Magnets

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About **Magnets**

DeltaScienceModules, THIRD EDITION

Students discover the Law of Magnetic Attraction and much more about the principles that govern magnetic behavior and interaction. They experiment with magnets of various sizes and shapes, even our planet-sized magnet, to explore this invisible but observable force. Students find out which materials are attracted to magnets and which can "block" the passage of magnetic force. They demonstrate magnetic fields and polarity using iron filings. Then they make compasses that align with Earth's magnetic poles. They model temporary magnetism and use a simple circuit and an iron nail to create an electromagnet. A space shuttle video challenges students to consider the applications of magnets in our technological society.

In the Delta Science Reader *Magnets,* students read about magnets and magnetic fields. They learn how magnets are made, how magnets can create electricity, what magnets are used for, and how Earth is like a magnet. They also read about Michael Faraday, the famous nineteenth-century scientist who invented the electric motor and the electric generator, both of which use magnets. Finally, students learn about applications of magnets in magnetic resonance imaging (MRI) and maglev trains.

Overview Chart for Hands-on Activities

Hands-on Activity	Student Objectives
1 The Floating Paper Clip *page 13*	• observe a paper clip that appears to float in the air • form hypotheses to explain why the paper clip floats • investigate magnetic attraction
2 What Does a Magnet Attract? *page 19*	• guess which objects will be attracted to a magnet • observe that metal objects made of iron and steel are attracted to a magnet • observe that metal objects made of aluminum, copper, and brass are not attracted to a magnet • observe that nonmetal objects are not attracted to a magnet
3 Can the Force Go Through It? *page 25*	• guess which objects will "block" the force of magnetism • place objects made of different materials between a magnet and a magnetic object • investigate which materials allow the magnetic force to pass through them
4 How Strong Is the Force? *page 29*	• guess the strength of different magnets • measure the strength at different places on each magnet • discover that magnetic force increases as the distance between a magnetic object and a magnet decreases
5 Magnetic Fields *page 35*	• observe the pattern made by iron filings on a sheet of paper placed over a magnet • infer that the pattern is made by the invisible field lines in the field surrounding a magnet • compare the pattern made by a single magnet to the pattern made by two magnets placed near each other
6 Investigating Magnetic Poles *page 41*	• observe that the interaction between two magnets results in attraction or repulsion • learn that the ends of magnets are referred to as poles • investigate the Law of Magnetic Attraction
7 Earth: A Giant Magnet *page 47*	• discover that Earth acts like a giant magnet • observe the influence of Earth's magnetic poles on a magnet
8 Making a Compass *page 53*	• make a small compass to find north • compare their compass with a compass from the kit • deduce the directions north, south, east, and west
9 Making a Magnet *page 59*	• discover two ways that an iron-containing object can be magnetized temporarily • observe how temporary magnetism is lost or weakened
10 A Different Kind of Magnet *page 65*	• observe the effect that a wire with electric current flowing through it has on a compass • infer a relationship between electric current and magnetism
11 Making an Electromagnet *page 71*	• construct an electromagnet using a battery, a nail, and coils of wire • use an electromagnet to attract magnetic materials • vary the strength of their electromagnet
12 Magnets in Space *page 77*	• observe the interactions of magnets on Earth and in space • formulate their own questions about the magnets
Assessment *page 83*	• See page 83.

Process Skills	Vocabulary	Delta Science Reader
observe, hypothesize	**hypothesis, magnet**	pages 2–3
predict, observe, compare, classify	**magnetic, nonmagnetic**	pages 2–3
predict, use variables	**magnetism**	pages 4–5
predict, measure, compare, infer		pages 4–5
observe, infer, compare	**field lines, magnetic field**	pages 4–5
observe, define based on observations	**attract, Law of Magnetic Attraction, poles, repel**	pages 3, 4–5
observe, communicate	**geographic North Pole, geographic South Pole, magnetic north pole, magnetic south pole**	pages 7, 8–9
make and use models, compare	**compass**	pages 8–9
experiment, infer	**temporary magnetism**	page 6
observe, infer	**electromagnetism**	pages 10, 11, 13
make and use models, use variables	**electromagnet, ferrous**	pages 10, 11, 12, 13
observe, communicate	**microgravity**	page 7

See the following page for the Delta Science Reader Overview Chart.

Overview Chart for Delta Science Reader *Magnets*

Selections	Vocabulary	Related Activity
Think About...		
What Is a Magnet? *page 2*	**attract, force, magnet, magnetic, magnetic pole, magnetism, metal, nonmagnetic, north-seeking pole, repel, south-seeking pole**	Activities 1, 2
• What Is a Magnetic Field? *page 4*	**field lines, magnetic field**	Activities 3, 4, 5, 6
• How Are Magnets Made? *page 6*	**permanent magnet, temporary magnet**	Activity 9
• How Is Earth Like a Magnet? *page 7*	**magnetic north pole, magnetic south pole**	Activities 7, 12
What Is a Compass? *page 8*	**compass, lodestone, magnetite**	Activities 7, 8
What Is an Electromagnet? *page 10*	**electric motor, electromagnet**	Activities 10, 11
How Can a Magnet Make Electricity? *page 11*	**generator**	Activities 10, 11
What Uses Do Magnets Have? *page 12*		Activity 11
People in Science		
• **Michael Faraday** *page 13*		Activities 10, 11
Did You Know?		
• **About MRIs** *page 14*		
• **About Maglev Trains** *page 15*	**friction**	

See pages 91–99 for teaching suggestions for the Delta Science Reader.

Science Background

Additional science background information appears at the beginning of each activity and in the Delta Science Reader section.

A **magnet** is an object that attracts other magnetic materials, such as iron, or materials that contain them, such as steel. This attractive force is called **magnetism.** Magnetism is a natural physical property that was first discovered by the ancient Greeks. In 600 B.C.E., Thales of Miletus wrote of rocks that attracted bits of iron and were both attracted and repelled by other similar rocks. The rocks were located near the town of Magnesia. Today we know that the rocks contained the mineral magnetite (Fe_3O_4), a naturally magnetic iron oxide also known as lodestone. The most common magnetic materials are iron, cobalt, and nickel.

Magnets share certain characteristics: a magnet can attract magnetic materials; each magnet is surrounded by an invisible force, called its **magnetic field,** which can act on a magnetic object from a distance; every magnet has two **poles** that are equal in strength; a magnet's force is strongest at its poles; and like poles **repel** and unlike poles **attract** (the **Law of Magnetic Attraction**). The invisible magnetic field of a magnet can be observed by sprinkling iron filings on a sheet of paper covering the magnet. The filings line up along the **field lines** of magnetic force.

Although today it is well known that electricity and magnetism are linked, this fact was not established until the nineteenth century. In 1821 Danish chemist Hans Christian Oersted discovered that an electric current naturally produces a magnetic field. Ten years later British physicist Michael Faraday discovered that the opposite is true as well. An electric current can be produced in a wire by passing it through a magnetic field. These two fundamental principles comprise **electromagnetism.** The relationship between electricity and magnetism forms the basis of the electric motor, in which electricity is converted to mechanical energy, and the generator, in which mechanical energy is converted to electricity. It also makes electromagnets possible. An **electromagnet** is made by coiling wire around a piece of soft iron. When an electric current is passed through the wire, a magnetic field is produced. The field magnetizes the iron core by aligning domains within the iron.

Domains are small regions within an object that have their own magnetization and act much like small bar magnets. When they are not being influenced by a magnetic field, they are randomly ordered and exhibit little magnetization. However, when exposed to a magnetic field, the domains of a magnetic material will align along the field lines of magnetic force and the material will become magnetized. The more domains the material has, the stronger its temporary magnetization.

Likewise, the more wire coils used to make an electromagnet, the stronger the magnetic field and the stronger the magnetization. The major difference between magnets and electromagnets is that the magnetism produced by an electromagnet can be turned on and off. When the current is switched off, the magnetic field is also turned off and the magnetization disappears.

An electromagnet is an example of a **temporary magnet,** a magnet that loses its magnetization when removed from a magnetic field. Likewise, any object that can be picked up by a magnet, such as a nail or a paper clip, is also a temporary magnet. (In fact, only materials that can be temporarily magnetized are attracted to a magnet.) The nail or paper clip is temporarily magnetized because its domains are aligned by the magnetic field. However, when the nail or paper clip is removed from the magnetic field, the object loses its magnetization.

A magnet that retains its magnetization after removal from a magnetic field is called a **permanent magnet.** Permanent magnets can occur naturally; lodestone is a natural permanent magnet. They can also be created by exposing a magnetic material like steel to a very strong magnetic field, such as that of an electromagnet. If you have a horseshoe-shaped magnet in your classroom, it was probably made using an electromagnet. However, even a "permanent" magnet may not last forever. Hitting it, dropping it, or heating it above a certain temperature, called the Curie temperature, can cause the magnet to lose all or part of its magnetism.

Earth itself is a giant magnet. The swirling molten iron in the outer core acts like an electric dynamo, or generator, producing and sustaining Earth's magnetic field. Humans and other animals, such as birds, use the magnetic field as a navigational aid. But while birds have a tiny amount of magnetite in their skulls, humans must use compasses. A **compass** is a magnetized needle mounted on a pivot so that it can swing freely to align itself along the field lines of Earth's magnetic field. The magnetized needle in the compass responds to Earth's magnetic field in the same way that iron filings respond to a smaller magnetic field.

The locations of Earth's two **magnetic poles** do not coincide with those of its **geographic poles.** Currently, the north magnetic pole is located in the Canadian Arctic. Unlike the geographic poles, which are fixed, the magnetic poles are always on the move. The north magnetic pole is moving northwest at a rate of about 15 km (9 mi) a year. The magnetic poles have wandered throughout geological history. This information is continually being recorded in newly formed igneous rocks. As the rocks cool and begin to harden, magnetic minerals in the rocks align with Earth's current magnetic orientation. When they harden, the record is fixed. The geological record of polar wander, taken from rocks around the globe, was a key piece of evidence supporting continental drift and the theory of plate tectonics.

The strength of Earth's magnetic field changes over time as well. From the geological record scientists know that the planet's magnetic field waxes and wanes and that the poles have occasionally reversed throughout Earth's history. The north-south flip-flops happen, on average, every 200,000 years and take a few thousand years to complete. The last reversal was 780,000 years ago. Scientists have recently found that Earth's magnetic field has been weakening for the past 2,000 years. Whether this weakening indicates that a reversal is imminent, however, is unknown.

In this Delta Science Module, students will learn that magnets are much more than just objects that hold notes against refrigerator doors. They have many important applications in our technological society. Motors, solenoids, and generators, for example, work because of the magnetic fields that are created when electric current flows through wires. Electromagnetism also makes possible the use of powerful industrial electromagnets as well as tiny ones used in microphones and computers disks. In the medical field, magnetic resonance imaging (MRI) allows doctors to examine even soft tissues such as the brain and internal organs. Magnetic levitation trains (maglev), which use the principle of like poles repelling to hover in the air over the track, may help to meet our transportation needs in the twenty-first century.

MATERIALS LIST

Magnets

Quantity	Description
8	aluminum foil, 5 cm × 5 cm*
1	ball, foam
16	batteries, D-cell*
8	battery holders with clips
1	bolt, metal
16	carts, plastic
8	cloths, flannel, 10 cm × 10 cm
8	compasses, magnetic
16	cups, plastic
8	dishes, plastic
75	dots*
1	dowel, wooden
8	emery cloths, 10 cm × 10 cm*
1	fishing line, nylon, 5 m
1	floating paper clip stand
1	iron filings, 150 g
8	magnet boats
8	magnetic/nonmagnetic objects, p/14
1	magnet, large bar
16	magnets, large
6	magnets, ring
16	magnets, rod
16	magnets, small
12	marbles, magnetic
1	marker, permanent, black
16	nails, iron
4	paper clips, p/100
2	paper, white, p/30*
4	string, 1.25 m*
1	tape, masking*
1	videotape, *Magnets in Space*
1	wire, enamel-coated, 18 m
1	**Teacher's Guide**
8	**Delta Science Readers**

Quantity	Description
TEACHER-PROVIDED ITEMS	
–	clothesline (optional)
–	paper, construction
–	paper towels
1	pitcher
11	rulers, metric
32	safety goggles
1	scissors
1	tack or pushpin
–	tape, transparent
1	VCR and monitor
–	water, tap

* = consumable item   † = in separate box

To order consumable items or refill kits, please call 1-800-442-5444.

ACTIVITY SUMMARY

In this Delta Science Module, students are introduced to many of the phenomena associated with magnetism. By experimenting with a variety of magnets and other materials, students identify the laws that govern magnetic behavior and interaction.

ACTIVITY 1 Students encounter a floating paper clip and offer explanations for this strange behavior. They soon discover that the paper clip is actually being held up by magnetism.

ACTIVITIES 2 and 3 Students investigate the force of magnetism. They find out which common materials are attracted to magnets, and which are not; which can block the passage of the magnetic force, and which cannot. They determine that the force of a magnet acting on a magnetic object is inversely related to the magnet's distance from that object.

ACTIVITY 4 Students compare the strengths of different magnets and see that bigger magnets are not necessarily stronger magnets. They also compare the strength of a single magnet at different points along its length and discover that force is concentrated at either end of a magnet rather than at the center.

ACTIVITY 5 Students use iron filings to visualize the invisible field lines that surround the magnets and notice the concentration of these lines at either end of the magnets. In this way students discover the polarity of magnets.

ACTIVITY 6 Students observe the interaction of poles (like poles attract, opposite poles repel) and define their observations as the Law of Magnetic Attraction.

ACTIVITY 7 Students discover that Earth is itself a giant magnet and that it interacts with the magnets found in its magnetic field just as two bar magnets interact when placed close together.

ACTIVITY 8 Students observe the effects of Earth's magnetic force when they construct their own compasses using floating magnets that, like real compass magnets, align themselves with the magnetic poles of the planet.

ACTIVITY 9 Students experiment to see if they can magnetize an object they identified as magnetic in Activity 2. They witness temporary magnetism when they see how a nail attached to, or stroked by, a permanent magnet becomes a temporary magnet.

ACTIVITY 10 Students discover that electric current flowing through a wire creates a magnetic field around the wire that can interact with the magnetic fields of other magnets.

ACTIVITY 11 Students create an electromagnet using a simple circuit and a steel nail. They find that this temporary magnet can be shut on and off simply by connecting or disconnecting the electric circuit. They learn that this feature is what allows electromagnets to operate many household appliances.

ACTIVITY 12 Students view and discuss a video of magnets being handled in space by astronauts on the space shuttle. They observe the behavior of spherical and ring magnets in the microgravity environment of the space shuttle and compare it to what they observe in their experiments on Earth.

Schedule

Hands-on Activity	SESSION												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1 The Floating Paper Clip *page 13* •													
2 What Does a Magnet Attract? *page 19*													
3 Can the Force Go Through It? *page 25*													
4 How Strong Is the Force? *page 29*													
5 Magnetic Fields *page 35*													
6 Investigating Magnetic Poles *page 41*													
7 Earth: A Giant Magnet *page 47*													
8 Making a Compass *page 53*							•						
9 Making a Magnet *page 59*													
10 A Different Kind of Magnet *page 65*													
11 Making an Electromagnet *page 71*													
12 Magnets in Space *page 77*											•		
Assessment *page 83*													

⟶ Continuing observation or wait time required

• Advance preparation required

PREPARING FOR THE ACTIVITIES

CLASSROOM MANAGEMENT

Materials

You may want to familiarize yourself with the kit materials before beginning the module. The contents of each drawer are listed on the drawer labels. We suggest that you refer to the Materials List on page 7 of this guide as you review the materials in each drawer.

Before beginning each activity, review the Materials list and the Preparation required for the activity. The Materials list indicates which items will be used in the activity, how many of each item will be needed for each individual and each student team, and the size of each team. We recommend that you ask student helpers to assist you in locating materials and preparing for each activity.

After you have completed the unit, make a list of any items that need to be ordered for the next use. Use the Replacement Parts catalog supplied in the kit or online at www.deltaeducation.com.

Distribution Stations

The most efficient way to distribute materials during an activity is to set up distribution stations from which students can obtain materials as needed. If space in your classroom is limited, you may have room for only one station. If you have more space, we recommend setting up two or three distribution stations, each containing about half or one-third of all the materials listed in the Materials list for each activity. In this way, each distribution station will contain all of the different items used in the activity, and students will not need to visit more than one station to obtain all of their materials.

Cooperative Learning

Delta Science Modules encourage and promote cooperative learning strategies. The quantity of materials included in each kit allows small groups of students to investigate phenomena and each student to make observations and report what he or she has learned. The interaction between team members is an integral part of each activity and enhances individual outcomes.

ADVANCE PREPARATION

Activity 1: You will need to assemble the Floating Paper Clip apparatus prior to class and out of sight of students. See page 13 for instructions.

Activity 8: Check the compasses in the kit to be sure the colored end of every compass needle points north. During shipment, or when stored near other magnets, compass needles may have their poles reversed. If a compass is not accurate, use a magnet's south pole to stroke the compass needle repeatedly from the silver end toward the colored pointer.

Activity 12: You will need to arrange to have a VHS videotape player and monitor in your classroom to view a videotape.

MATERIALS MANAGEMENT

To protect the materials in this kit, store the magnets with their unlike poles together to maintain their strength. Remember—unlike poles attract, so put the magnets together so that they attract each other. Store the compasses and the videotape in the kit as far from the magnets as possible. Do not keep them in the same container. Also, magnets can damage objects such as computer disks, CDs, credit cards, and other cards with magnetic strips. Always store the magnets carefully.

ACTIVITY 4

How Strong Is the Force?

OBJECTIVES

Students investigate the strength of different magnets and then the strength at different places on each magnet. They also investigate the relationship between distance and magnetic force.

The students

- guess the strength of different magnets
- measure the strength at different places on each magnet
- discover that magnetic force increases as the distance between a magnetic object and a magnet decreases

SCHEDULE

About 45 minutes

MATERIALS

For each student

1	Activity Sheet 3, Parts A and B

For each team of two

2	dots
1	magnet, rod
1	magnet, small
25	paper clips

PREPARATION

1. Make a copy of Activity Sheet 3, Parts A and B, for each student.
2. Each group of two students will need a rod magnet, a small magnet, two dots, and twenty-five paper clips.

BACKGROUND INFORMATION

The strength of a magnet can be measured by how many paper clips it can pick up. This same method can be used to compare the relative strength of two or more magnets as well as the relative strength of different parts of the same magnet.

During this activity, students explore two laws of magnetic attraction: (1) The force of a magnet is strongest at its ends. (2) Magnetic force increases as the distance between a magnetic object and the magnet decreases.

▼ **Activity Sheet 3, Part A**

How Strong Is the Force?

Magnet	Guess	Number of paper clips lifted			
		Trial 1	Trial 2	Trial 3	Average
rod magnet, dotted end		Answers will vary.			
rod magnet, undotted end					
small magnet, dotted end					
small magnet, undotted end					

1. Which end (dotted or undotted) of the rod magnet is stronger? same
2. Which end (dotted or undotted) of the small magnet is stronger? same
3. Which magnet is stronger? the rod magnet

▼ **Activity Sheet 3, Part B**

How Strong Is the Force?

Magnet	Guess	Number of paper clips lifted			
		Trial 1	Trial 2	Trial 3	Average
rod magnet, middle		Answers will vary.			
small magnet, middle					

4. Did the ends or the middle hold more paper clips? the ends

Guiding the Activity

1 Begin a discussion by reminding students of the tests they conducted in Activities 2 and 3 to determine which objects the magnet did and did not attract, and which objects did and did not block the magnetic force. Then hold up a rod magnet and a small magnet and ask, **How strong do you think these magnets are?**

2 Ask, **Is there a way to measure the strength of our magnets?**

Suggest that the students use their magnets to pick up several paper clips and to see how many clips their magnets can lift.

Additional Information

Answers will vary.

Students may suggest several methods. Acknowledge all student responses and, if possible, test one of the students' methods in addition to the paper clip method described below.

Guiding the Activity

Additional Information

3 Divide the students into teams of two. Distribute copies of **Activity Sheet 3, Parts A and B,** to each student**.** Distribute a rod magnet, a small magnet, and two dots to each team. Ask students to put a colored dot on one end of each magnet. Then ask students to guess how many paper clips they think each end of each magnet can lift.

Have them record their guesses in the chart on Part A of their activity sheets.

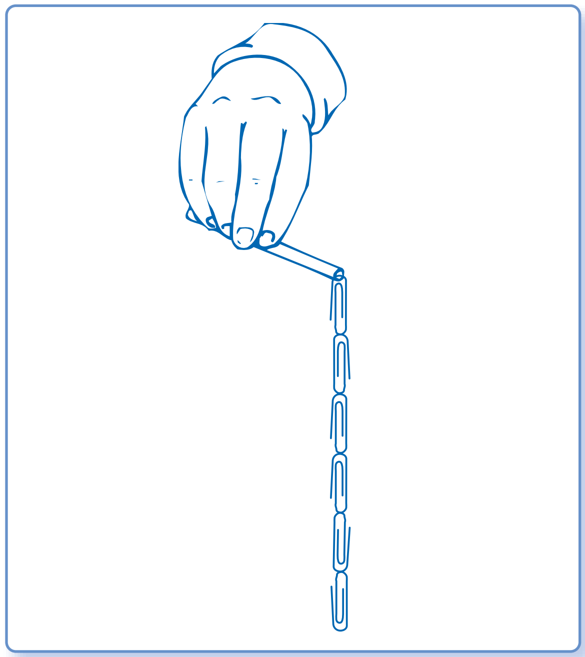
4 Distribute twenty-five paper clips to each team. Have them pick up one by one, end to end, as many paper clips as possible by the dotted end of the rod magnet. Have them repeat this step three times and record their results on Activity Sheet 3, Part A.

Help students to average their results by adding the number of paper clips picked up in each trial and dividing by the number of trials (three).

Tell the students to repeat the procedure using the undotted end of the rod magnet. Remind them to record their results.

After students have recorded the results for the rod magnet, ask them to repeat the procedure with the small magnet.

Check to make sure that students are not "linking" the paper clips but rather allowing magnetism to hold the clips end to end, as shown in Figure 4-1.



▲ ***Figure 4-1.*** *Lifting paper clips.*

5 When students have calculated the average number of paper clips held by each end of each magnet, ask, **Which magnet is stronger? How do you know?**

Students should say that the rod magnet is stronger because it can lift more paper clips.

Ask, **Are both ends of each magnet equally strong?**

Yes. In addition, those students who have been playing with their magnets may have already discovered that the ends of a magnet are stronger than the middle. Others, however, may be unsure or unaware of this.

Guiding the Activity

Additional Information

	Guiding the Activity	Additional Information
6	Encourage the students to think of methods for testing the strength of the middle of a magnet. Use the methods they think of in addition to finding out how many paper clips the magnet can hold at its middle. Ask, **How many paper clips do you think each magnet can hold at the middle?** Have students write their predictions on Activity Sheet 3, Part B.	
7	After students have made their predictions, tell them to begin picking up paper clips using the middle of each magnet. Remind them to write down their results, to repeat the procedure three times, and to find the average number of paper clips held at the middle of each magnet.	
8	Ask, **How did the number of paper clips held at the ends of the magnet compare with the number of clips held at the middle?**	*Students will discover that either end of a magnet will hold more paper clips than the middle of that same magnet.*
9	Now have one member in each team place a paper clip in the palm of one hand and hold the small magnet between the thumb and index finger of the other hand. Have him or her slowly move the magnet toward the paper clip until the clip begins to react to the magnet. Have the second team member perform the same procedure. Then ask, **What happens to the magnetic force as the distance between the magnet and the paper clip decreases?**	*The magnetic force felt by the paper clip increases as the distance decreases.*
10	Begin a discussion by asking, **What can you hypothesize about magnets based on the results of these activities?**	*(1) Magnetic force is strongest at the ends of a magnet. (2) Magnetic force increases as the distance between a magnetic object and the magnet decreases.*

REINFORCEMENT

Ask, **Which part of which magnet do you think would enable you to pick up a paper clip from farthest away?** Students should be able to apply what they have discovered in this activity—that the rod magnet is stronger than the small magnet, and that the ends of a magnet are stronger than its middle.

Assessment Opportunity

This Reinforcement also may be used as an ongoing assessment of students' understanding of science concepts and skills.

SCIENCE JOURNALS

Have students place their completed activity sheets in their science journals.

CLEANUP

Students will enjoy using their magnets to gather up the loose paper clips. Tell them to return the clips to the boxes. Remove the dots from the magnets and return all materials to the kit.

SCIENCE AT HOME

Have students examine various magnets found in the home. Are they all the same strength? Compare the magnets holding the refrigerator door closed with the magnets used to hold notes or photographs to the front of the refrigerator door. Ask students to test how far they have to shut the refrigerator door before it closes automatically. How close must a magnet be held to the refrigerator door before it is attracted to the door?

Connections

Science Extension

Provide magnets of different shapes—horseshoe magnets, U magnets, square or round magnets with the poles on the flat sides, and so forth. Have students test these magnets as described on the activity sheet. Do these magnets have stronger and weaker areas? If so, where on each magnet are those areas located?

Have students test a horseshoe magnet to find out how many iron nails can be picked up with each end of the magnet separately and how many can be picked up with both ends together. Make sure that the nails are long enough to extend across both ends of the magnet. Students will discover that more nails can be picked up with both ends together than with either end separately.

To demonstrate the greater strength of a horseshoe magnet, have students extend their arms straight out from their sides and imagine that they are a bar magnet. Tell them to try to lift a chair with one extended hand (representing one end of the magnet). Then tell them to extend their arms straight out in front of them with their hands about 0.5 m (18 in.) apart to represent a horseshoe magnet, and again try to lift the chair. Which "magnet" lifted the chair more easily?

Science and Math

Encourage students to use a dictionary or encyclopedia to find out the difference between the mean (the average), the median (the middle number in a series of numbers arranged from highest to lowest), and the mode (the most frequent number in a series). Use the data from their investigations with the magnet and paper clips to demonstrate the difference between the mean, the median, and the mode.

Science and Language Arts

Ask each student to choose one magnet that he or she identified in Science at Home in this activity or in an earlier activity and to write one or two paragraphs describing how the magnet is used. Encourage students to examine the magnet closely and to include details in their description—for example, the shape of the magnet, whether its side or an end is in contact with metal, what type of anchoring device is used, and so forth. Have students share their descriptions in class, and encourage other students to ask questions about any details that may have been omitted.

Science and Social Studies

Explain that scientists measure force, including magnetic force, in units called *newtons*. Suggest that students use an encyclopedia to find out how the newton got its name.

Science, Technology, and Society

A magnetometer is an instrument used to measure the strength of a magnetic field. Magnetometers of various types are used in medicine to detect brain abnormalities, in industries such as the manufacture of superconductors, and by field geologists to detect oil or mineral deposits. Magnetometers also help geologists learn more about rock formations below the Earth's surface. Encourage students to find out more about how magnetometers work and who uses them.