on the floor, a bat hitting a ball, and a hand pulling on a doorknob. Most of our daily interactions involve this type of force: touching. The second type of interaction occurs over a distance. Examples of this include the Earth pulling on the moon, magnets attracting or repelling one another, and a charged balloon sticking to a wall. We certainly experience the force of gravity constantly in our daily lives and experience magnetic and electrostatic forces to a lesser degree. The activities listed below will allow you and your young scientist the opportunity to extend and apply what they have learned at school about magnetic forces.

MATERIALS (BY ACTIVITY)

- Flat Magnet Activity
  - Flat magnet (can be found inside a cabinet latch)
  - Screwdriver
  - Various small items (paperclip, screw, safety pin, etc.)
  - Notebook/paper
  - Pen/pencil
- Cabinet Magnet Activity
  - Cabinet door
  - Magnetic latch from cabinet door
  - Screwdriver
  - Notebook/paper
  - Pen/pencil
- Interaction at a Distance Activity
  - Magnetic latch from cabinet door
  - Cabinet door
  - Newspaper, index cards, or sticky notes
  - Rubberband
  - Ruler
  - Notebook/paper
  - Pen/pencil
- Standing Magnet Activity
  - Several flat magnets
  - Ruler
  - Notebook/paper
  - Pen/pencil
- Compass Magic Activity
  - Compass
  - Magnets of various sizes
- Magnetic Tape Activity
  - Magnetic Tape
  - Ruler
  - Various small items (paperclip, screw, safety pin, etc.)

HOME ACTIVITY

1. **Flat Magnet Activity:** One way for your young scientist to demonstrate and continue to explore the strength vs. distance phenomena involves the magnetic latches found on some cabinet doors. Help your young scientist unscrew a magnetic latch from a cabinet so you both can examine it. Even though you probably can't separate the magnet from its housing, your young scientist might be able to recognize the flat magnet that's bound inside the housing. Even in its housing, the magnet can be attached to steel objects and tested in a variety of ways to see how strong it is. Once you have taken the magnet off the cabinet, test its strength by trying to pick up various items (safety pin, screw, paperclip, etc.). Record your findings in a notebook or on a piece of paper.

2. **Cabinet Magnet Activity:** Most magnetic cabinet latches have adjustment screws that can be used to move the magnet closer or farther from the metal plate that is screwed to the door itself. Again with your supervision, have your young scientist vary this distance while pulling on the door to observe the change in force needed to pull the door open. Another factor that is easily changed is how much of the metal plate that is screwed to the cabinet door actually comes in contact with the magnet. Loosen the screw holding the plate to the door, rotate it to expose more or less of it to the magnet, and test each time to see how much force is needed to open the door. Record your findings in a notebook or on a piece of paper.

3. **Interaction at a Distance:** You and your young scientist can carry out an investigation similar to the one they did in school that involved putting index cards between a stack of magnets and a single magnet.

    a. Instead of using a stack of magnets, you will use the magnet attached inside a cabinet and the metal plate attached to the cabinet door. Adjust the magnet latch so it holds the door closed as firmly as possible. Place items such as newsprint, index cards, sticky notes or other thin material between the magnet and the metal plate on the door. Vary the number of layers of material to see what effect the thickness of material has on the amount of force needed to pull the door open.

    b. One way to make some numerical measurements of this force is to measure the stretch of a rubber band. Loop a small rubber band around the handle of the cabinet and pull on the other end of the rubber band with sufficient force to open the door. Measure this stretch or distance with a ruler. Place a sheet of paper or other material between the magnet and its plate, close the door on this sheet, and pull the door open with the same rubber band, measuring the stretch. It should not stretch as much this time before the door opens. Add another sheet and again measure how far the rubber band stretches before the door opens. In this way, you can gather some numerical data about the force needed to open a cabinet door that has a magnetic latch.

4. **Standing Magnet Activity:** If you have access to the flat magnets found in these door latches (they can be purchased at many hardware or some electronics stores) try the following investigation. This activity requires that the magnets are rectangular prisms that are box-shaped so they can stand up on one of their sides.
    a. Stand a magnet up vertically on a flat surface so the narrower side is sitting on the table.
    b. Hold a second magnet vertically and parallel to the first and slowly move it towards the first magnet and observe the distance between the two magnets when the first magnet either falls toward the second magnet or falls away from it.
    c. Measure this distance with a ruler or mark the positions of the two magnets on paper and measure their separation later.
    d. Add a second magnet to the magnet you hold with your fingers and repeat the process.
    e. Measure and record the distance between the single magnet and stack of two magnets as you slowly bring the two close together.
    f. Again, measure or record the distance.
    g. Add another magnet to the stack and repeat the procedure with as many magnets as you have.
    h. Ask your young scientist how this investigation (and its results) relates to the investigation they did at school using magnets.
5. **Compass Magic Activity:** If a compass is available, you and your young scientist could begin to investigate the unique interaction between a magnet and compass. This could lead to discoveries about magnetic fields, polarity of magnets, and the strength of different types of magnets, if they are available.

6. **Magnetic Tape Activity:** Magnet Tape is adhesive on one side and magnetic on the other. Besides its practical use around the house, this tape could provide inquiry opportunities for your young scientist. If available, investigate the following:
    a. Can you increase its strength if you stack it in layers as your child did at school or you've perhaps done with the activity suggested above?
    b. Does putting two strips next to each other double the holding strength of one strip?
    c. Does a 20 cm length of this magnetic tape hold twice as much weight as a 10 cm length?

VOCABULARY

- **Magnet:** a piece of metal that can pull certain types of metal towards it.
- **Magnetic Strength:** the force of a magnet to attract or repel a magnetic material; determined by the motion of electric charges.

THOUGHT/CONVERSATION STARTERS

- Why are some magnets stronger than others?
- How much weight can one magnet hold?
- Can combining two magnets allow them to hold more weight?
- What magnets do we have and use around the house?

DOCUMENT THE LEARNING IDEA

- Take pictures and/or videos of the activities as you complete them. You may choose to turn these into a digital collage or video to showcase your findings.
- Draw pictures of your family completing the activities and what you found in your explorations.
- Take notes during your explorations in a journal or on a piece of paper.

*Work together as a family to document your learning. Add a short description to your creation, explaining what you did and what you learned. Bring the creation to school to share with the class.

CONTINUE MAKING CONNECTIONS

Magnets are all around us! What other magnetic items can you find in your house? Go on a Magnet Hunt with your family. Draw a picture or take pictures of each magnetic item you find. Write how you use each magnetic item you found. Create a collage with your findings and bring it to school to share with the class.