UNIT OVERVIEW

Magnets have the ability to pull on, or attract, certain metals because they exert a force called *magnetism.* This invisible force is caused by the electrons in a magnet lining up in a north-south pattern. The Magnets unit helps students discover what magnets are and how they work. Students will learn that magnets come in many shapes and sizes, and that they have two poles. These poles either attract or repel the poles of other magnets. Magnetic lines of force flow out from the north pole of a magnet and back in through the south pole. These lines of force form a powerful magnetic field around the magnet. Students will also learn that magnetism and electricity are related. Magnets are used for many purposes, including generating electricity, running motors, moving large trains, lifting scrap metal, and scanning the human body for illness. Magnets can also be found in common items, such as toys, games, doors, cabinets, and appliances.

Certain reading resources are provided at three reading levels within the unit to support differentiated instruction. Other resources are provided as a set, with different titles offered at each reading level. Dots on student resources indicate the reading level as follows:

- • low reading level
- : middle reading level
- ⋮ high reading level

THE BIG IDEA

Without magnets, our lives would be quite different. Magnets help generate electricity, are used in motors, and can be found in a variety of common items. Magnets are used in medicine, industry, transportation, and other important fields. Magnets behave in predictable ways, which makes them reliable and valuable tools.

Other topics

This unit also addresses topics such as: large magnets can be very strong and useful, Earth acts as an enormous magnet, magnets can work without touching the objects they attract, and magnetism can be transferred.

SPARK

The spark is designed to get students thinking about the unit's topics and to generate curiosity and discussion.

Materials

- 1 small magnet
- piece of thin cardboard (a file folder cut in half works well)
- assortment of magnetic and nonmagnetic items (for example, coins, paper clips, yarn, aluminum foil, toothpicks, paper, scissors, metal washers)

Activity

Begin with a "magic" demonstration. Hold a magnet behind a piece of thin cardboard so students can't see it. Make a paper clip cling to the side of the cardboard opposite the magnet and in view of the students. Show everyone that the paper clip doesn't fall off, even if you shake the cardboard! Ask students what might be holding the paper clip in place. After several guesses, begin to move the magnet so the paper clip moves, too. Ask students what they think is making the paper clip move.

Explain that a magnet is holding the paper clip in place, and show students the magnet. Explain that magnets can hold onto certain things, even through a sheet of cardboard.

Now allow pairs of students to try the "magic" themselves. Let them explore fun ways of moving the paper clip without touching it. For example, they might tilt the cardboard like a ramp and make the paper clip stop sliding down it by placing the magnet on the other side. After using the magnet and paper clip, have two pairs of students share their magnets and try using one magnet to move another through the cardboard. Also encourage them to find out whether the magnet can move any of the other objects, either with or without the cardboard barrier.

Below are questions to spark discussion.

What makes the paper clip stick to the magnet, even through the cardboard?

What happened when you tried moving one magnet with another magnet? How was it different from trying to move the paper clip?

Which other object was most attracted to the magnet?

Why didn't some of the objects stick to the magnet?

Use this activity to begin an introductory discussion about magnets and magnetism. Explain that *magnetism* is a natural force that can move certain metal objects, sometimes without even touching them. Only certain things are *magnetic,* which means a magnet will pull them. Throughout the unit, students will learn more about magnets.

Many of the unit's vocabulary terms are related to the spark activity and can be introduced during the spark. For vocabulary work, see the Vocabulary section in this *Unit Guide*.

PRIOR KNOWLEDGE

Invite students to explain their understanding of magnets and their experiences with magnets.

Probing Questions to Think About

Use the following questions to have students begin thinking of what they know about magnets.

- How do you use magnets at home? In school?
- What are some things that magnets pull on?
- What are some things that magnets do not pull on?
- How do two magnets behave when they are near each other?
- How do you think magnets can move objects without touching them?
- How are magnets related to electricity?
- What is the strongest magnet you have ever seen? What was it used for?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

Each unit provides a wide variety of resources related to the unit topic. Students may read books and other passages, work in groups to complete hands-on experiments and investigations, discuss science ideas as a class, watch videos, complete writing tasks, and take assessments.

Resources are available for printing or projecting, and many student resources are also available for students to access digitally on **Kids A–Z**.

Selected unit resources are available in more than one language.

For a complete list of materials provided with the unit, see the Magnets unit page on the Science A–Z website.

VOCABULARY

Use the terms below for vocabulary development throughout the unit. They can be found in boldface in the *Nonfiction Book*, the *Quick Reads*, and/or other unit resources. These terms and definitions are available on *Vocabulary Cards* for student practice. Additional vocabulary lists are provided in the teaching tips for *Investigation Packs* and *FOCUS Books*.

Core Science Terms

These terms are crucial to understanding the unit.

attract	to pull something closer
electricity	a form of energy made when tiny parts move around in an atom; energy that can power many devices
force	a push or a pull
iron	a strong, hard, silver-gray metal
lines of force	invisible lines of magnetic force that flow through and around a magnet

magnet	a piece of metal that attracts other pieces of metal
magnetic field	an area around a magnet where magnetic force can be felt
magnetism	a force that pushes and pulls certain metals
metal	a material, usually hard and shiny, that lets electricity and heat move through it
poles	two opposite parts of something, such as the two ends of a magnet
repel	to push something away

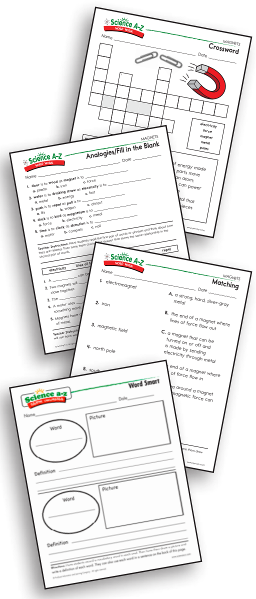
Other Key Science Terms

The following vocabulary is not essential for comprehending the unit but may enrich students' vocabulary.

compass	a tool with a needle that always points north, used for showing direction
core	the center of something, such as Earth or a piece of fruit
electromagnet	a magnet that can be turned on or off and is made by sending electricity through metal
electrons	tiny parts that move around in an atom and can make electricity
lift	to move something to a higher level
motor	a machine that uses electricity to make something move or work
MRI machine	a device that uses a magnetic field to make computer images of the inside of a person; magnetic resonance imaging machine
nail	a pin-shaped piece of metal used to hold materials together
north pole	the end of a magnet where lines of force flow out
pull	to use force to move something closer
push	to use force to move something away
south pole	the end of a magnet where lines of force flow in
spin	to move in circles

Vocabulary Activities

You may choose to introduce all the terms that will be encountered in the unit before assigning any of the reading components. *Vocabulary Cards* with the key science terms and definitions are provided. Dots on the cards indicate the reading levels of the *Nonfiction Book* or the *Quick Reads* in which each term can be found. If all level dots appear, the term may come from another resource in the unit. Students can use these cards to review and practice the terms in small groups or pairs. The cards can also be used for center activity games such as Concentration.



The *Word Work* activity sheets offer fun puzzles and practice with key vocabulary terms from the unit. For further vocabulary practice and reinforcement, you can choose from the vocabulary *Graphic Organizers*. To build customized vocabulary lessons with terms related to the topic, see **Vocabulary A-Z**.

Students can use the *Word Smart* vocabulary *Graphic Organizer* to organize information on the science terms. You may want to assign each student one to three words to share his or her *Word Smart* knowledge with classmates. Students who have the same word should first compare their *Word Smart* sheets with each other and then report to the larger group.

The science terms can be used in oral practice. Have students use each term in a spoken sentence.

As students read, encourage them to create a science dictionary by recording new vocabulary terms and definitions in their *SAZ Journal*.

BACKGROUND AND MISCONCEPTIONS

Use this section as a resource for more background knowledge on unit content and to clarify the content for students if misconceptions arise. Refer to Using the Internet below for more ways to extend the learning.

Q: *Do magnets attract all metals?*

A: No. Only certain metals are attracted to magnets; these include iron, cobalt, and nickel. Combinations of metals, called *alloys*, that contain these metals may also be magnetic. Other metals, such as aluminum, copper, silver, and gold, are not magnetic. Most coins, for example, are made of nonmagnetic metals.

Q: *Are bigger magnets stronger than smaller ones?*

A: Generally yes, but not always. A larger magnet made from the same material and shaped in the same way as a smaller one will be stronger. But magnets made of different materials have differing degrees of magnetic force. For example, "super magnets" are made from neodymium, boron, and iron. A smaller super magnet has a stronger pull than a much larger common magnet. Additionally, an electromagnet may be stronger than a regular magnet of similar size.

Q: *Can anything other than metal be turned into a magnet?*

A: Yes. While magnets made of metal are by far the most common, the electrons in certain other materials can be rearranged to make them magnetic. Examples include plastic, rubber, and ceramic magnets. However, it takes special circumstances for nonmetallic items to be magnetized, so these types of magnets are unlikely to occur in everyday life.

Q: *Are the poles of magnets named after Earth's North and South Poles?*

A: No. In each case, the north and south ends are called *poles* because that term refers to two points at opposite ends of an object. But Earth and magnets do have something in common. Earth has a huge magnetic field with a north and a south pole, just as any magnet does.

Q: *What is the difference between Earth's two kinds of north poles? Which one does a compass needle point to?*

A: The geographical poles represent the ends of the vertical axis around which the planet rotates. The magnetic poles are the ends of the vertical axis through Earth's magnetic field. Earth's geographical poles do not change much, but its magnetic poles are constantly on the move. (In fact, Earth's so-called North Pole is currently a south magnetic pole, based on the flow of the magnetic lines of force.) Over many years, the magnetic poles can migrate and have even been known to switch places. Scientists determine their historical locations based on geological research into the alignment of electrons in magnetic rocks.

To accurately use a compass, it is important to account for the difference between the present location of magnetic north and Earth's geographical North Pole. While a compass always points to magnetic north, people are likely more interested in knowing which way true (geographical) north is, in order to set a course on a map or toward a known destination. (Earth's migrating magnetic poles have been known to cause problems for airports. Runways have had to be relabeled because pilots rely on Earth's magnetic field to navigate in the proper direction during landings.)

Q: *Is a magnetic field really just a group of lines? Could a magnetic item "dodge" the magnetic force if it were placed between some of those lines?*

A: While magnetic fields are often shown in diagrams as being made up of lines, they actually encompass a continuous area surrounding a magnet. When iron filings position themselves in lines around a magnet, we see how the magnetic field affects the filings. It turns each filing into a tiny magnet, and since magnets are attracted to opposite poles and can repel one another, the filings line up. But the actual magnetic field is just that—a field. The term *lines of force* helps describe the field and the direction of force.

Q: *Are electricity and magnetism the same thing?*

A: No, but the two are related. Magnetism and electricity are fundamentally two manifestations of the same force—electromagnetism. But in practice, they behave differently. Magnetism is a force that can help generate electricity. When magnets spin around wires, they cause charged particles to flow through the wires. This process generates an electric current. Other wires carry the current to homes and businesses. Meanwhile, electricity can also create magnetic fields. If you wrap a wire around a piece of metal and pass an electric current through it, a magnetic field forms. If you turn off the electricity, the field disappears. While electricity and magnetism work together and are aspects of the same force, they are not the same.

Q: *Doesn't* attract *mean something else?*

A: We do sometimes say that one person *attracts* another, meaning that someone thinks the person has good looks and/or a good personality. This context is similar to saying that a magnet attracts certain objects because, in both cases, one thing or person draws other things or people closer to it. Interestingly—like magnets—people can also *repel* (or be *repulsed* by) each other. We sometimes even say that a person has a *magnetic* personality, meaning that others want to be near or befriend him or her. These terms are used in other similar contexts as well. Sugary foods can attract ants. Armies can repel an enemy. However, in this unit, *attract* and *repel* refer solely to magnetism as a physical force.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when the term *magnet* or *magnetism* is entered. You can also search for information on a specific use of magnets or a certain type of magnet. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- What is magnetism?
- magnetic metals
- magnetic north pole
- magnet arts and crafts
- magnetic field
- Is a(n) ______ magnetic?
- magnets in toys
- electromagnets

Projects and Activities

- **Project:** Students can use the magnets and cardboard from the spark activity to make a magnetic puzzle or game. For example, they might draw a bird's-eye view of roads through a town on the cardboard. They can draw a small car on another piece of cardboard, cut it out, and glue it to a magnet or a piece of magnetic metal. Then they can use another magnet on the underside of the cardboard to move the car through the course.
- **Arts:** Let students use magnets to paint pictures. Working in pairs, have one student hold a piece of thin cardboard still while the other operates the magnet. They should put a small amount of paint (tempera or other thin paint) on the surface of the cardboard and place a screw, washer, paper clip, or other small magnetic object in the paint. The painter uses a magnet beneath the cardboard to move the object and create designs. Encourage students to experiment with shapes and colors.
- **Field Trip:** Tour a power plant to see electric generators—and the magnets that get the current flowing—in action.
- **Guest:** Invite an electrician or someone who repairs appliances to explain how magnets are used to generate electricity inside motors, using tangible models.
- **Physical Education:** Get students moving in a game based on the way magnets behave. Select two students to jog toward each other in an open space. Before they reach each other, call out "north and south," "north and north," or "south and south." If you call out opposite poles (north and south), students should run together and join hands. If you call out the same two poles (north and north or south and south), students should veer away from each other. You might also use chalk to sketch a magnet and its lines of force on a basketball court, and then hold relay races along those lines.
- **Home Connection:** Ask students to take an inventory of magnets in their home. Appliances with motors include hair dryers, blenders, mixers, refrigerators, and clocks. Cars, lawn mowers, and power tools also contain magnets. Electronics such as computers, MP3 players, headphones, and speakers do, too. Don't forget the refrigerator magnets. Students may be surprised at how many magnets are in their homes.

- **Literature:** Good books for kids about magnets include *What Makes a Magnet?* by Franklyn M. Branley and *What Magnets Can Do* by Allan Fowler.
- **Writing:** What would it be like to be able to use your body as a magnet? Have students write a pro-con composition about what it might be like to possess this ability. See Writing A–Z for extensive writing instruction.
- **Research/Home Connection:** Students can conduct research as a family/home project or in the library/media center to extend the learning about a topic in one of the *Quick Reads* or other unit resources.