Basic Level

Physical Science

Electricity and Magnetism

Electromagnetic Energy

LOOK INSIDE FOR:

- Core Curriculum Covered
- Student Book
- Assessments and Reading Activities

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Electromagnetic Energy

What are the properties of electricity and magnetism?

CORE CURRICULUM STATEMENTS

Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

Objects have properties that can be observed, described, and/or measured: length, width, volume, size, shape, mass or weight, temperature, texture, flexibility, reflectiveness of light.

The material(s) an object is made up of determine some specific properties of the object (sink/float, conductivity, magnetism).

Properties can be observed or measured with tools such as hand lenses, metric rulers, thermometers, balances, magnets, circuit testers, and graduated cylinders.

Objects and/or materials can be sorted or classified according to their properties.

Energy exists in many forms, and when these forms change energy is conserved.

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.

Interactions with forms of energy can be either helpful or harmful.

Energy and matter interact through forces that result in changes in motion.

Magnetism is a force that may attract or repel certain materials.

The forces of gravity and magnetism can affect objects through gases, liquids, and solids.

The force of magnetism on objects decreases as distance increases.

FOCUS ON SCIENCE

Basic Level

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Student Book

Electromagnetic Energy

Print pages 5–18 of this PDF for the student book.

BL

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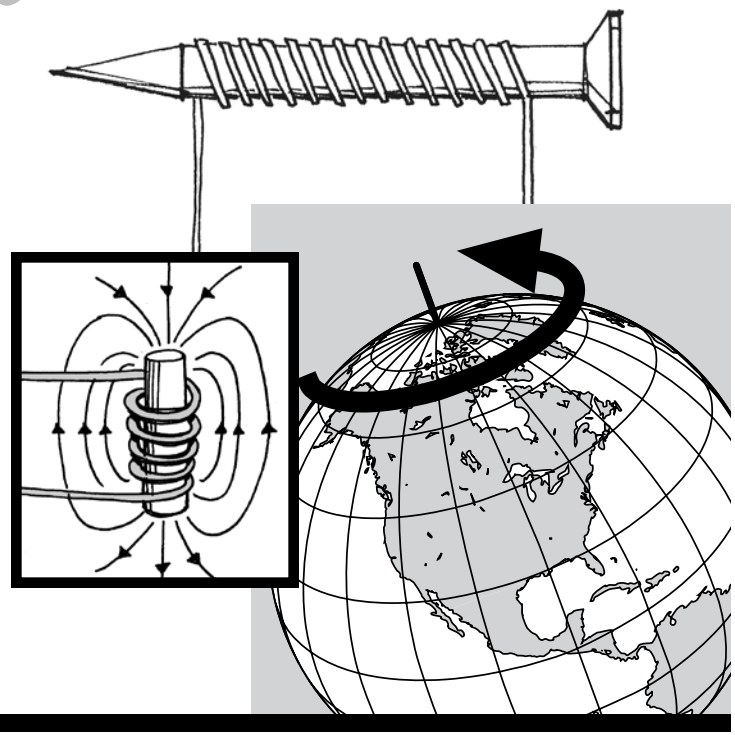
Physical Science

Electricity and Magnetism

Electromagnetic Energy

by Ken Sibila



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Curriculum materials for **your** content standards

Table of Contents

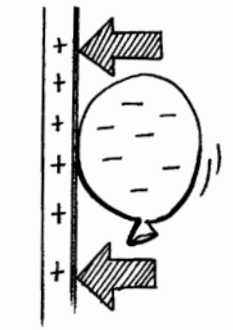
INTRODUCTION

Electrical Charges

Everything in the world is made up of tiny particles. Some particles have an electrical charge. Some charges are positive and some are negative. Positive charges **attract**, or pull toward, negative charges.

For example, when you rub a balloon against your hair, the tiny particles move. The balloon picks up negative particles and gets a negative charge. The negative particles in the balloon attract positive particles in the wall. This causes the balloon to stick to the wall.

Positive charges and negative charges are opposite. Opposite charges attract!

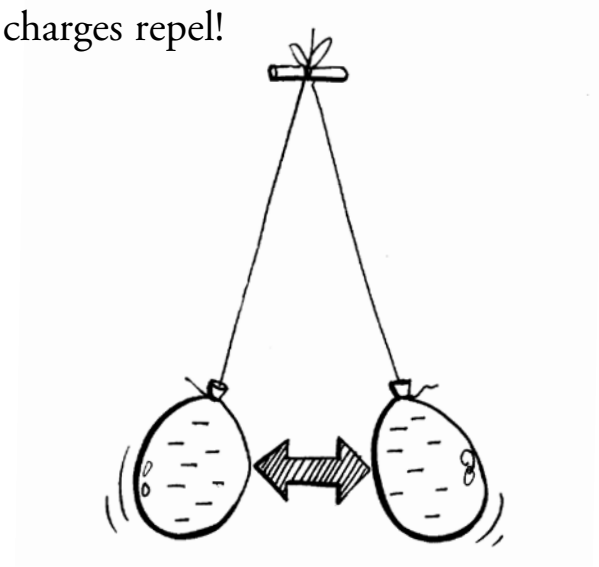


attract: to make something come closer

Objects with a negative charge **repel**, or move away from, other objects with a negative charge.

Tie strings to two balloons. Rub each balloon on your hair. Both balloons get a negative charge. Then hold them close together by the strings. The balloons move apart. They repel each other because both charges are negative.

Negative charges repel each other. Positive charges repel each other too. Similar charges repel!



repel: to make something move away

CHAPTER 1

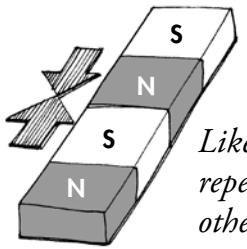
Magnets

Magnets are objects that attract certain metals. Magnets also have electrical charges. They attract and repel.

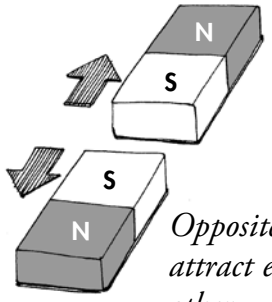
Magnets have two ends. These ends of a magnet are called poles. One end is the north pole (N). The other end is the south pole (S).

Put opposite poles of two magnets close together. They will pull each other together. Opposite poles attract!

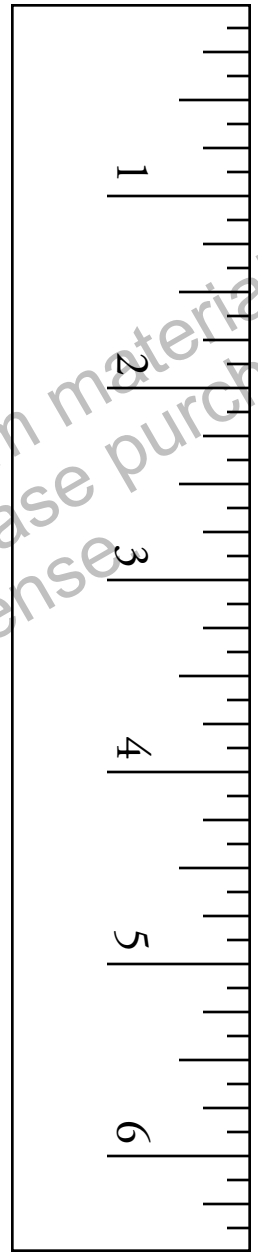
Put poles that are the same close together. They will repel each other. Like poles repel!



Like poles repel each other.

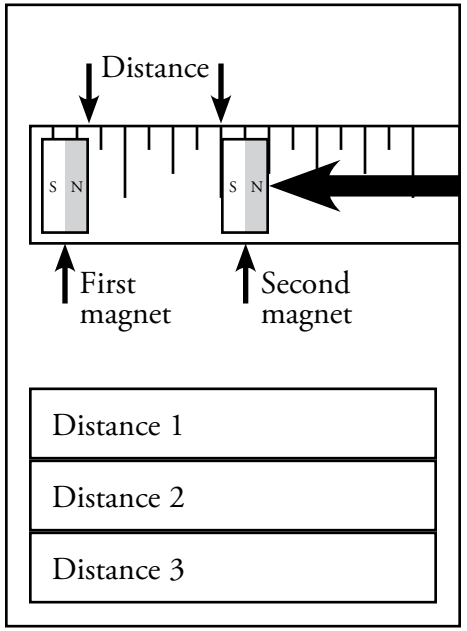


Opposite poles attract each other.



Try it Yourself!

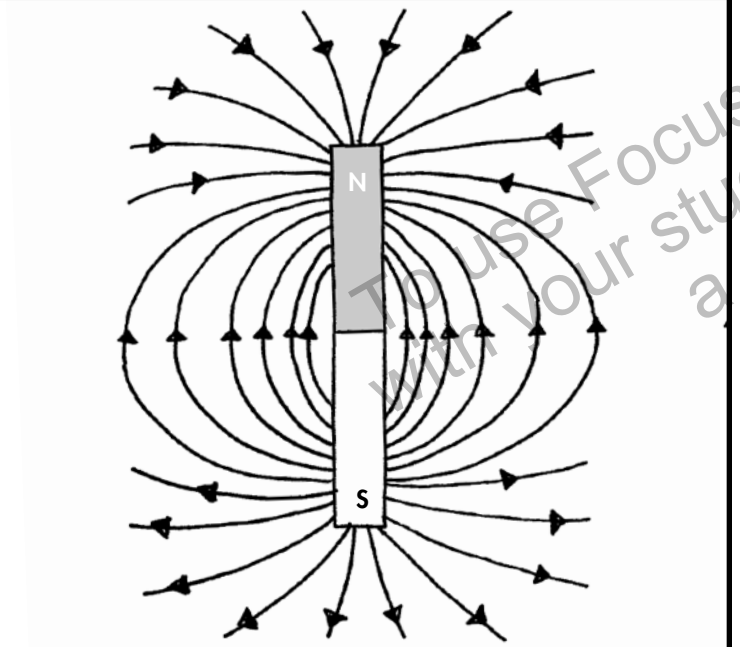
Gather different sizes and shapes of magnets. Place one magnet at the end of this ruler. Place the other magnet a few inches away. Slide the magnet toward the other magnet at the end of the ruler. Record what happens in a journal.



Magnetic Fields

A magnet has forces that push and pull. The forces surround the magnet with a magnetic field. The force of the magnetic is strongest at the north and the south pole of the magnet.

Magnetic Field of a Magnet

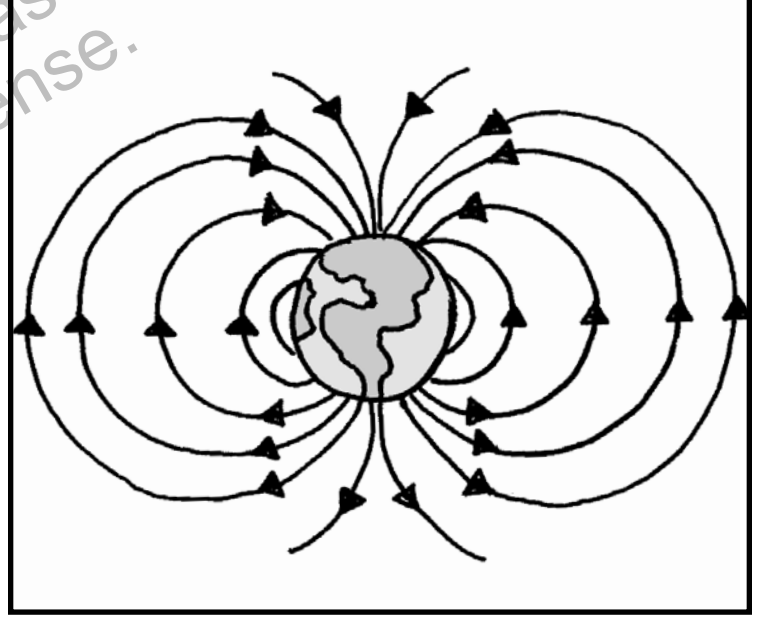


–Recall–
Where is the magnetic field the strongest?

Earth Is a Magnet

Earth is a giant magnet. It also has a magnetic field around it. Like a magnet, the Earth has a north pole and a south pole. The Earth's magnetic field is strongest at the north and south magnetic poles.

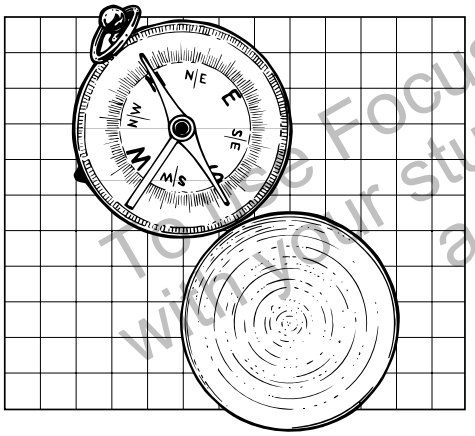
Magnetic Field of Earth



How a Compass Works

A compass is a simple **device** that can keep people from getting lost. A compass has a magnet called the needle. No matter which way you turn the compass, one end of the needle always point towards the north. The other end always points toward the south.

A compass has a magnet. The tip of one end of the magnet is attracted to Earth's north pole.



device: something made or invented for a special use

Try It Yourself!

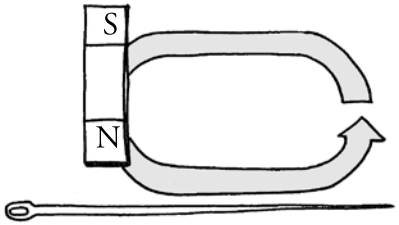
You can make your own compass. To create one, you will need the following:

Materials

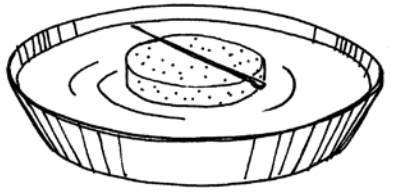
- craft needle
- magnet
- cork or sponge
- bowl filled with water

Procedure

1. Rub the magnet in the same direction along the needle 25 times.



2. Place the cork or sponge in the bowl. Rest the needle on top.

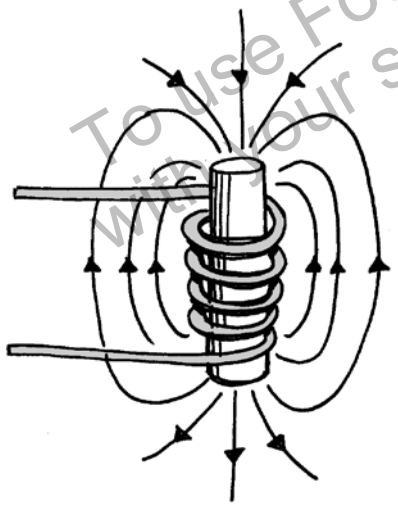


3. In which direction does the needle on your compass point?

Electricity Creates Magnetic Fields

When an electric current flows through a wire, the wire has its own weak magnetic field. This magnetic field can be made stronger if the wire is coiled around an iron bar. This creates a **temporary** magnet called an electromagnet.

The electromagnet only has a magnetic field when the electricity flows. If the current is switched off, the electromagnet loses its magnetic field. It is no longer a magnet.



Electricity flows through the electromagnet. It then has a magnetic field.

temporary: lasting only for a short time

Hans Christian Oersted

Hans Christian Oersted was a teacher in Denmark. One day in 1819, he set up two **demonstrations**. First, he was going to show how an electric current heats a wire. Then he was going to show magnetism using a compass.

While Oersted was showing how electricity heats a wire, he looked at the compass. He noticed that when the electric current was switched on, the nearby compass needle moved.

He discovered that an electric current flowing through a wire could move the needle of a compass. His discovery showed the connection between electricity and magnetism.

demonstration: showing how something works

Try It Yourself!

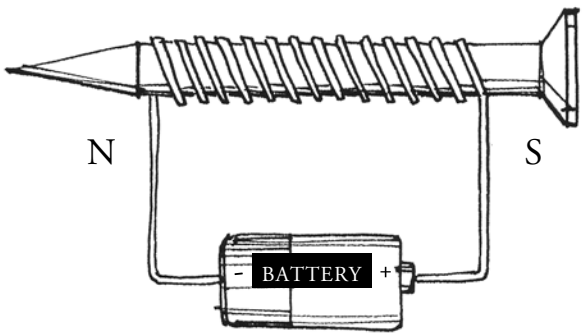
You can make your own electromagnet.

Materials

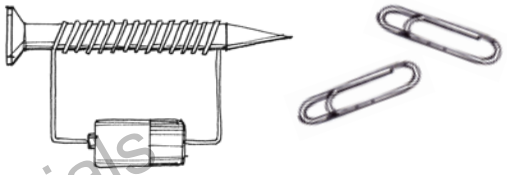
- copper wire with insulation
- 8d iron nail
- D battery
- tape
- small metal items such as paper clips, and staples
- compass

Procedure

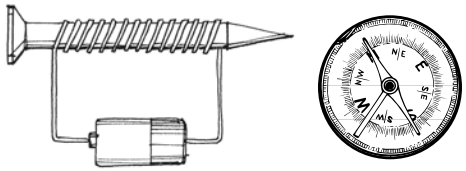
1. Ask an adult to strip the insulation off both ends of the copper wire.
2. Carefully wrap, or coil, the copper wire around the nail ten or more times.
3. Attach one end of the wire to the negative (–) side of the battery with tape. Attach the other end to the positive side (+).



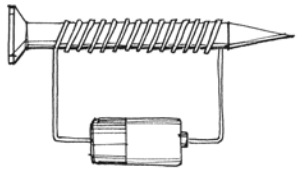
4. Place the nail close to the small metal objects. Record what happens.



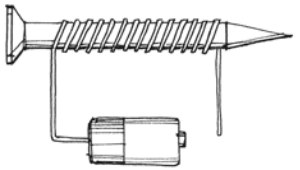
5. Place the compass close to the nail. Move the compass around the nail. Record your findings.



6. Reverse the wires on the battery. Repeat steps 3, 4 and 5. Record your findings.



7. Disconnect one wire from the battery and repeat steps 4 and 5. Record your findings.



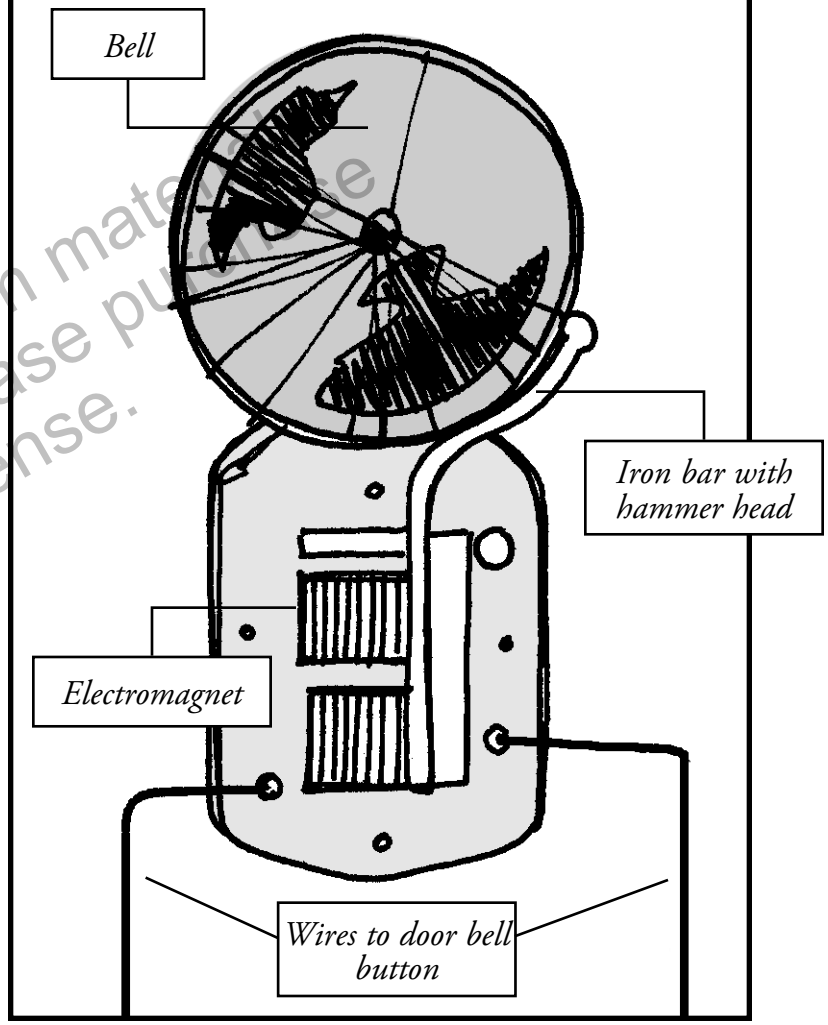
CHAPTER 2

Electromagnets in Use

Electromagnets are all around us. The bell on a classroom wall can use an electromagnet. Look at the picture to see how it works.

First, someone pushes a button connected to the bell. This sends an electric current to the electromagnet in the bell. Now the electromagnet has a magnetic field. An iron bar with a hammer head is attracted to the magnetic field. This causes the hammer head to strike the bell.

Diagram of a Classroom Bell

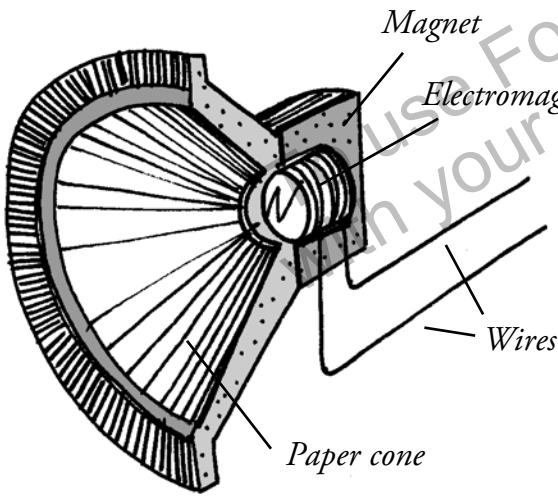


Brainstorm a list of things you use or have seen that have an electromagnet.

The speaker in your classroom is also an electromagnet. Look at the picture below. The speaker has a paper cone, a magnet, and an electromagnet.

Magnetic forces between the electromagnet and the magnet push or pull on the paper cone. The movement of the cone forms sound waves.

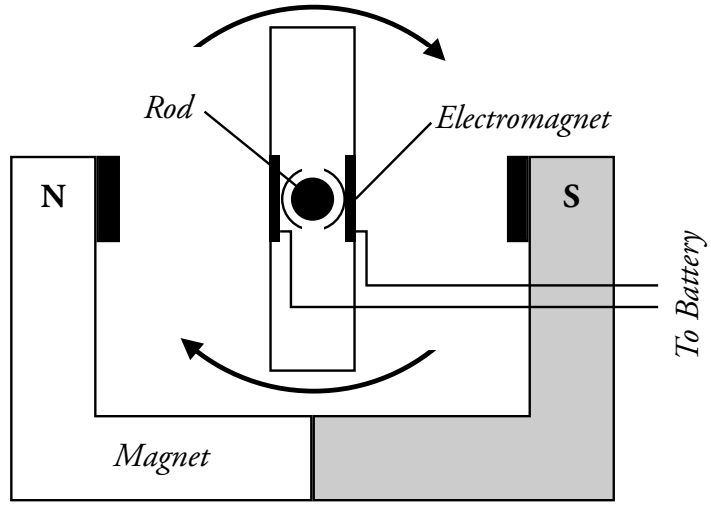
Diagram of a Speaker



The electromagnet in a speaker helps convert electrical energy into sound energy.

A motor uses an electromagnet. The electromagnet is surrounded by a magnet. The electromagnet is connected to a rod. The rod allows the electromagnet to spin. When an electric current passes through, the magnetic force causes the electromagnet to spin.

Diagram of an Electric Motor



Try It Yourself!

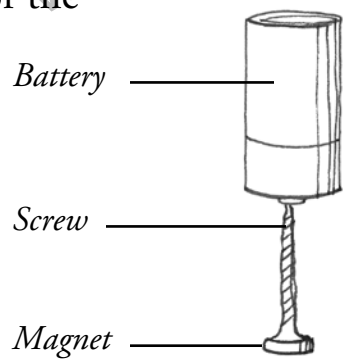
You can make your own electric motor.

Materials

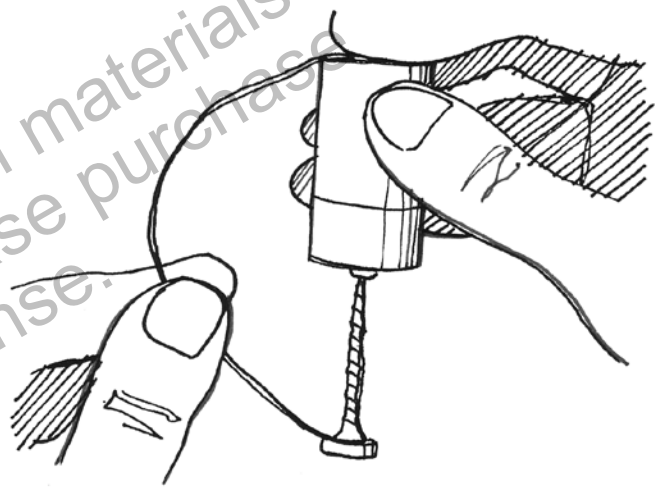
- safety glasses
- 6 inches of copper wire
- 1.5 V battery
- small neodymium disk magnet
- iron screw with flat head such as a drywall screw

Procedure

1. Have an adult strip the insulation off both ends of the wire.
2. Attach the magnet to the flat head of the screw.
3. Hold the battery as shown and place the tip of the screw to the button end of the battery.



4. Press and hold one end of the wire to the top of the battery.
5. Lightly touch the other end of the wire to the side of the magnet.



Caution

Be sure you and anyone nearby is wearing safety glasses.

6. Record your findings and explain what you observed.

Glossary

attract—to make something come closer

device—something made or invented for a special use

demonstration—showing how something works

repel—to make something move away

temporary—lasting only for a short time

To Find Out More . . .

Want to learn more about electromagnetic energy?

Try these books

Electricity and Magnetism (Usborne Understanding Science) by Peter Adamczyk. Usborne Books, 2008.

Awesome Experiments in Electricity & Magnetism by Michael A. DiSpezio. Sterling, 2006.

The Science of Electricity & Magnetism: Projects and Experiments With Electricity And Magnets (Tabletop Scientist) by Steve Parker. Heinemann, 2005.

Access these Web sites

Creative Kids at Home
http://www.creativekidsathome.com/science/magnet.html

Energy Kid's Page
http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html

The NASA Sci Files
http://scifiles.larc.nasa.gov/text/kids/D_ Lab/acts_electric.html

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Published by FOCUScurriculum

866-315-7880

www.focuscurriculum.com

Order Number: PS-32BL

Created by Kent Publishing Services, Inc.

Designed by Signature Design Group, Inc.

Basic Level

Physical Science

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Assessments

Electromagnetic Energy

Print pages 20–22 of this PDF for the reading activities.

Electromagnetic Energy

Check Understanding

Shade the circle next to the correct answer.

1. If an object is attracted to a magnet, the object is most likely made of

Ⓐ plastic

Ⓑ wood

Ⓒ rubber

Ⓓ metal

2. Which sense can be used to determine an objects ability to repel?

Ⓐ hearing

Ⓑ smell

Ⓒ sight

Ⓓ taste

3. An electromagnet creates a magnetic field when

Ⓐ electricity is flowing through it

Ⓑ electricity stops flowing through it

Ⓒ a wire is coiled around an iron nail

Ⓓ a battery is disconnected from it

4. An example of an electromagnet used in everyday life is

Ⓐ a bar magnet

Ⓑ a compass

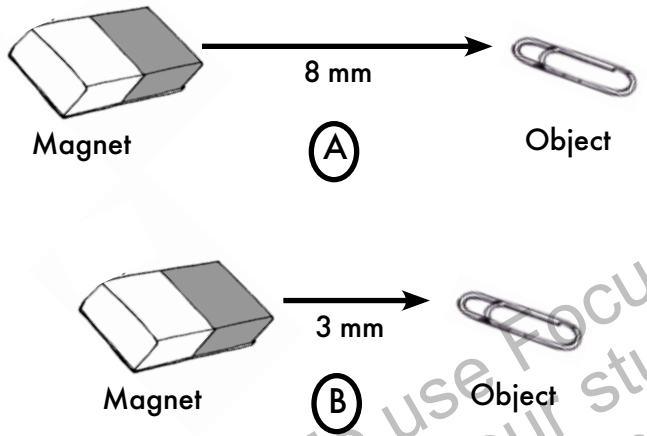
Ⓒ an electric motor

Ⓓ a refrigerator

Check Understanding

Write your answer on the lines provided.

5. Diagrams A and B below show the same magnet attracting the same object from two different distances.



Explain why the magnet attracts the object with less force in diagram A than in diagram B.

_____

_____

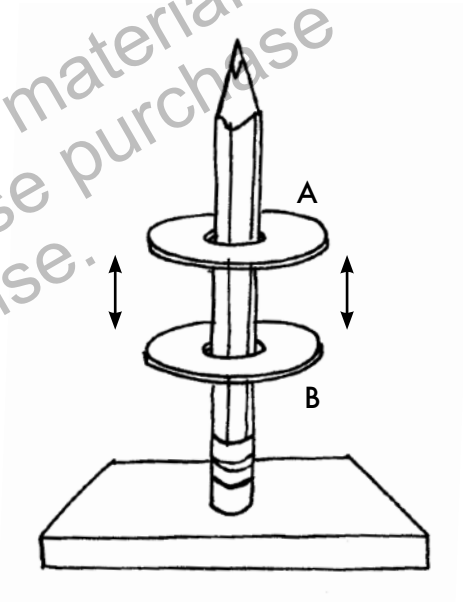
_____

_____

_____

Note that question 6 has only three choices.

6. A student put two rings magnets on a pencil as shown in the diagram below. Magnet A repelled magnet B.



Why did the magnets repel each other?

Ⓐ The north pole of magnet A was facing the north pole of magnet B.

Ⓑ The south pole of magnet A was facing the north pole of magnet B.

Ⓒ The north pole of magnet A was facing the south pole of magnet B.

Electromagnetic Energy

Assessment Scoring Guidelines

1. Answer D is correct.

2. Answer C is correct.

3. Answer A is correct.

4. Answer C is correct.

5. The magnet attracts the object with less force in diagram A because the object is farther away.

6. Answer A is correct.

Basic Level

Physical Science

Electricity and Magnetism

English-language Arts Activities

Electromagnetic Energy

Print pages 24–28 of this PDF for the reading activities.

Synonyms and Antonyms

Words that mean the same, such as *tiny* and *small*, are synonyms. Words that mean the opposite, such as tiny and *large*, are antonyms.

For example, a synonym for *push* is *shove*. *Push* and *shove* have the same meaning. An antonym for *push* is *pull*. *Push* and *pull* have opposite meanings.

Write the correct words from the box on the lines. You will use some of the words twice.

attract	negative	opposite	strongest
temporary	discovered	nearby	

1. A synonym for *found* _____

2. An antonym for *same* _____

3. An antonym for *weakest* _____

4. A synonym for come *closer* _____

TRY THE SKILL

5. A synonym for *the other end* _____

6. An antonym for *repel* _____

7. A synonym for *close* _____

8. An antonym for *positive* _____

Find more words in the book that have synonyms and antonyms. Write them on the lines below.

_____

_____

_____

_____

_____

_____

Sequential Order

Sequential order is the order in which things happen. Understanding sequential order can help you understand and remember what you read. You can retell the sequential order. To do this, use words such as, *first, then, next,* and *finally*.

Read this passage from *Electromagnetic Energy*.

Tie strings to two balloons. Rub each balloon on your hair. Both balloons get a negative charge. Then hold them close together by the strings. The balloons move apart. They repel each other because both charges are negative.

What are the steps in this investigation? A graphic organizer can help you identify the steps.

Step 1	Tie strings to two balloons.
Step 2	Rub each balloon against your hair.
Step 3	Hold the balloons close together.

TRY THE SKILL

Read this passage from *Electromagnetic Energy*. How does a bell with an electromagnet work? Retell in sequential order. Use the graphic organizer to help.

First, someone pushes a button connected to the bell. This sends an electric current to the electromagnet in the bell. Now the electromagnet has a magnetic field. An iron bar with a hammer head is attracted to the magnetic field. This causes the hammer head to strike the bell.

Step 1	
Step 2	
Step 3	
Step 4	

Identify a Purpose

As you choose something to read, you usually have a purpose in mind, such as these:

- **to gain or understand information**
- **to learn how to do something**
- **to gather information in order to form an opinion**
- **to be entertained**

For example, you read this book to gain information about electromagnetic energy. You also learned how to perform several experiments—another purposes for reading.

As you look through books, magazines, and articles, think about your purpose for reading. Choose reading material that matches your purpose.

Read the description of each selection. Then identify its main purpose.

1. This selection tells why magnets attract and repel each other.

Ⓐ to inform
Ⓑ to tell how to do something
Ⓒ to persuade
Ⓓ to entertain

TRY THE SKILL

2. This selection tells how to build an electromagnet.

Ⓐ to inform
Ⓑ to tell how to do something
Ⓒ to persuade
Ⓓ to entertain

3. This selection explains the benefits of using electric powered cars.

Ⓐ to inform
Ⓑ to tell how to do something
Ⓒ to persuade
Ⓓ to entertain

4. This selection tells about early scientists who investigated magnetism.

Ⓐ to inform
Ⓑ to tell how to do something
Ⓒ to persuade
Ⓓ to entertain

Distinguish Fact from Opinion

TRY THE SKILL

A fact can be proved. For example, a scientists can say that an electromagnet only has a magnetic field when the electricity flows through it.

An opinion is what someone believes. For example, a person might say electromagnets waste energy However, other people might disagree with this opinion.

Being able to tell facts from opinions makes you a better reader. Opinion sentences often have words such as *better, worse, should, difficult, toughest,* and *easy*. Here are more examples:

Fact

Hans Christian Oersted was a teacher in Denmark.

Opinion

Hans Christian Oersted made the most important discovery about magnetic fields.

Mark each statement below *F* for fact or *O* for opinion.

1. Everything in the word is made up of atoms. ____
2. The experiment testing the strength of two magnets was fun. ____
3. Objects with a negative charge repel other objects with a negative charge. ____
4. You should never leave on a trip without a compass. ____
5. Earth is a giant magnet. ____
6. Hans Christian Oersted should have known what caused the compass needle to move. ____
7. A speaker uses an electromagnet to send sound waves. ____
8. Opposite charges attract. Similar charges repel. ____

Write one fact and one opinion about electromagnetic energy.

_____

_____

_____

_____

Answer Key

Synonyms and Antonyms

1. discovered

2. opposite

3. strongest

4. attract

5. opposite

6. attract

7. nearby

8. negative

Sequential Order

Step 1: Someone pushes a button

Step 2: An electric current is sent to the electromagnet

Step 3: An iron bar with a hammer head is attracted to the magnetic field.

Step 4: The hammer head strikes the bell.

Identify a Purpose

1. A

2. B

3. C

4. A

Distinguish Fact from Opinion

1. F

2. O

3. F

4. O

5. F

6. O

7. O

8. F