TCM Teacher Created Materials

SCIENCE READERS

Content *and* Literacy *in* Science

Lessons and Activities

Grade 3

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SCIENCE READERS

Content *and* Literacy *in* Science

Grade 3

Teacher's Guide

Teacher Created Materials
PUBLISHING

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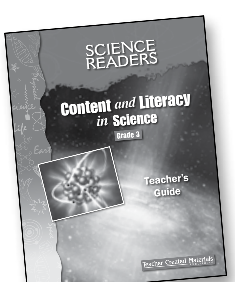
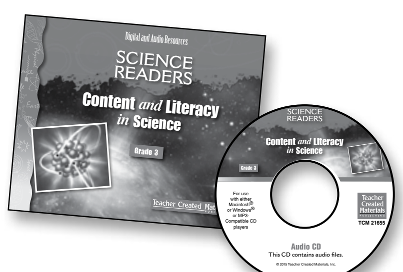


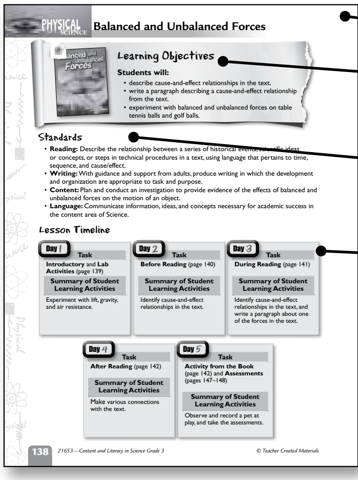
Teacher's Guide



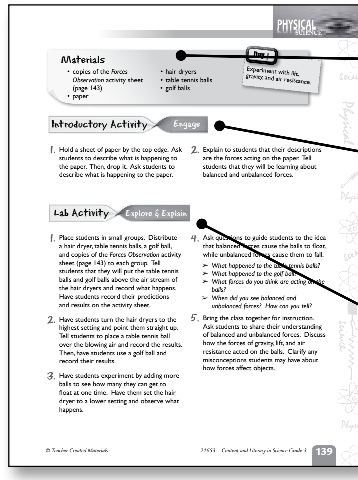
Digital and Audio Resources

Unit Organization

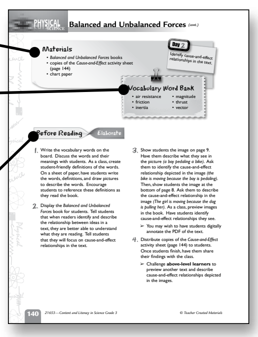
Overview Page



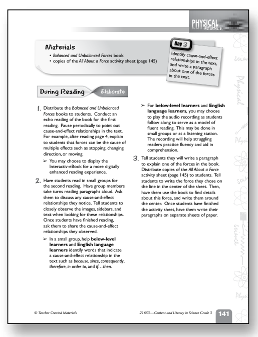
Introductory and Lab Activities



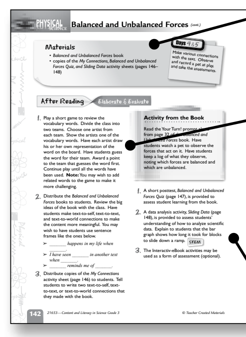
Before Reading



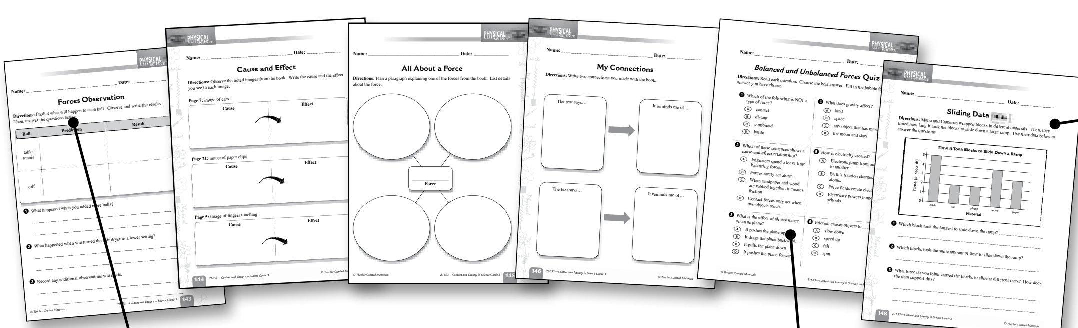
During Reading



After Reading



Student Reproducibles and Assessments



Pacing Plan

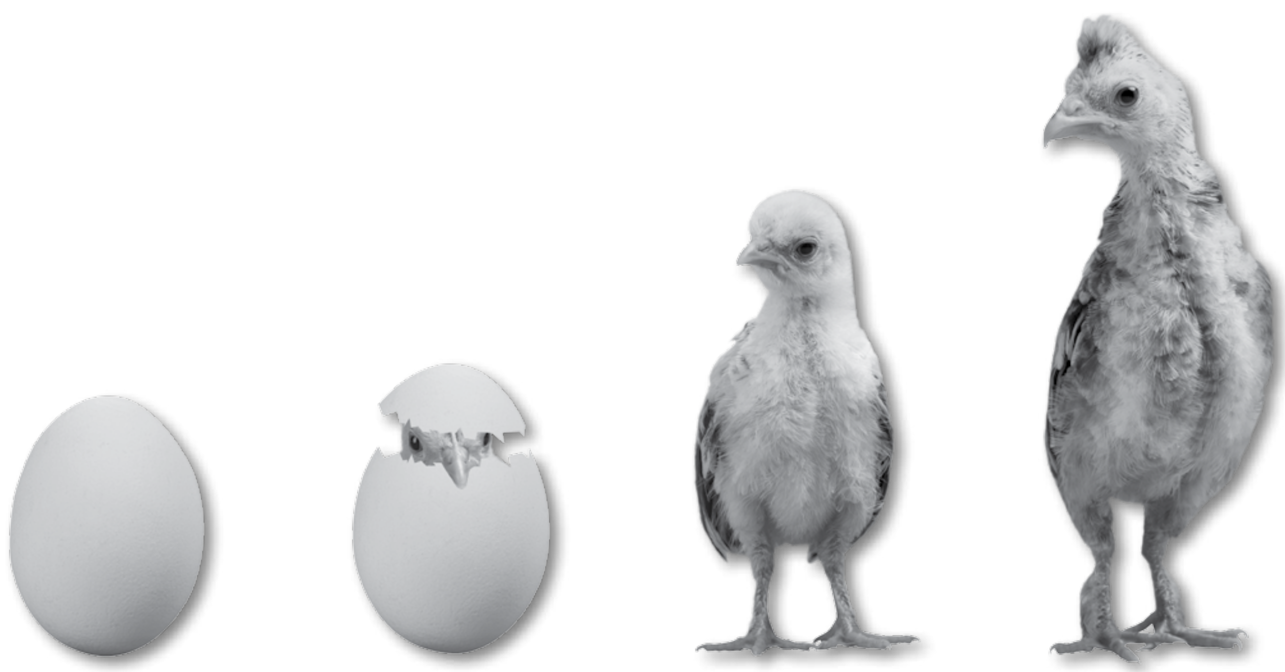
The following pacing plan shows an option for using this product. Teachers should customize this pacing plan according to their students' needs. One lesson has been included for each of the 16 books. Each day of the lesson requires 30 to 45 minutes of time and spans 5 instructional days, for a total of approximately 40–60 hours over the course of 80 days.

Instructional Time	Frequency	Setting
30–45 min/day	5 days/week	Whole-class, small-group or one-on-one instruction

Day 1	Day 2	Day 3	Day 4	Day 5
Introductory and Lab Activities	Before Reading	During Reading	After Reading	Activity from the Book and Assessments

Lab Safety

To ensure safety in the science classroom, a Science Safety Contract has been provided in the Digital Resources (safety.pdf). Distribute copies of this contract to students prior to beginning any science instruction. Discuss with students how to be respectful and responsible during science activities. Ask students and their parents/guardians to sign and return the contract for your records.



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Science Strands

The books and lessons in this kit cover the three strands of science which encompass the Disciplinary Core Ideas. The icons in the lessons and on the back of the books denote each strand. One book in this kit is devoted completely to scientific practices. This book describes how to think like a scientist and study the natural world.

Differentiation

Students learn best when material is scaffolded appropriately. If a student is confronted with material that is too difficult, he or she may become frustrated and give up. However, if a student is not challenged enough, he or she may become bored and lose interest in the subject. Differentiation is not about making the work easy for students. Instead, it is about challenging all students appropriately.

The books in this kit are leveled to target and support different groups of learners. The chart on page 26 contains specific information on the reading levels of the books included in this kit. The lesson plans for these books have **differentiation strategies** to help **above-**, **on-**, and **below-level learners** comprehend the material. These strategies will ensure that students are actively engaged in learning while receiving the support or enrichment that they need.

English language learners have different instructional needs. Although these students may struggle with reading, that is not always the case. English language learners need different support depending on their level of English proficiency. The lesson plans in this kit offer suggestions to differentiate instruction for the unique needs of English language learners.

SCIENCE READERS

Differentiation Tools in This Kit

- Audio recordings of texts model fluency and support auditory learners.
- An Interactiv-eBook for each book supports students through video, audio, and other digital functions.
- Graphic organizers support visual learners and language learning.
- Hands-on lab activities engage tactile learners.
- Leveled books support above-, on-, and below-level learners.
- Differentiation strategies embedded in each lesson support a variety of learners.

Assessment

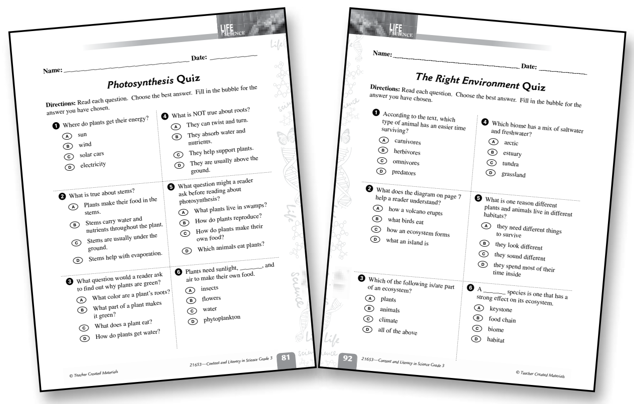
Assessment is an important part of this unit of study. The *Science Readers* series offers multiple assessment opportunities. You can gain insight into students' learning through multiple-choice quizzes, small-group observations, analysis of written assignments, and a culminating activity. These formal and informal assessments provide you with the data needed to make informed decisions about what to teach and how to teach it. This is the best way for you to know who is struggling with various concepts and how to address the difficulties that students are experiencing with the curriculum.

Multiple-Choice Quizzes—At the end of each book's lesson in this Teacher's Guide is a short quiz with multiple-choice questions. These short assessments may be used as open-book evaluations or as review quizzes in which students read and study the content prior to taking the quiz. Additionally, the quizzes may be used as a more formal assessment to provide evidence of learning.

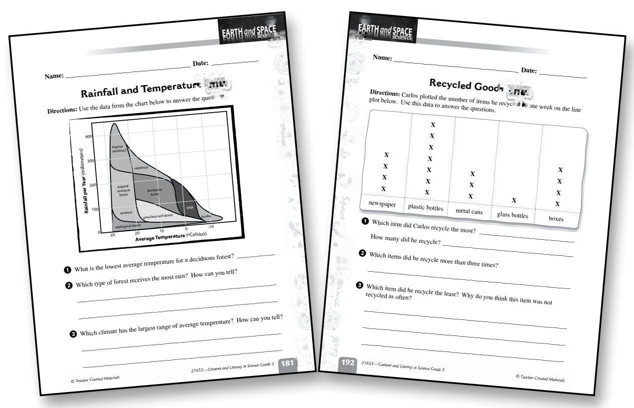
Data Analysis Activities—Each activity includes content-related data and text-dependent questions. These questions help students develop and strengthen critical thinking skills.

Culminating Activity—The culminating activity asks students to apply what they have learned throughout the units in an engaging and interactive way. Students use what they have learned to create new ideas in a real-life context.

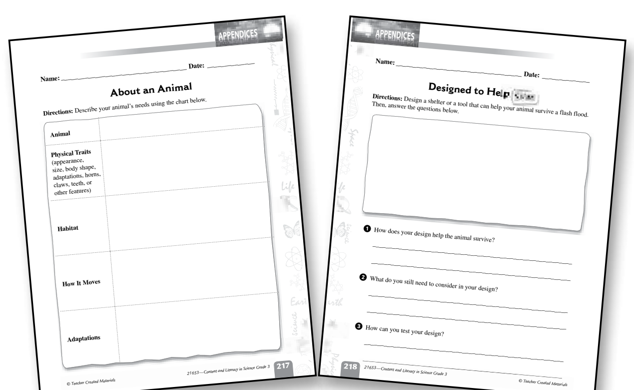
Progress Monitoring—There are several points throughout each lesson where useful evaluations can be made. These evaluations can be made based on group, paired, and individual discussions and activities.



Multiple-Choice Quizzes

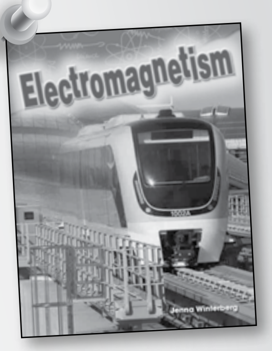


Data Analysis Activity



Culminating Activity

Electromagnetism



Learning Objectives

Students will:

- use context clues to determine the meaning of unknown words in the text.
- use information from the text to find meanings of words.
- experiment with the cause-and-effect relationship of electromagnetic interactions.

Standards

- **Reading:** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 3 topic or subject area.
- **Writing:** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
- **Content:** Ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other.
- **Language:** Communicate information, ideas, and concepts necessary for academic success in the content area of Science.

Lesson Timeline

Day 1

Task

Introductory and **Lab Activities** (page 128)

Summary of Student Learning Activities

Build an electromagnet and experiment with its strength.

Day 2

Task

Before Reading (page 129)

Summary of Student Learning Activities

Preview unknown words in the text.

Day 3

Task

During Reading (page 130)

Summary of Student Learning Activities

Use context clues to determine the meanings of words in the text, and use the book to find and record the meanings of words.

Day 4

Task

After Reading (page 131)

Summary of Student Learning Activities

Use context clues to determine the meanings of challenging words.

Day 5

Task

Activity from the Book (page 131) and **Assessments** (pages 136–137)

Summary of Student Learning Activities

Create a dance about magnetism, and take the assessments.

Electromagnetism *(cont.)*

Materials

- copies of the *Stronger Magnet* activity sheet (page 132)
- magnet
- pencils or large nails
- insulated copper wire
- 9-volt batteries
- metal paper clips

Day 1

Build an electromagnet and experiment with its strength.

Introductory Activity — Engage

1. Show students a magnet, and ask them to describe it. Ask students to predict which objects in the classroom might be attracted to the magnet. Have students take turns testing their predictions. **Note:** Do not let students use the magnet on any electronics.

2. Explain to students that a magnet is able to attract certain metals. Tell students that they will learn about and build a type of magnet.

Lab Activity — Explore & Explain

1. Place students in small groups. Distribute a pencil or a large nail, insulated copper wire, a 9-volt battery, and metal paper clips to each group. Have students coil the wire around the pencil or nail, making sure to leave a few inches of wire loose at the ends. Have students wrap the loose ends of the wire around the battery terminals. **Note:** Using a nail rather than a pencil will create a stronger magnet.

2. Have students hold their magnets over a pile of paper clips and observe what happens.

3. Distribute copies of the *Stronger Magnet* activity sheet (page 132) to groups. Have students add and remove coils and count the number of paper clips the magnet lifts. Have students record their observations on the activity sheet. **Note:** Have students disconnect their batteries when not in use to prevent overheating. STEM

4. Ask questions to guide students to the idea that the number of coils affects the strength of the magnet.
   - ➢ *What happens when you have more coils?*
   - ➢ *What happens when you have fewer coils?*
   - ➢ *How does the tightness of the coils relate to the strength of the magnet?*
   - ➢ *What happens when you disconnect the battery? Why do you think this happens?*

5. Bring the class together for instruction. Clarify misconceptions by having students explain their understandings using logic and evidence to support their ideas.

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Day 2

Preview unknown words in the text.

Materials

- *Electromagnetism* books
- copies of the *Previewing Words* activity sheet (page 133)
- index cards

Vocabulary Word Bank

- circuit
- conductor
- current
- electricity
- electron
- static electricity

Before Reading — Elaborate

1. Write the vocabulary words on the board and discuss their definitions. Then, write vocabulary words on individual index cards and distribute them to students. Have students go around the class and introduce themselves as the word without saying the word. For example, students might say, "Hello, I am a particle with a negative charge." Have another student try to guess what word is being represented *(electron)*. Be sure all students have a chance to guess each of the words.

2. Display the *Electromagnetism* book. Discuss the word *electromagnetism* and what students think it means. Tell students that determining the meaning of words and phrases is key to understanding informational text. Explain that it is especially important to be aware of challenging or unknown words such as *electromagnetism*.

3. Flip through the book and have students identify academic and domain-specific words and phrases. Have students discuss what they know about the words. Demonstrate how to look at the context to determine the meaning of words. Explain to students that context clues can include a definition in the text, an example of the word, a synonym, or an antonym.

4. Distribute copies of the *Previewing Words* activity sheet (page 133) to students. Have students choose two words or phrases from the text and write what they know about them. Once students finish, discuss the words and their meanings as a class.

   ➢ Have **below-level** and **English language learners** write a list of challenging words that are key to understanding the text. Help them use the glossary and context clues to understand their meanings. Have them draw pictures to represent the words. Have them use this visual dictionary throughout the lesson.

Electromagnetism *(cont.)*

Materials

- *Electromagnetism* books
- copies of the *Dig Deeper* activity sheet (page 134)

Day 3

Use context clues to determine the meanings of words in the text, and use the book to find and record meanings of words.

During Reading — Elaborate

1. Distribute the *Electromagnetism* books to students. Review how to use context clues to understand the meaning of unknown words. Read the book aloud as students follow along. Pause periodically to point out how to use context clues. Read page 6 aloud. Point to the word *charge* and explain how it is defined in context. Continue to model how to use context clues to help determine the meaning of various words, such as *orbit* (page 10), *nucleus* (page 12), and *demagnetized* (page 19).
   - ➢ You may choose to display the Interactiv-eBook for a more digitally enhanced reading experience.
2. Have students read in pairs for the second reading. Tell them to identify challenging or interesting words and strategies for finding their meanings. Have students pause periodically to ask and answer questions about the words in the text. Examples include:
   - ➢ *What words are challenging?*
   - ➢ *What words should we reread?*
   - ➢ *How can we use the context to help us understand what they mean?*
   - ➢ *What else can we do to understand the words?*
   - ➢ You may wish to have students digitally annotate the PDF of the text.
   - ➢ For **below-level learners** and **English language learners**, you may choose to play the audio recording as students follow along to serve as a model of fluent reading. This may be done in small groups or at a listening station. The recording will help struggling readers practice fluency and aid in comprehension.
3. Once students have finished reading, review their notes as a class and discuss the words they identified. Create a T-chart on the board. As a class, fill one side of the chart with students' words. On the other side of the chart, write the strategies students used to find the meanings of the words.
4. Distribute copies of the *Dig Deeper* activity sheet (page 134) to students. Have students use the book to complete the activity sheet. Once students have finished, discuss their answers as a class.

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Materials

- *Electromagnetism* books
- copies of the *Words in Context, Electromagnetism Quiz,* and *Magnetic Fields* activity sheets (pages 135–137)
- index cards

Days 4 & 5

Use context clues to determine the meanings of challenging words. Create a dance about magnetism, and take the assessments.

After Reading — Elaborate & Evaluate

1. Write the vocabulary words on the board. Divide the class into six groups, and assign vocabulary words to each group. Have groups create an action to demonstrate the meaning of their word. Have groups perform their action while the other students guess which word it represents.
   - ➢ Challenge **above-level learners** to combine the actions of all the words to create a dance.
2. Distribute the *Electromagnetism* books to students. Have students share some of the words they were able to understand by using context clues. Allow time for students to share their words and strategies.
3. Distribute copies of the *Words in Context* activity sheet (page 135) to students. Have them use the book to complete the activity. Once students have finished, discuss the context clues as a class.

Activity from the Book

Read the Your Turn! prompt aloud from page 32 of the *Electromagnetism* book. Have students use index cards to create a dance based on their knowledge of positive and negative magnetic charges.

1. A short posttest, *Electromagnetism Quiz* (page 136), is provided to assess student learning from the book.
2. A data analysis activity, *Magnetic Fields* (page 137), is provided to assess students' understanding of how to analyze scientific data. Explain to students that the chart shows the strength of the magnetic field around common kitchen items. STEM
3. The Interactiv-eBook activities may be used as a form of assessment (optional).

Name: ______________________________________ **Date:** ______________

Stronger Magnet STEM

Directions: Record your observations of electromagnets in the chart. Then, write your findings on the lines below.

Number of Coils	Number of Paper Clips

____

____

____

____

____

____

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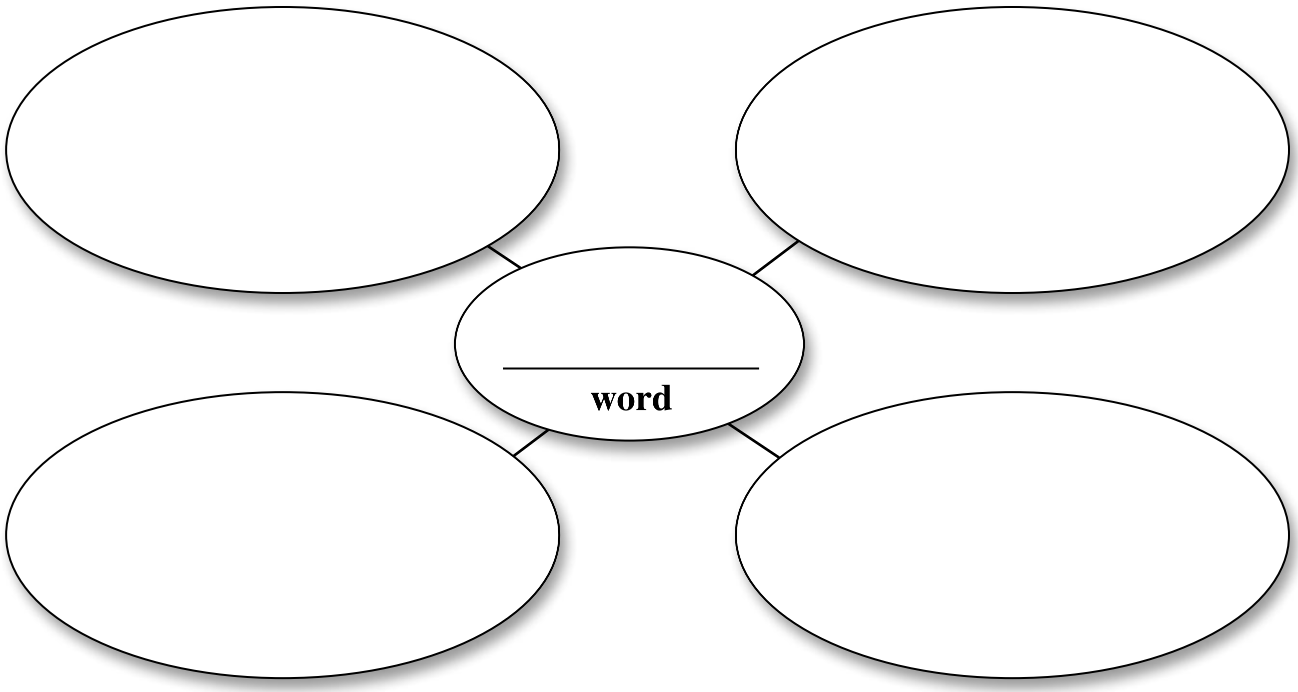
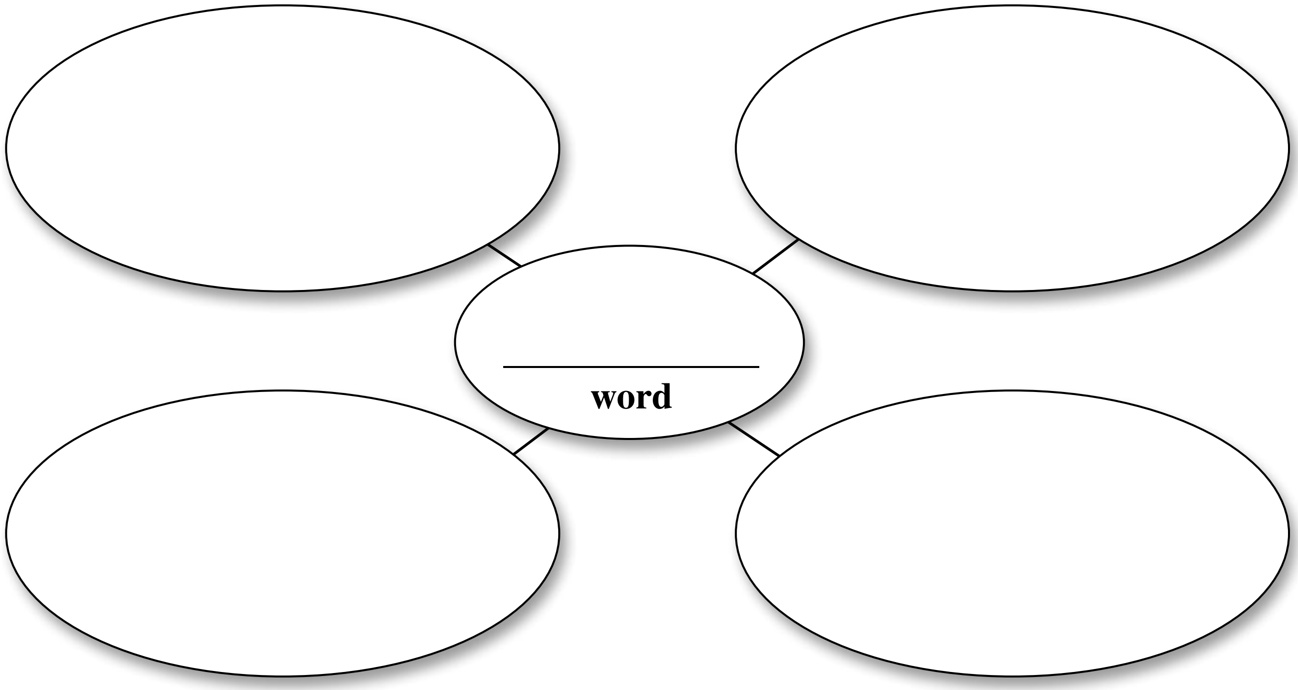
Name: ______________________________ **Date:** ____________

Previewing Words

Directions: Write two words from the text. Then, write what you know about each word.





Name: ___________________________________ **Date:** _____________

Dig Deeper

Directions: Write the meaning of each word or phrase below. List the context clues that helped you determine the meaning.

1. conductivity (page 9)

____

____

Context Clues: ____

2. repelled (page 13)

____

____

Context Clues: ____

3. magnetized (page 19)

____

____

Context Clues: ____

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Name: ______________________________ **Date:** ____________

Words in Context

Directions: Use context clues to determine the meaning of the underlined words. Circle the context clues you used. Then, write a definition for the underlined words.

1. <u>Alternating current</u> has electricity moving in both directions.

   ____

   ____

2. A power plant has a <u>generator</u> that produces electricity.

   ____

   ____

3. A <u>conductor</u> does not prevent you from getting a shock.

   ____

   ____

4. A <u>circuit</u> follows a loop. If the loop is broken, the flow stops.

   ____

   ____

Name: ____________________________________ **Date:** ______________

Electromagnetism Quiz

Directions: Read each question. Choose the best answer. Fill in the bubble for the answer you have chosen.

1. What does the word *conductor* mean in the book?
   - (A) someone who directs musicians
   - (B) a person who drives a train
   - (C) an object that electricity can move through
   - (D) the complete path that an electric current travels along

2. Which of these inferences about electricity is supported by the passage below? *Electricity flows from a battery when it joins with another object to form a circuit.*
   - (A) Our bodies have electricity.
   - (B) Electrical power is measured in volts.
   - (C) There are two types of circuits.
   - (D) Electricity flows in a loop.

3. What is one way to clarify the meaning of an unknown word?
   - (A) look at the words around it
   - (B) ignore it
   - (C) find it in the index
   - (D) look at the table of contents

4. What is true about neutrons?
   - (A) They are a strong force.
   - (B) They are a form of current.
   - (C) They flow in one direction.
   - (D) They are neither positive nor negative.

5. Which of these inferences about electrons is supported by the passage below? *Electrons are found inside tiny bits of matter called atoms.*
   - (A) Electrons can be seen with a microscope.
   - (B) Electrons are smaller than atoms.
   - (C) Electrons have a negative charge.
   - (D) Electrons have a positive charge.

6. _______ and _______ are actually the same force.
   - (A) Push, pull
   - (B) Electricity, magnetism
   - (C) Water, lightning
   - (D) Gravity, magnetism

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Name: ______________________________ **Date:** ____________

Magnetic Fields STEM

Directions: Kayla and Marissa measured the magnetic fields around common kitchen items. The more milligauss (or mG) an item has, the stronger its magnetic field is. Use their chart to answer the questions.

Kitchen Item	Magnetic Field from 1 ft. (measured in mG)	Magnetic Field from 3 ft. (measured in mG)
coffee maker	1	<1
toaster	4	<1
blender	11	1
microwave	60	6
refrigerator	2	<1
stove	22	4

1. Which item has the strongest magnetic field? ______________________

   ____

2. Is the magnetic field stronger or weaker as you get farther away from the toaster? ________________ The blender? ________________

   How can you tell? ______________________________

   ____

3. What conclusions can you draw about the strength of magnetic fields?

   ____

   ____

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Electromagnetism

Jenna Winterberg

Consultant

Michael Patterson,
Principal Systems Engineer
Raytheon Company

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Library of Congress Cataloging-in-Publication Data

Winterberg, Jenna, author.
Electromagnetism / Jenna Winterberg.
pages cm
Summary: "Electromagnetism - now that's a big word! But what is it? For starters, it's the force that runs the electronics in your home. Your TV, computers, and even simple light bulbs use electromagnetism. You can't see it, but it's hard at work. It may seem complex, but once you break it down it's simple."—Provided by publisher.
Audience: K to grade 3.
Includes index.
ISBN 978-1-4807-4645-9 (pbk.)
ISBN 978-1-4807-5089-0 (ebook)
1. Electromagnetism—Juvenile literature. I. Title.
QC760.2.W56 2015
537—dc23
2014034269

Teacher Created Materials
5301 Oceanus Drive
Huntington Beach, CA 92649-1030
http://www.tcmpub.com
ISBN 978-1-4807-4645-9
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Forces

You've worn headphones. You've watched TV. You've worked on a computer. Chances are you've also sat in a car. You may have even been on a high-speed roller coaster. The same force powers them all. That force is *electromagnetism*.

The word is a mouthful. But breaking it down makes it easier to understand. *Electro-* means "electric," as in electricity. *Magnetism* refers to the pull between certain metals. Electricity and magnetism were once thought to be two separate forces. But now we know they are both interrelated.

Electromagnetism at Work

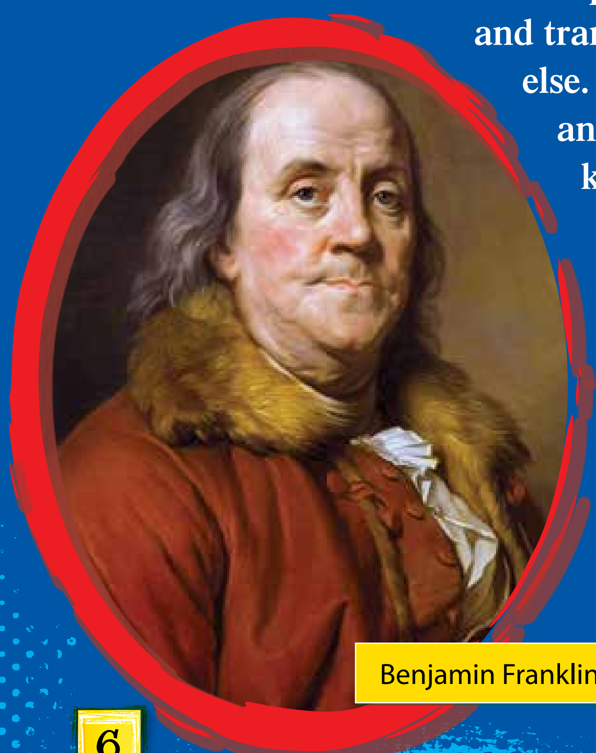
Electromagnetic cranes can be used to lift and move shipping containers onto trucks and ships. The electromagnet is turned on to lift the container. It is turned off to put the container in the required place.

Electricity

Many people think Benjamin Franklin discovered electricity, but by the 1700s, the discovery was thousands of years old.

Ancient Greeks knew electricity was a type of energy. They also knew its energy could transfer from item to item. They learned this by rubbing pieces of fur on amber. They found the fur was drawn to the stone. This is now called **static electricity**, but it didn't have a name back then.

So what did Franklin study? Lightning. He thought lightning was a type of static electricity. To test this, he needed to capture the energy in the air and transfer the charge to something else. So he tied a key to a kite and used a wire to connect the key to a jar that would store the energy. The kite was carried up to the clouds.



Benjamin Franklin

Static at Play

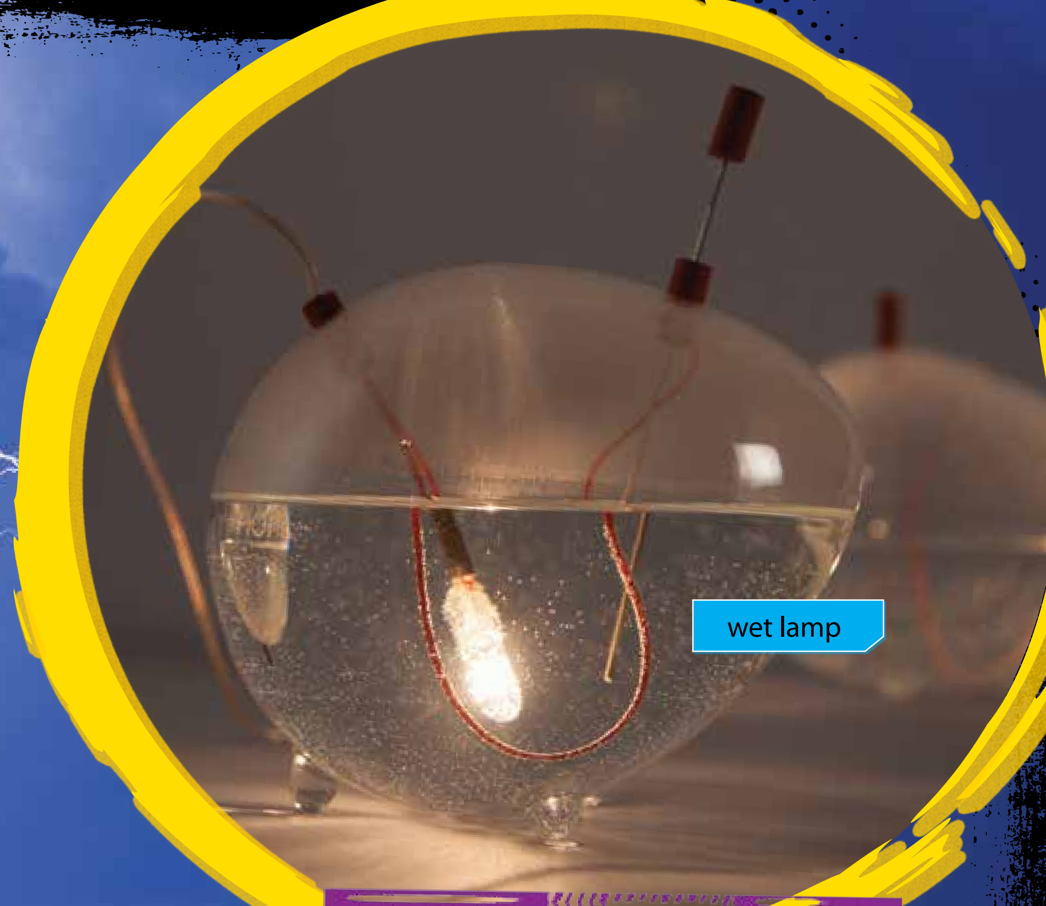
You can create static electricity. Blow up a balloon, rub it against your shirt, and hold it up to a wall. What happens when you let go?

January 9 is National Static Electricity Day in the United States!

Now all Franklin needed was a storm. When the time came, he and his son set up the kite, and then they waited. But Franklin didn't want to wait in the rain, so he took a seat in the barn, where he kept warm and dry. Time passed and he had nearly given up. But then, he noticed the fibers of the string were standing up. Franklin touched the key and he got a jolt.

Franklin was right! There was static electricity in the air. This meant that lightning was electric. But he almost didn't live to tell about his find. Like metal wire, water is a **conductor**. It helps electric charges travel. That means electricity from lightning can travel down a wet string. A man holding that wet string would get quite a jolt. But luckily Franklin did not get struck by lightning.

Even after Franklin's experiment, people knew very little about electricity. It wasn't until later that people found ways to use and control it.



A Bright Idea

The wet lamp uses water's conductivity to create electricity. It turns on and becomes brighter as a thin metal rod slides into the water. To turn the lamp off, the rod is pulled out of the water.

Electricity can be dangerous. Always find an adult to help you with any electrical work you do!

Atoms

The first step to controlling a natural force is understanding it. So what makes electricity work? Science didn't find the answer until the 1800s. That's when scientists discovered the **electron**.

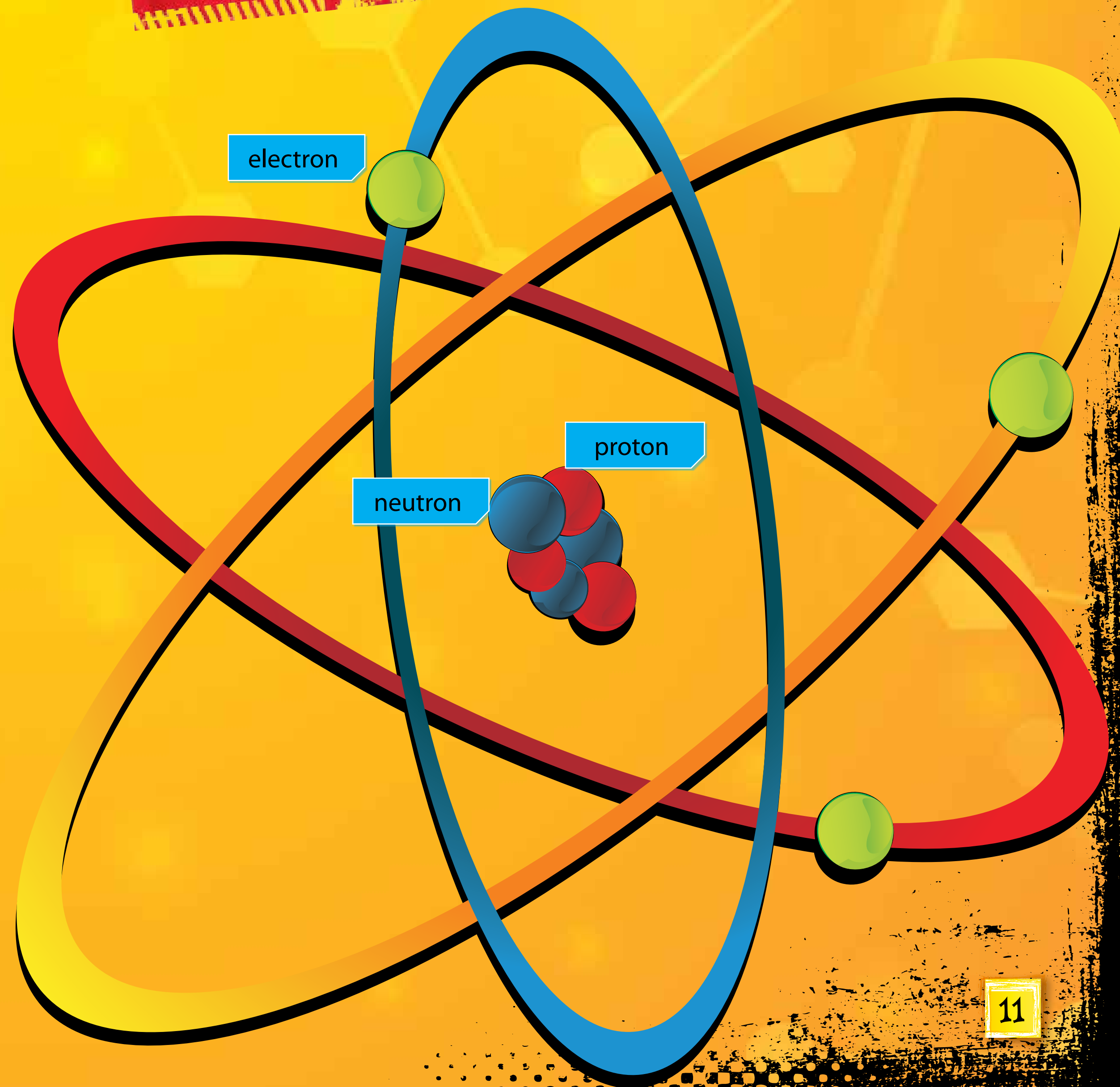
Electrons are very, very small. They are found inside tiny bits of matter called **atoms**. Atoms are also very small. They're much smaller than the tiny cells that make up our bodies! In fact, trillions of atoms fit inside the period at the end of this sentence. We're made up of atoms. So are our friends and pets. Our homes and schools are, too. Even stars are made of atoms. All matter is made of atoms.

Protons are found at the center of atoms. They have a positive charge. Electrons zip around them. They have a negative charge. These two opposites attract. As a result, protons keep electrons in **orbit**. It's a bit like the way the moon orbits Earth.

Every year, your body replaces 98 percent of its atoms.

Atom Model

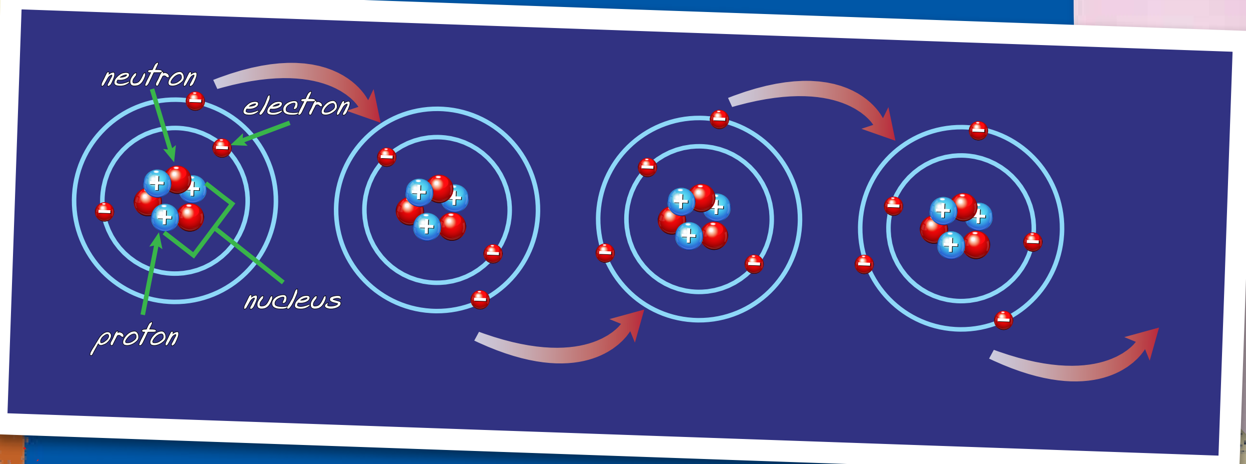
The atom model below helps scientists visualize atoms. But no one has actually seen one with his or her own eyes. Even the most powerful microscopes only give the general idea of what an atom looks like.



Atoms also have **neutrons**. They aren't positive or negative. They are neutral. In other words, they are balanced and have no charge. They are found with the protons at the center of an atom. The center of the atom is called the *nucleus*.

A neutral atom has an equal number of protons and electrons. But atoms gain and lose electrons. That makes atoms positive or negative. Atoms seek balance. When positive, they attract electrons. When negative, they push them away.

Electricity is the energy produced by electrons in motion. First, a negative atom sheds an electron. That lost electron jumps to the next atom. The new atom sheds an electron. The cycle continues on and on. The result is a flow of energy.



Protons and neutrons can be broken down into smaller particles called quarks.

Far Out!

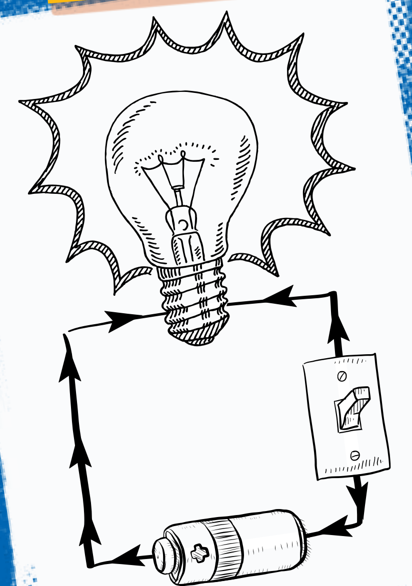
If you rub a balloon against your hair, your hair will stand up. That's because electrons have jumped from your hair to the balloon. And the positively charged atoms (+) in your hair are repelled, or pushed away, by each other. So each strand of hair spreads away from the other strands. But the positively charged atoms in your hair are attracted to the negatively charged atoms of the balloon.

– negatively charged atom
+ positively charged atom

Currents and Circuits

The flow of electricity is called a **current**. It comes in two forms: alternating current (AC) and direct current (DC). When we plug in a device at home, it uses AC. In this form, electrons flow from positive to negative, as well as from negative to positive. They alternate between directions. And they travel at very fast speeds!

Direct Current



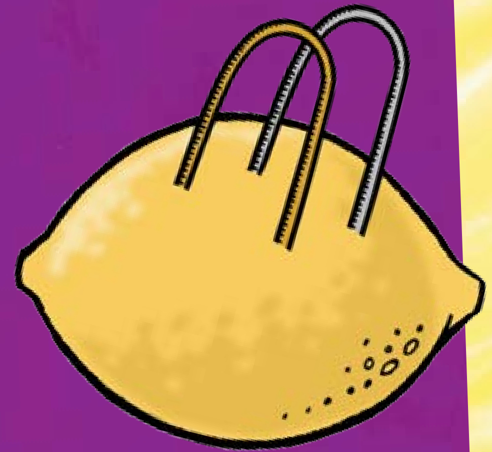
When batteries power an item, the electrons only flow in one direction. Have you ever noticed the symbols on a battery? They indicate a negative end (-) and a positive end (+). In DC, the flow always starts at the negative end and travels to the positive end.

Electricity flows from a battery when it joins with another object to form a **circuit**. A circuit is like a loop. If a circuit is broken, the flow stops. What happens when you flip down a light switch? The lights turn off because the circuit is broken.

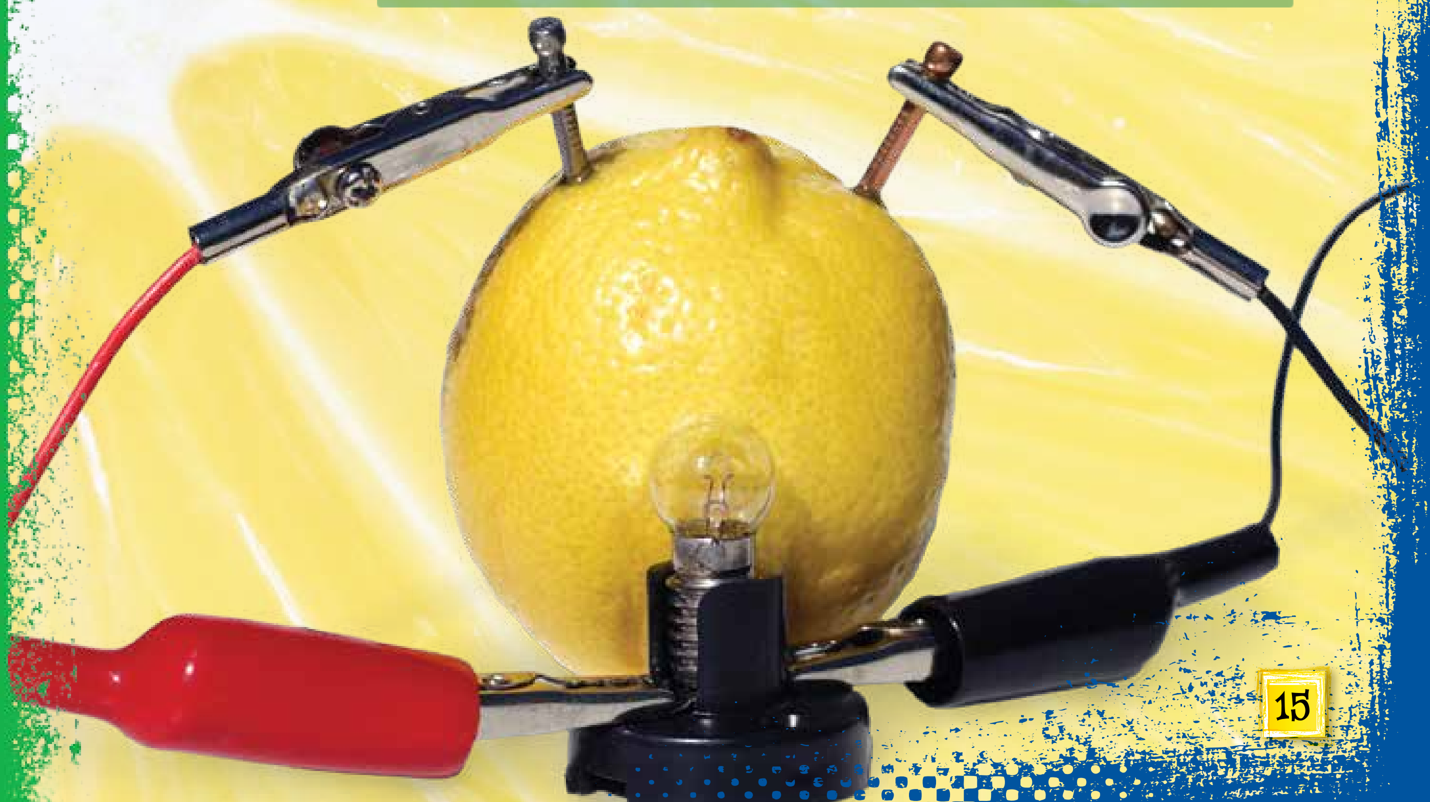
Electric Lemonade

Squeezing a lemon is one way to make lemonade. Here's another way to make some "juice."

1. Find an adult to help you bend copper wire and a paper clip into a U-shape.
2. Roll a lemon to loosen its juices, and then stick in all the sharp ends of the wires.
3. Touch your tongue to both wires. Feel the power of a lemon battery!



The electrical current in our ears sparks the nerves in our brain. This allows us to hear things.

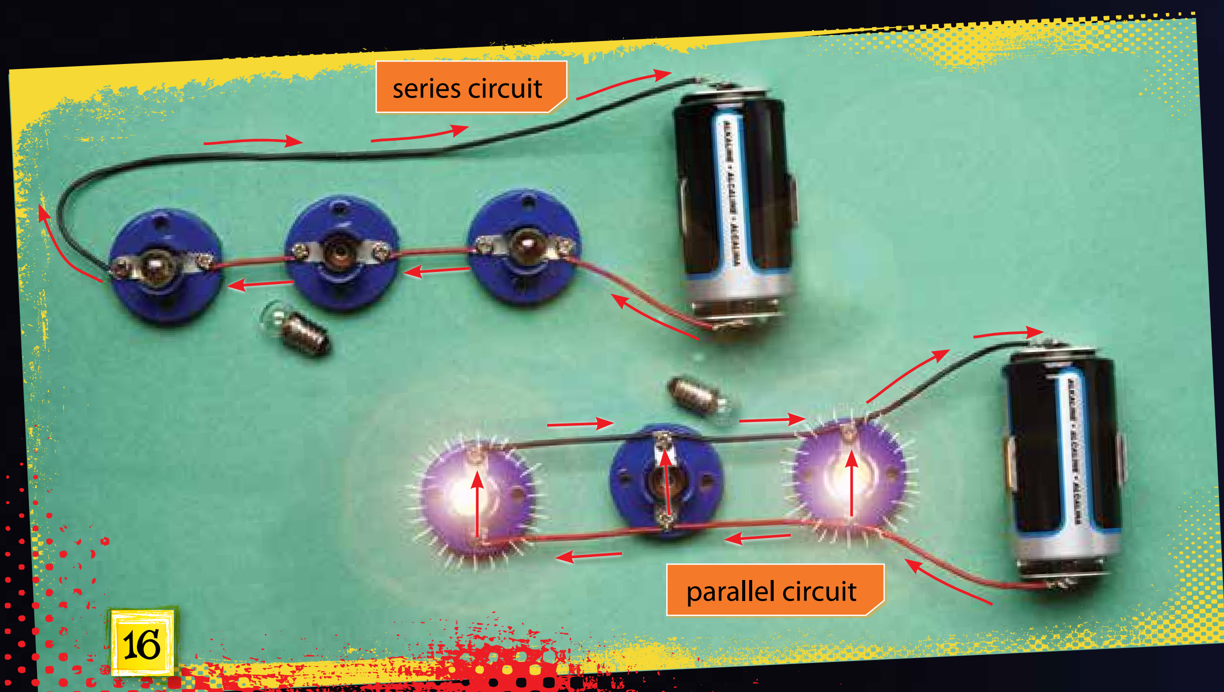


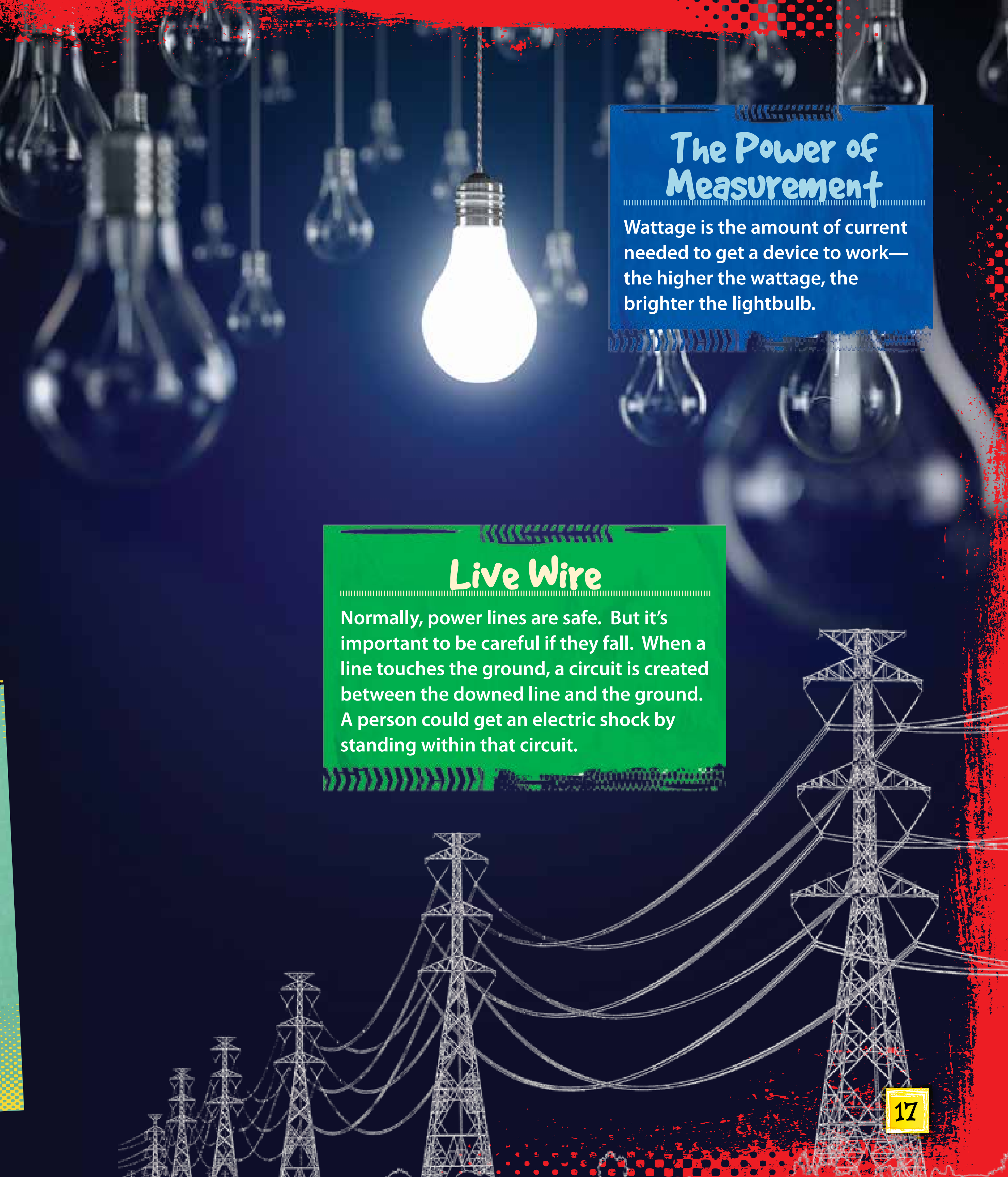
There are two basic types of circuits: series and parallel.

What usually causes a string of lights to go out? One bad bulb. Those lights are in a series circuit. One wire passes through each bulb on the way to the next. If a bulb gets loose or burns out, the circuit breaks. None of the lights will work.

What would happen if all the lights in your home were wired in a series? If a bulb burned out, everything would go dark and stop working. And you wouldn't know which bulb to replace. You would have to check every single light to fix the problem.

It's no surprise that most items in our homes don't use series circuits. Instead, they have parallel circuits. For this type of circuit, each item that needs power has its own separate pathway. The current takes more than one path at the same time. If one path is broken, the others still have juice.





The Power of Measurement

Wattage is the amount of current needed to get a device to work—the higher the wattage, the brighter the lightbulb.

Live Wire

Normally, power lines are safe. But it's important to be careful if they fall. When a line touches the ground, a circuit is created between the downed line and the ground. A person could get an electric shock by standing within that circuit.

Magnetism

Some magnets are formed naturally. One such magnet was found thousands of years ago. It's a rock called *lodestone*.

But most magnets today are made from iron and steel. These materials aren't natural magnets. We train them to be magnets.

Most magnets are made by an electric current. When electrons move in the same direction, they create a current. This makes a magnetic effect. Magnetic objects can attract iron and other metals. But magnets don't attract all metals. Even the strongest magnet can't pick up silver or gold. And nonmetals, such as glass, plastic, and wood, are never attracted to magnets. In gold, plastic, and wood, electrons move in many directions. There is no magnetism.

lodestone

Objects can be magnetized. They can be demagnetized, too. You can change a magnet into a nonmagnet. Just stop the electrons from moving in the same direction.

Training a Magnet

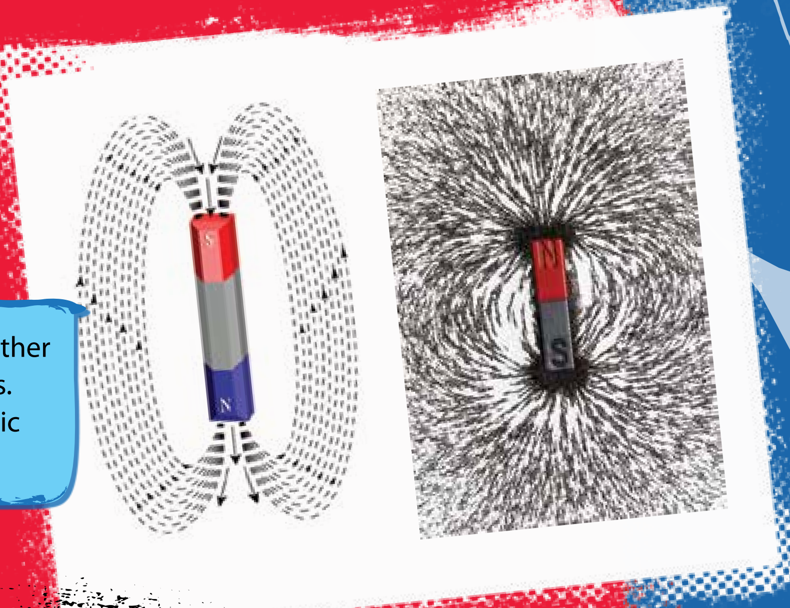
You can easily train a needle to become a magnet. Stroke the end of a sewing needle against one end of a bar magnet for a minute. This sets all the electrons moving in the same direction.

A Sixth Sense

Humans can't feel magnetism. But animals such as sharks, pigeons, and bees can sense it. They use magnetism to find their way.

Every magnet has two poles. One is found at each end of a magnet. They're named *north* and *south*, just like the poles on Earth. Opposite poles attract. The north and south poles draw each other near. But two like poles repel each other. For example, two north poles will push each other away.

Every magnet has a limit to its force. The area it can affect is its *magnetic field*. Fields are areas where forces influence objects. The stronger the magnet is, the bigger its field will be. But bigger doesn't always mean stronger. The strongest magnet on Earth is 500,000 times stronger than the biggest one. Can you guess what the biggest magnet is? Earth itself!



Field lines come together at the magnetic poles. This is where magnetic force is strongest.

Planet Magnet

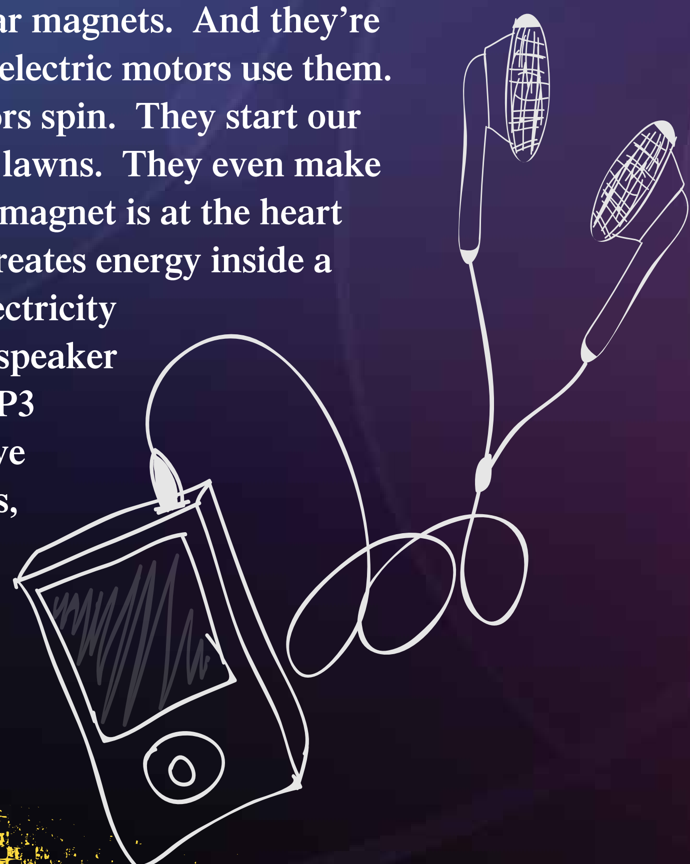
Scientists think Earth acts as a magnet because its core is mostly hot, liquid iron. As Earth spins, a magnetic force is produced.

Electromagnetism

Scientists found the link between electricity and magnetism almost 200 years ago.

Hans Christian Oersted (UR-sted) noted it first. He was showing friends how metal acts as a conductor. That's when he saw his compass needle move. Oersted knew right away he found a link between electricity and magnetism. But he couldn't figure out how and why it worked.

Today, scientists understand magnets much more deeply. They've found ways to create electromagnets, which are much stronger than regular magnets. And they're everywhere you turn. All electric motors use them. They are what make motors spin. They start our cars and help us mow our lawns. They even make our fans work. An electromagnet is at the heart of every power plant. It creates energy inside a **generator**. That's how electricity gets to our homes. Every speaker uses them. Your radio, MP3 dock, and headphones have them inside. So do phones, TVs, and computers. They're even at the amusement park. There, they speed up and slow down the fastest rides.



Types of Magnets

Natural

- found in the ground
- always on

Temporary

- man-made
- created by stroking an object with a permanent magnet
- lose their magnetism over time or when dropped or heated

Permanent

- man-made, hold their magnetism
- usually made of iron
- always on

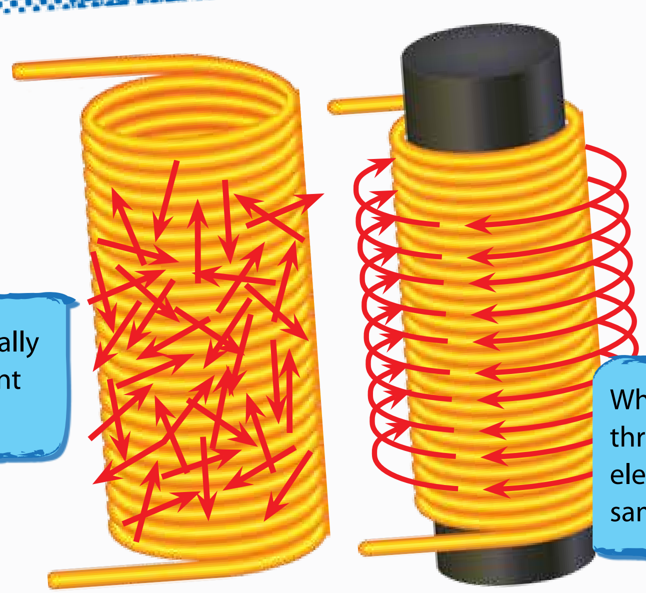
Electromagnet

- iron or steel inside a **coiled** wire connected to an electric current
- stronger than ordinary magnets
- can be turned on and off

Electricity creates a magnetic field. But a moving magnet also creates an electric field! That means you can create a magnet using electricity. And you can create electricity using a magnet. This process is called **induction**.

Wires are thin, flexible pieces of metal. They are often used in electrical work. Usually in a wire, electrons move in all directions. When a magnetic field moves across the wire, the electrons suddenly travel in the same direction. That creates a current. The current can be weak or strong depending on the strength and speed of the magnetic field. If the wire is coiled, so the magnetic field passes through several lengths of wire, more electrons will be affected. That makes the current stronger, too.

Creating a Current

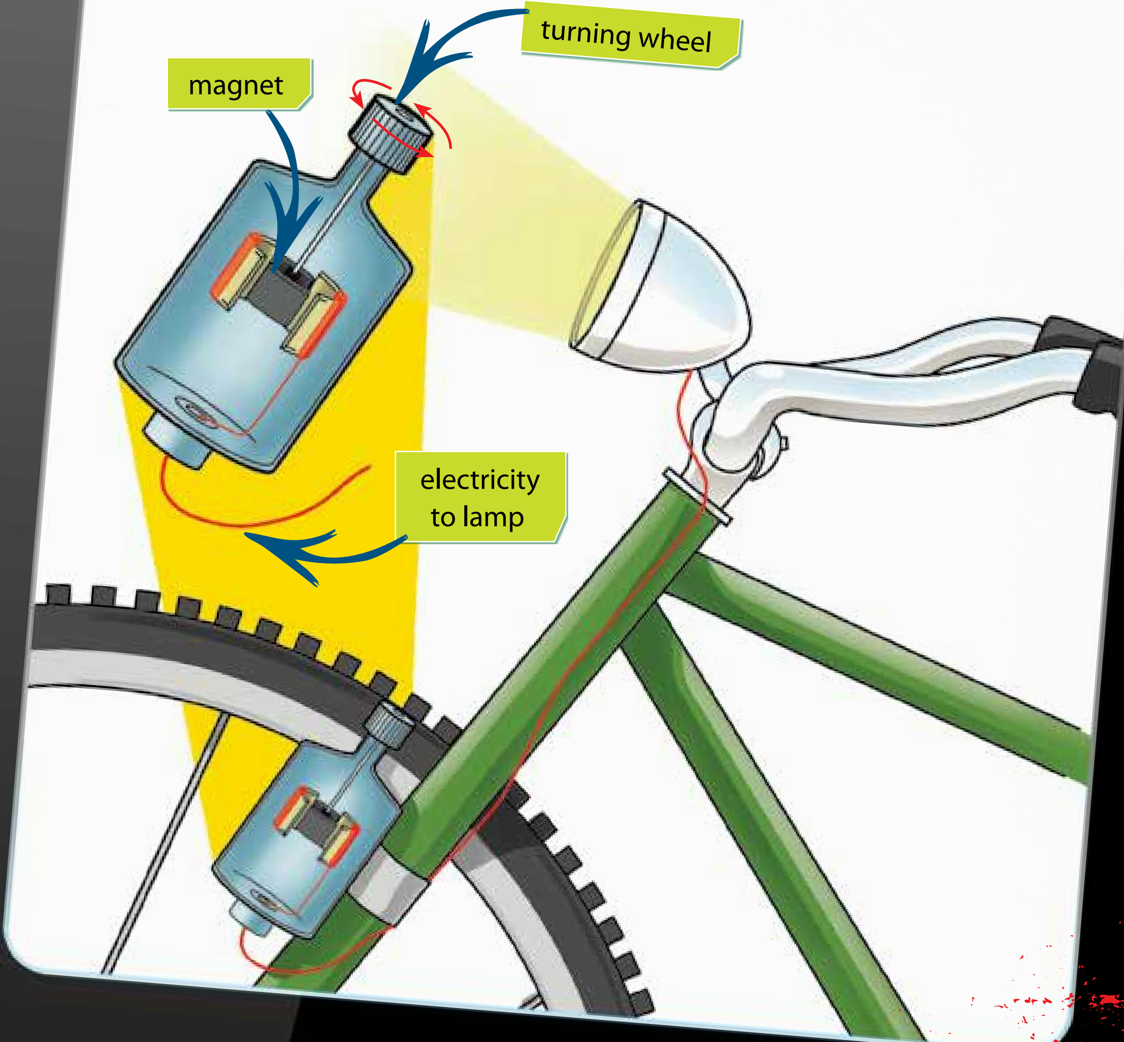


Electrons normally move in different directions.

When a magnet moves through a wire, all electrons move in the same direction.

Induction in Action

Magnetic fields can be used to induce current in some bicycle headlights. As the bicycle moves, the tire turns a wheel on top of a small container holding a magnet. This turns a magnet inside. A current is induced. The current travels through the wire. It powers the lamp on the bicycle.



Knowledge Is Power

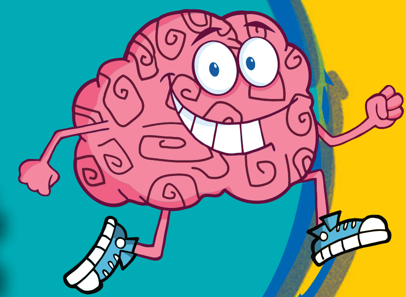
We're still exploring all that electromagnetic force can do. New, super-fast trains now use electromagnetic rails. They float above the track. NASA is creating a new launch system with electromagnets. It will carry a jet across a runway at a speed of 390 kilometers per hour (240 miles per hour)!

Electromagnetism is creating the future. But it's also a force we already use every day. It powers the world as we know it. It's at work when your alarm clock goes off. And it's there when you get out of bed to turn on the lights. It's with you when you ride in a car or a bus to school. And it allows you to listen to music or watch TV when you return home.

You may not have known its name. But by now it's clear—knowledge of electromagnetism is power!

Electromagnetic force is extremely strong. It's even stronger than gravity!

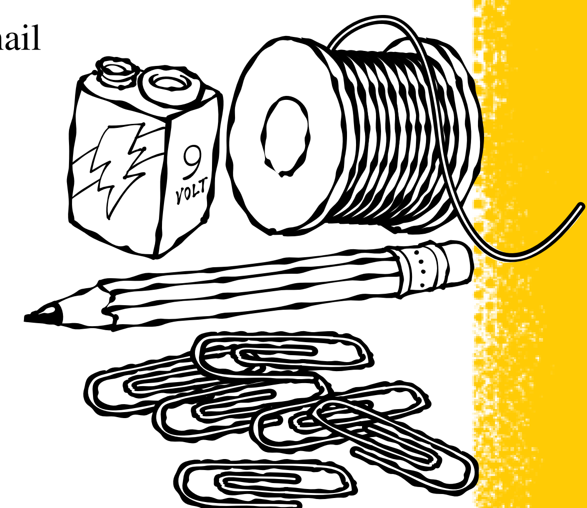
Think Like a Scientist



What does it take to build a magnet? Experiment and find out!

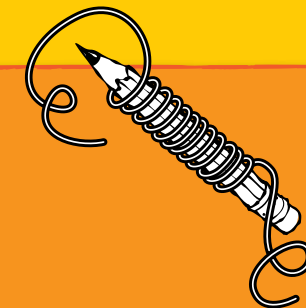
What to Get

- 9-volt battery
- insulated copper wire
- metal paper clips
- pencil or large nail

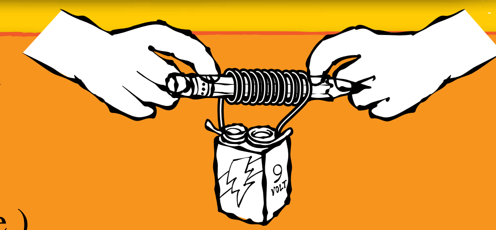


What to Do

1. Wrap the wire in a coil around the pencil or large nail. Leave a few inches of copper wire loose at each end. (Have an adult clip the wire if it is too long.)

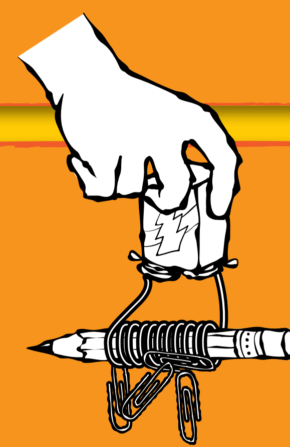


2. Wrap each of the loose parts of the wire around one of the two battery terminals. (The terminal is the part that sticks up above the main shape.)



3. Hold your electromagnet over a pile of paper clips. Observe what happens.

4. Experiment with the magnet's strength. Repeat the experiment. Each time, make the coils looser or tighter. What difference does the change make? Record your results in a table like the one below.
*Note: When finished, disconnect wire from battery to avoid overheating.



Number of Coils	Number of Paper Clips

Glossary

atoms—tiny particles that make up all matter

circuit—the complete path that an electric current travels along

coiled—wound into circles

conductor—a material or object that allows electricity or heat to move through it

current—a flow of electricity

electricity—a form of energy made up of a stream of electrons

electron—a particle that has a negative charge and travels around the nucleus of an atom

generator—a machine that produces electricity

induction—the process by which an electric current, an electric charge, or magnetism is produced in objects by being close to an electric or magnetic field

neutrons—particles with neutral charges and are part of the nucleus of the atom

orbit—the circular path an object follows as it goes around something else

protons—particles that have positive charges and are part of the nucleus of the atom

static electricity—an electrical charge that collects on the surface of things instead of flowing as a current

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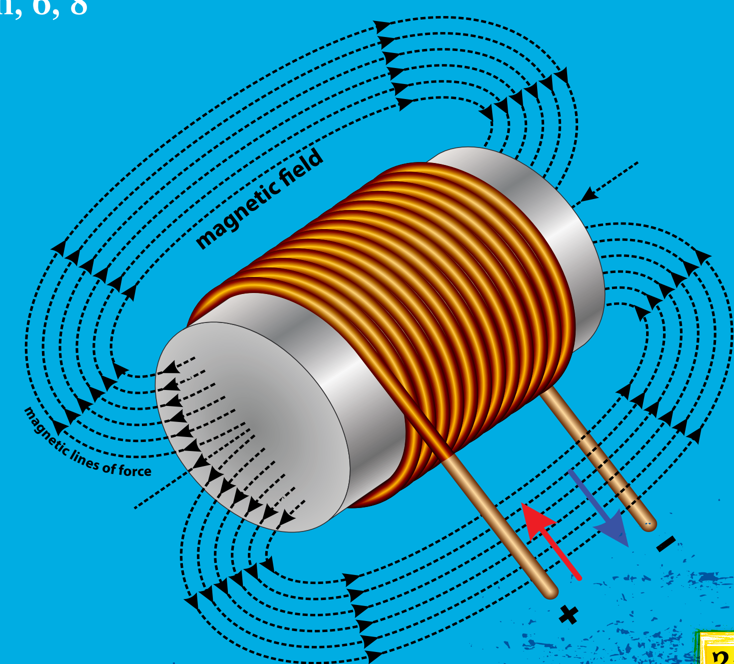

Your Turn!

The Electric Slide

Gather a bunch of friends together. Give each friend an index card with the word *positive* or *negative* written on it. Tape it to the front of each person's shirt. Now, create a dance based on the charges. Remember, opposites attract and like charges repel!