WONDERS OF ENERGY

3–8 Science Unit Study

THE GOOD AND THE BEAUTIFUL

Wonders of Energy

CREATED BY THE GOOD AND THE BEAUTIFUL TEAM

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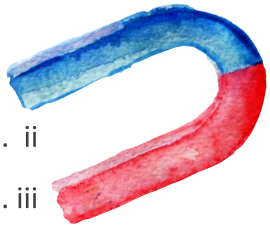


Unit Information

Science Journal

All The Good and the Beautiful science units include activities in a student journal. Each student should have his or her own student journal, and the parent or teacher will direct the student regarding when to complete the activities as directed in the lessons. Student journals can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Wonders of Energy* unit link.

Science Wall

All The Good and the Beautiful science units include vocabulary words to be placed on your science wall, which is a wall or trifold presentation board in your learning area on which you can attach the vocabulary words and other images. ***Cut out the vocabulary word cards at the beginning of the unit.*** The course will indicate when to place them on the wall.

Lesson Preparation

All The Good and the Beautiful science units include easy-to-follow lesson preparation directions at the beginning of each lesson.

Activities and Experiments

Many of The Good and the Beautiful science lessons involve hands-on activities and experiments. **An adult should always closely supervise children as they participate in the activities and experiments to ensure they are following all necessary safety procedures.**

Experiment Videos

Go to **goodandbeautiful.com/sciencevideos** and click on the *Wonders of Energy* link or use the Good and Beautiful Homeschool app to see videos of experiments used in this unit. This is a convenient way to watch experiments that may be more complicated. Children often learn best through hands-on experience; therefore, this unit includes a supply list and instructions for all experiments, and you may choose to do as many as you wish.

Unit Videos

Some lessons include videos that were created by The Good and the Beautiful. Have a device available that is capable of playing the videos from **goodandbeautiful.com/sciencevideos** or on the Good and Beautiful Homeschool app.

Content for Older Children

Some lessons include extra content that is more applicable for older children (grades 7–8). Parents or teachers may choose to skip this content if instructing only younger children.

Content for Younger Children

Some lessons include extra content that is more applicable for younger children (grades 3–6). Parents or teachers may choose to skip this content if instructing only older children.

Versions

New discoveries are being made on an ongoing basis. This course is reviewed and revised periodically to keep information as up to date as possible. This version is the second edition of this unit.

Read-Aloud Book Pack

The books below are optional read-aloud books that complement this unit. These books can be purchased as a book pack by going to **goodandbeautiful.com/science** and clicking on the *Wonders of Energy* science unit product page.

The Spark
By Shannen Yauger

The Amazing Mind of Granville Woods
By Maggie Felsch

CORRELATED BOOKS

The Good and the Beautiful Library has several books that correlate well with the *Wonders of Energy* unit. It can be a wonderful experience for children to read books on their levels related to the subjects they are learning in science. The library includes both fiction and nonfiction books organized according to reading level. Find the correlated books by going to **goodandbeautiful.com/science** and clicking on the *Wonders of Energy* unit.

GRADES 7–8

Lesson Extensions

How the Extensions Work

Each lesson has an optional lesson extension for children in grades 7–8. Complete the lesson with all the children, and then have the older children complete the self-directed lesson extension. These extensions are located in the *Grades 7–8 Wonders of Energy Student Journal*.

Answer Key

The answer key for the lesson extensions can be found on the Good and Beautiful Homeschool app in the science section. Visit **goodandbeautiful.com/apps** for information on accessing the app. The app can be accessed from a computer, phone, or tablet.

Flexibility

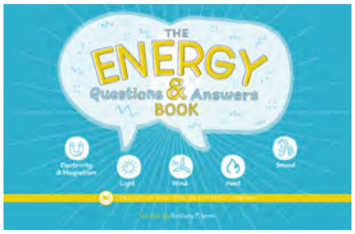
The amount of time it will take to complete each lesson extension will vary for each child. The average time is about 10–15 minutes per extension. Parents/teachers and children may choose to omit parts of the lesson extensions if desired. Encourage the children to stretch their capabilities, but also reduce work if needed.

Taking Notes

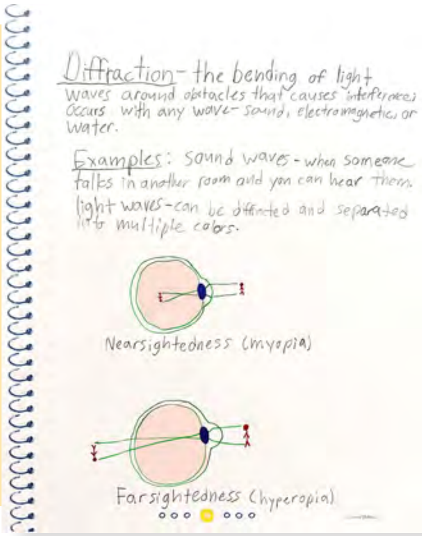
Some of the grades 7–8 lesson extensions have the children summarize the material read. Teach the children to look for key information, summarizing the most important points. Students can also add drawings and notes with their thoughts and the facts that are most interesting to them.

Optional Grades 7–8 Reading Book

We recommend *The Energy Questions & Answers Book* as extra reading for students in grades 7–8. This book can be purchased by going to **goodandbeautiful.com/science** and clicking on the *Wonders of Energy* unit link.



The Energy Questions & Answers Book
By Anthony Klemm



Supplies Needed

This section is divided into supplies needed for **activities** and supplies needed for **experiments**. If you would prefer to watch the experiments instead of perform them, you can watch all the experiments at **goodandbeautiful.com/sciencevideos** or on the Good and Beautiful Homeschool app. The activities, however, are not filmed.

Lesson 1
- Apple
- Knife
- Stopwatch or phone with a timer app

Lesson 2
- Bean bag, crumpled paper, or something else small to throw

Lesson 3
- Calculator (optional, for grades 7–8)

Lesson 4
- A small/medium bouncing ball for each child
- 2 rubber bands for each child
- Magnet
- Refrigerator or other magnetic surface
- A small snack (cracker, string cheese, apple)

Lesson 5
- 1 balloon for each child

Lesson 6
- Supplies to make a cup of hot chocolate for each child on the stove
- Ice cube for each child
- Pot filled with water
- Metal spoon for each child
- 3 clear jars
- Hot water
- Cold water
- Red and blue dye

Lesson 7
- Handheld or bathroom mirror
- Flashlight
- CD or DVD
- Clear glass cup
- Pencil or straw

Lesson 8
- Slinky®
- Small bowl
- Plastic wrap
- Dry rice
- Metal cookie sheet or pan
- Spoon

Lesson 9
- Plate
- Many small pieces of paper
- Blown-up balloon
- 6-sided die
- Small game piece
- Candles (optional)
- Calculator (optional, for grades 7–8)

Lesson 10
- Battery
- Uncoated copper wire (4 pieces, 6–12 inches each)
- 2 E10 flashlight bulbs
- 2 E10 bulb holders
- Phillips screwdriver
- Electrical tape
- 2 AA batteries

Lesson 11
- Quarter or similar coin
- Compass
- Magnets
- Hair dryer
- 24-in piece of uncoated copper wire
- 2-in nail
- Electrical tape
- D battery
- Paper clips or safety pins

Extension Supplies:
- 2 bar magnets
- Iron filings
- Sheet of card stock
- Tape
- Tray

Lesson 12
- A straw for each child

Lesson 13
- 2 flashlights

Lesson 14

Solar Oven:
- Small box with attached lid
- Aluminum foil
- Plastic wrap
- 2 sticks, rulers, or pencils
- Crackers
- Pizza sauce
- Cheese
- Pepperoni
- Transparent tape

OR

Pinwheel (for each child):
- 1 square piece of paper
- Pushpin
- Straw
- Ruler
- Pencil or pen
- Scissors

Energy Is Everywhere

Objective Help the children understand what energy is and help them recognize examples of energy in the world around them.

Preparation:

- ☐ Cut out the "Finding Energy" cards.

Activity Supplies:

- Apple
- Knife
- Stopwatch or phone with a timer app

☐ Energy Is Everywhere

Read to the children: Imagine a thunderstorm with intense flashes of lightning and crashes of thunder that echo across the sky. Lightning and thunder are both impressive forms of energy, but energy isn't always big and showy like a thunderstorm. It is not even something tangible that we can pick up and hold. ***Energy*** is the ability to do work or to make something change, move, or grow. Energy is all around us and powers everything we do, from walking to a park to cooking dinner on a stove.

☐ Science Wall

Place the vocabulary card ENERGY on your science wall. Read and discuss the word and its definition.

Energy

☐ Let's Use Energy Activity

Read the following activities in the blue box and complete them with the children.

This activity may be adapted for older children by having them carry a chair or similarly sized piece of furniture across a room instead of running in place.

Let's run in place quickly.
Now jump up and down.
Clap your hands.
Blow air on your fingertips.
Lift a pinky finger.
Blink once.

Read to the children: Think about all that work you just completed. Did you need energy to do the work of running? Jumping? What about when you blinked your eyes? Big things use energy, but small things do too. Look at your hands and imagine all the energy just waiting inside, ready to do some kind of work. God gave us energy, and we have the power to choose what work we will do with it. We can use our energy poorly, wasting it, or we can choose to use our energy for good. What is one good way you could use the energy inside of you?

Apple Energy Activity

Place an apple on the table. Read to the children: Let's think of other places where energy is found. Energy is in a lightning bolt, but it is also in the sun, the air, the plants, our food, and our bodies when we run, jump, sing, and play. Energy moves all around us, constantly passing from one thing to the next. Let's look at this apple. You might be thinking, "That apple isn't doing anything. It's just sitting on the table. There isn't any energy there." **Hold up the apple.** Is it doing anything? Do you think it has any energy? **Slice the apple and give each child a slice.** Do you see any energy now? What do you think will happen if you eat your apple slice? Energy isn't always visible. When we eat, a type of energy that is stored in food like apples is released into our bodies. **Have the children eat the pieces of apple if desired.** Where did the apple get its energy? Let's watch a video to learn more.

Energy and the Sun Video

WATCH ONLINE

Watch the "Energy and the Sun" video at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

Read to the children: What is something new that you learned about our sun? [life without the sun is impossible; the sun heats the earth because of nuclear fusion] How does the sun affect energy around us every day? [The energy from the sun creates the food chain that gives us our food, such as the apple we just ate.]

Energy Hunt in Art

Have the children turn to the "Energy Hunt in Art" page in Lesson 1 of their student journals to observe and study the painting titled "Windmill," modeled after art by John Constable.

Read to the children: Find at least five examples of work, movement, or changes in the painting. Remember, these examples may not appear to be actively using or creating energy, so also look for things that can do work, change, or move. [wind moving the windmill, horses pulling the plow, people walking, birds flying, trees growing] There are many examples in this painting because almost anything can be pushed, pulled, moved, burned, eaten, or used in some way. **Have the children write or draw their answers in their student journals. An answer key is available at the end of this lesson.**

Finding Energy Activity for Younger Children

3–6

Take out the "Finding Energy" cards. Place the "Yes" and "No" cards at opposite sides of a room. Have the children stand between the "Yes" and "No" cards. The children will then draw a card, one at a time, and show it to everyone. Have them decide whether or not the image has energy. Have them run to the correct side of the room for each card. Once the children have identified the correct side of the room, have them return to the starting place, between the "Yes" and "No" cards.

If the children are having difficulty identifying the correct location for the image cards, here are a few hints:

- **Salad:** What happens when you eat it?
- **Running children:** Are they moving?
- **Light bulb:** Tiny electrons move inside the light bulb to make it light up.
- **Hand mixer:** Is the mixer moving?
- **Lightning bolt:** How does the lightning bolt move?
- **Kitten:** Can the kitten jump and climb?
- **Fire:** Can the fire make heat to keep you warm?
- **Truck:** Can the truck move?
- **Bowling ball and pins:** Are the bowling ball and pins moving?
- **Teapot:** Is the steam coming from the teapot moving?

Read to the children: Did you notice a pattern in the answers? That's right! All of them were "yes." That is because energy is all around us! I hope that you will keep looking for God's gift of energy every day and tell me where you are seeing it.

☐ Finding Energy Activity for Older Children

7–8

Instruct the older children that they have one minute to search throughout their home for eight things that have energy. Meet back together and discuss the things they have found. Some examples include a moving fan, a pet, food, a light, a computer, or a phone that is turned on.

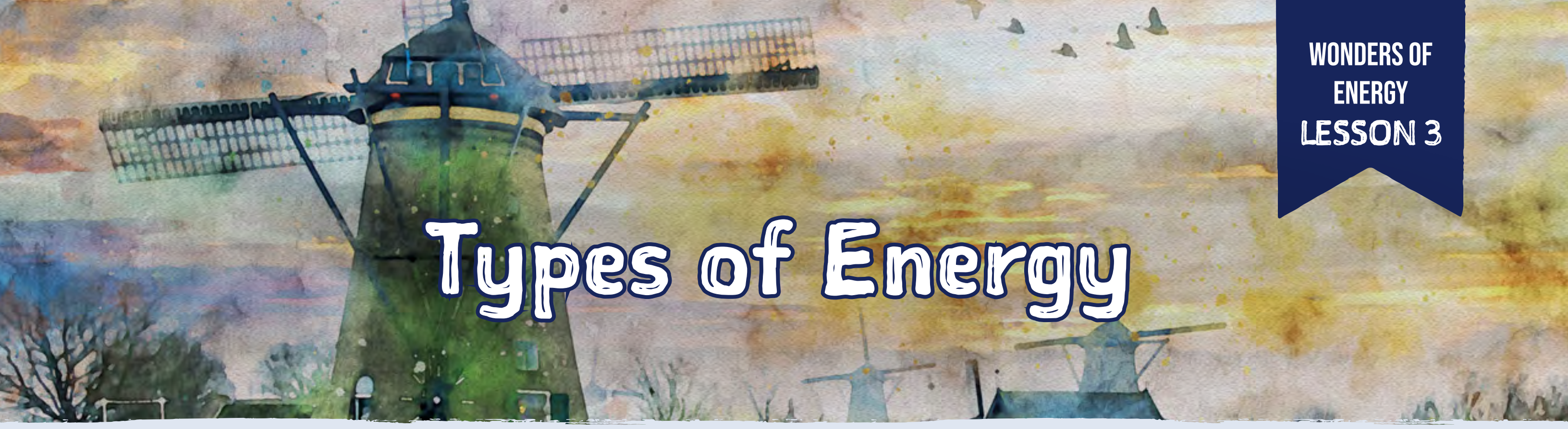
☐ Lesson 1 Extension

7–8

Have children grades 7–8 complete the self-directed Lesson 1 extension titled "Earth's Energy-Producing Star" in their student journals.


YES


NO



Types of Energy

Objective Help the children gain an understanding of 10 types of energy: chemical, electrical, elastic, gravitational, thermal, light, magnetic, mechanical, nuclear, and sound.

Preparation:

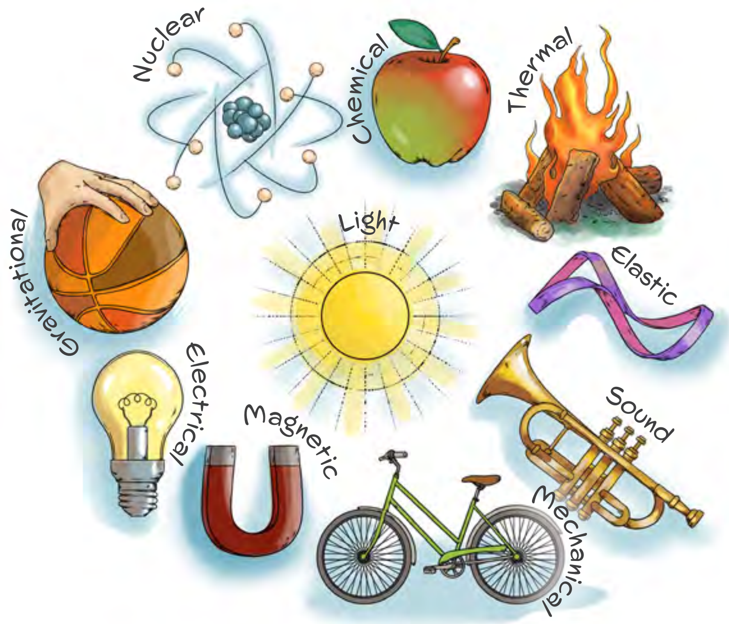
- ☐ Cut out the "Energy Detective Cutouts" in Lesson 3 of each child's student journal.

Activity Supplies:

- Calculator (optional, for grades 7–8)

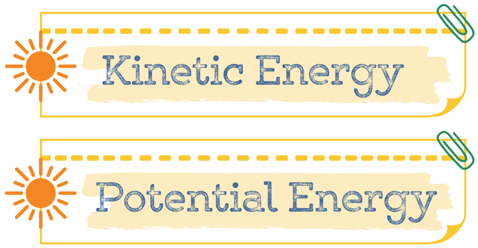
☐ Ten Types of Energy

Read to the children: You have learned that energy is the ability to do work, and you know that the ways we have used energy have changed throughout history. <u>But did you know there are different types of energy?</u> Today we are going to learn about 10 different types of energy: chemical, electrical, elastic, gravitational, thermal, light, magnetic, mechanical, nuclear, and sound energy. Those are a lot of different kinds of energy! It might be hard to remember them all, but all 10 types of energy can be sorted into two simple categories. Each of them can be labeled as either ***kinetic energy*** or ***potential energy***. *Kinetic energy* is energy that is moving. *Potential energy* is energy that is present but hasn't done any work yet. Think back to that apple you ate in Lesson 1. The apple wasn't doing any work—it was just there—but it had potential energy stored inside. Once we ate the apple, we unlocked its potential energy and used it to move our bodies. Moving your body is kinetic energy because you are actually in motion.



☐ Science Wall

Place the vocabulary cards KINETIC ENERGY and POTENTIAL ENERGY on your science wall. Read and discuss the words and definitions.



2

Clue 1: I always travel from hotter to colder objects.

Clue 2: I am a type of energy you can feel.

Clue 3: The faster my molecules move, the hotter I get.

Clue 4: The fire in your backyard radiates light and me.

3

Clue 1: I am released during chemical reactions.

Clue 2: My energy can be used as fuel for cars, animals, humans, and more.

Clue 3: I am often noticed in cooking or baking food.

Clue 4: You use me to transform an apple you eat into usable energy.

4

Clue 1: Electrons move rapidly from atom to atom to create me.

Clue 2: Benjamin Franklin helped people understand me better.

Clue 3: I am generated in power stations and travel to your home.

Clue 4: You see me as a lightning bolt on a stormy night.

5

Clue 1: Every object has my kind of energy.

Clue 2: I am kinetic energy plus potential energy.

Clue 3: I am the energy that moves an object.

Clue 4: You use me when you cut with scissors or work with hand tools.

6

Clue 1: I store my energy in an invisible force field.

Clue 2: I push or pull on other objects like me.

Clue 3: I am what makes a compass work.

Clue 4: You might use my energy to stick things on your refrigerator.

7

Clue 1: I travel through solids, liquids, and gases as waves.

Clue 2: I come from vibration.

Clue 3: I am often measured in decibels.

Clue 4: You will hear my energy when you play a guitar.

8

Clue 1: I provide one-fifth of the United States' energy.

Clue 2: I am stored inside an atom.

Clue 3: I am created when an atom's nucleus is split or joined with another atom.

Clue 4: When I am used in a power station, I create dangerous radioactive substances.

9

Clue 1: I am stored when objects are bent or deformed.

Clue 2: Objects usually return to their natural state after they release my energy.

Clue 3: Stretching, contracting, and twisting are necessary for me to work.

Clue 4: Rubber bands work because of me.

10

Clue 1: I keep people on the ground.

Clue 2: I help hold the moon in place.

Clue 3: The higher you go, the more of this kind of energy you have.

Clue 4: An apple about to fall from its tree is an example of my energy working.

☐ **Lesson 3 Extension**

7–8

Have children grades 7–8 complete the self-directed Lesson 3 extension titled "Inventors of the Modern Temperature Scales" in their student journals.

ENERGY DETECTIVE

Key

1

Light ENERGY

2

Thermal ENERGY

3

Chemical ENERGY

4

Electrical ENERGY

5

Mechanical ENERGY

Number Correct

Round 1

Round 2

Round 3

Round 4

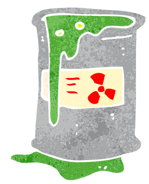
6

Magnetic ENERGY

7

Sound ENERGY

8



Nuclear ENERGY

9

Elastic ENERGY

10

Gravitational ENERGY

Light Energy

Objective Help children understand that light energy allows us to see. Light energy can be reflected, refracted, and absorbed and can be divided into individual colors.

Preparation:

- [ ] None

Activity Supplies:

- Handheld or bathroom mirror
- Flashlight
- CD or DVD
- Clear glass cup
- Pencil or straw

☐ Light Is Energy

Read the poem below to the children.

Prismatic Light
By Chantelle Ivie

Glinting raindrops falling fast,
Scattered light still shining past.
Brilliant colors seem to fly,
Rainbow stripes into the sky.
Energy for all to see
Calling out to you and me.

Read to the children: Where do you notice references to light in this poem? [glinting raindrops, scattered light, shining past, brilliant colors, rainbow stripes] Do you notice any energy mentioned in this poem? Light is actually a type of energy! Light is made up of photons, which are basically little bundles of pure energy. These small bundles of energy travel in waves to reach our eyes. They move incredibly fast. In fact, light is the fastest-moving thing in the universe! The speed of light is approximately 299,792 km (186,282 mi) per second. If you could travel that quickly, you would be able to zoom around Earth's equator 37.5 times in just 10 seconds!

Light is essential to our existence. In fact, it's so important that it was the very first thing God made during the creation (Genesis 1:3). Let's learn more about God's beautiful creation of light.

☐ Reflection Activity

Read to the children: Light travels in straight lines made up of waves. We will learn about three basic ways light behaves. You're probably familiar with all three without realizing it. **Have the children look into a handheld mirror or bathroom mirror.** What do you see? That's right—yourself! More accurately, you are seeing a reflection of yourself. Reflection is how light behaves when light waves bounce off a surface; in this case, the mirror is reflecting the light. Reflected light is actually what allows us to see our surroundings. A source, such as the sun or a lamp, provides light. That light bounces off an object and into our eyes, and our brains transform that into an image of the object.

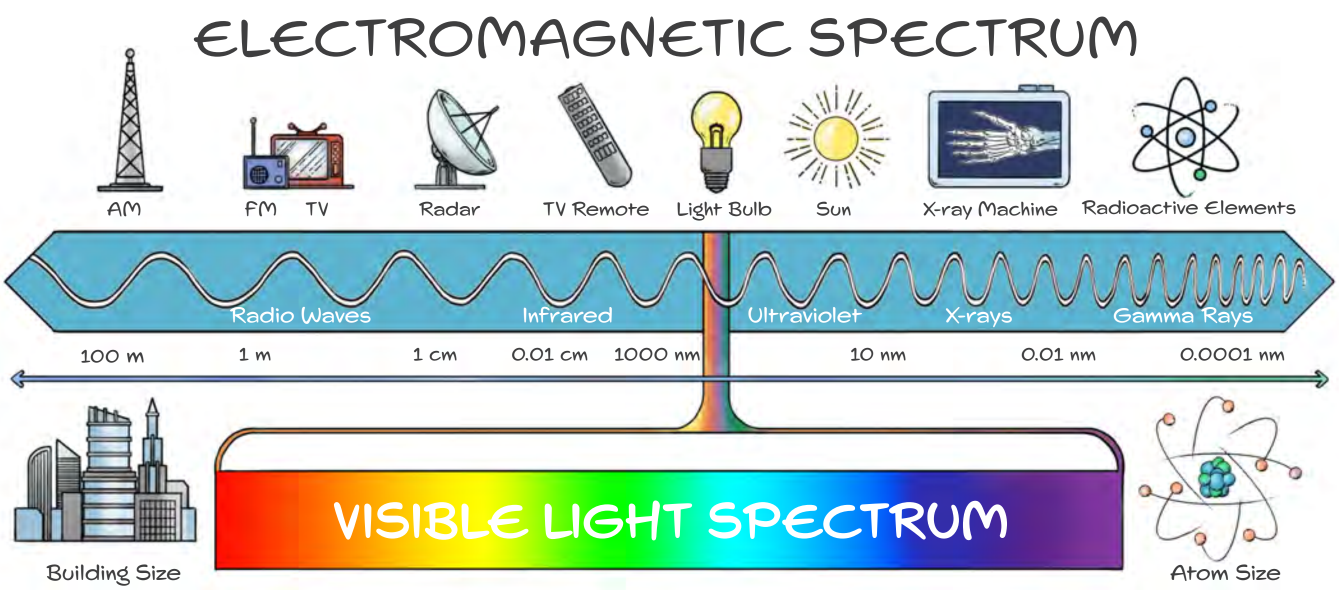
Refraction Activity

Read to the children: Another behavior of light is refraction. *Refraction* takes place when light waves bend. They continue moving forward but in a different direction. Refraction occurs because light moves at slightly different speeds through different materials. The light waves bend because they are changing speed when coming in contact with a new material. Let's try another activity to see a common example of refraction.

Fill a glass at least halfway with water. Place a straw or pencil in the glass. What do you notice about the straw or pencil? **Point out how it looks broken.** Is the straw or pencil actually broken? No, the refraction of the light simply makes it appear that way! Light travels at a different speed through air than through the water. This causes the object to look broken where the light changes speed.

Diffraction Activity

Read to the children: Finally, let's discuss diffraction. *Diffraction* happens when light waves hit obstacles that force the waves to overlap and interfere with each other. Let's see it in action. **Pull out the CD or DVD and flashlight. Turn off the lights. Shine the light against the CD or DVD at an angle so that the light is bounced back onto a wall or paper.** What do you see? The colors in the rainbow reflect in strange patterns because the light waves are being diffracted. **Let the children take turns reflecting the light off the CD or DVD.** What seems like white light from the flashlight is broken into all the separate wavelengths that make up the colors of the rainbow. The colors come from the ***visible light spectrum.*** Look at the diagram below. The visible light spectrum is just a small part of the larger electromagnetic spectrum that includes waves of many different types. These waves radiate energy outward. The spectrum includes light waves and also waves that can make music play on the radio, microwave your



food, and x-ray your broken bones. All the colors of visible light are just a small part of the spectrum.

☐ Science Wall

Place the vocabulary card VISIBLE LIGHT SPECTRUM on your science wall. Read and discuss the words and definition.

☐ Seeing Colors

Read to the children: <u>Did you know that seeing colors is dependent on both the reflection and absorption of light? We know about reflection, but what is absorption?</u> The *absorption* of light occurs when some of the light waves get taken in or soaked up by the object with which they have come into contact. Look at the images below. When we see white, it is because all colors are being reflected equally. When you see a red shirt, it seems red because when white light hits the shirt, all other colors of light are absorbed except for red, which bounces back to your eyes. When we see black, it is because all colors have been absorbed. Absorption helps determine all the colors that we see.

☐ Light Student Journal

Have the children complete the "How Light Moves" page in Lesson 7 of their student journals. An answer key is available at the end of this lesson.

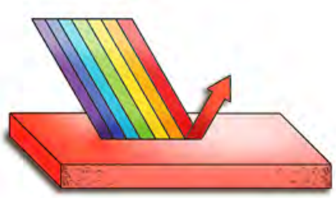
☐ Light Energy Video

WATCH ONLINE

Watch the "Light Energy" video at goodandbeautiful.com/sciencevideos or from the Good and Beautiful Homeschool app.

☐ Lesson 7 Extension

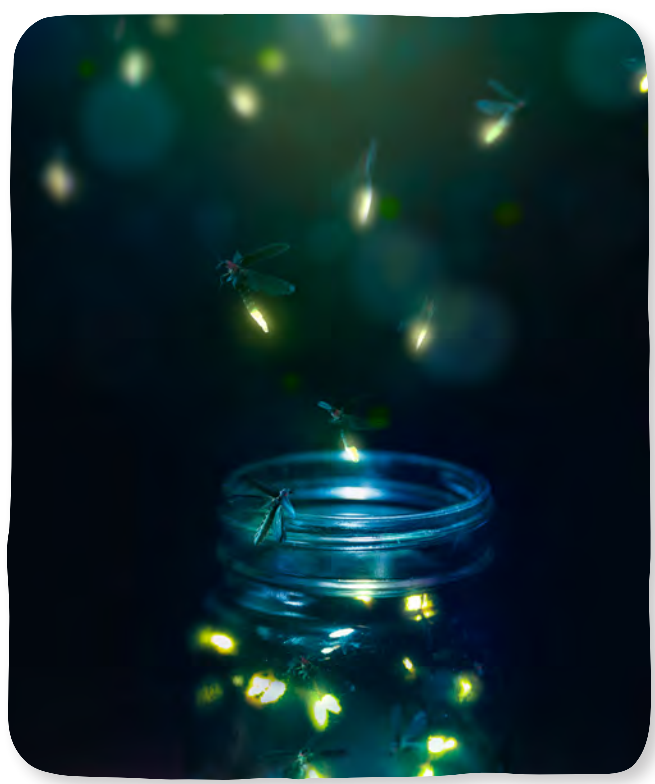
Have children grades 7–8 complete the self-directed Lesson 7 extension titled "Diffraction: The Motion of Interrupted Waves" in their student journals.



A red object reflects red and absorbs other colors of white light.

A white object reflects all colors of white light equally.

An object is seen as black if it absorbs all colors of white light.



POWER LINE GAME QUESTIONS

Generation Station

The generation station is where electricity is duedcorp. Generation stations can use coal, the sun, wind, natural gas, and many other sources to create electricity.

Transformer

Electricity traveling long distances can lose energy, but going through the transformer increases the voltage (electrical push) to prevent yenreg sols.

High-Voltage Transmission Lines

Electricity traveling long sdinsatce does so on special lines meant for high-voltage electricity.

Substation

As the electricity approaches its destination, it arrives at a substation. The substation lowers the olvtgae, decreasing the electrical push as well as spreading the electricity to the next set of power lines.

Distribution Lines

These power lines take energy to neighborhoods. You might see the lines up in neighborhoods, or they might be ndourrgednu.

Neighborhood Transformer

Neighborhood transformers lower the voltage of the celirytciet so that it can be used by houses.

Meter & Service Panel

Once the electricity arrives at a uoseh, it passes through a meter to calculate how much electricity is being used before it enters into the service panel. The service panel sends the electricity to the right wires within the house.

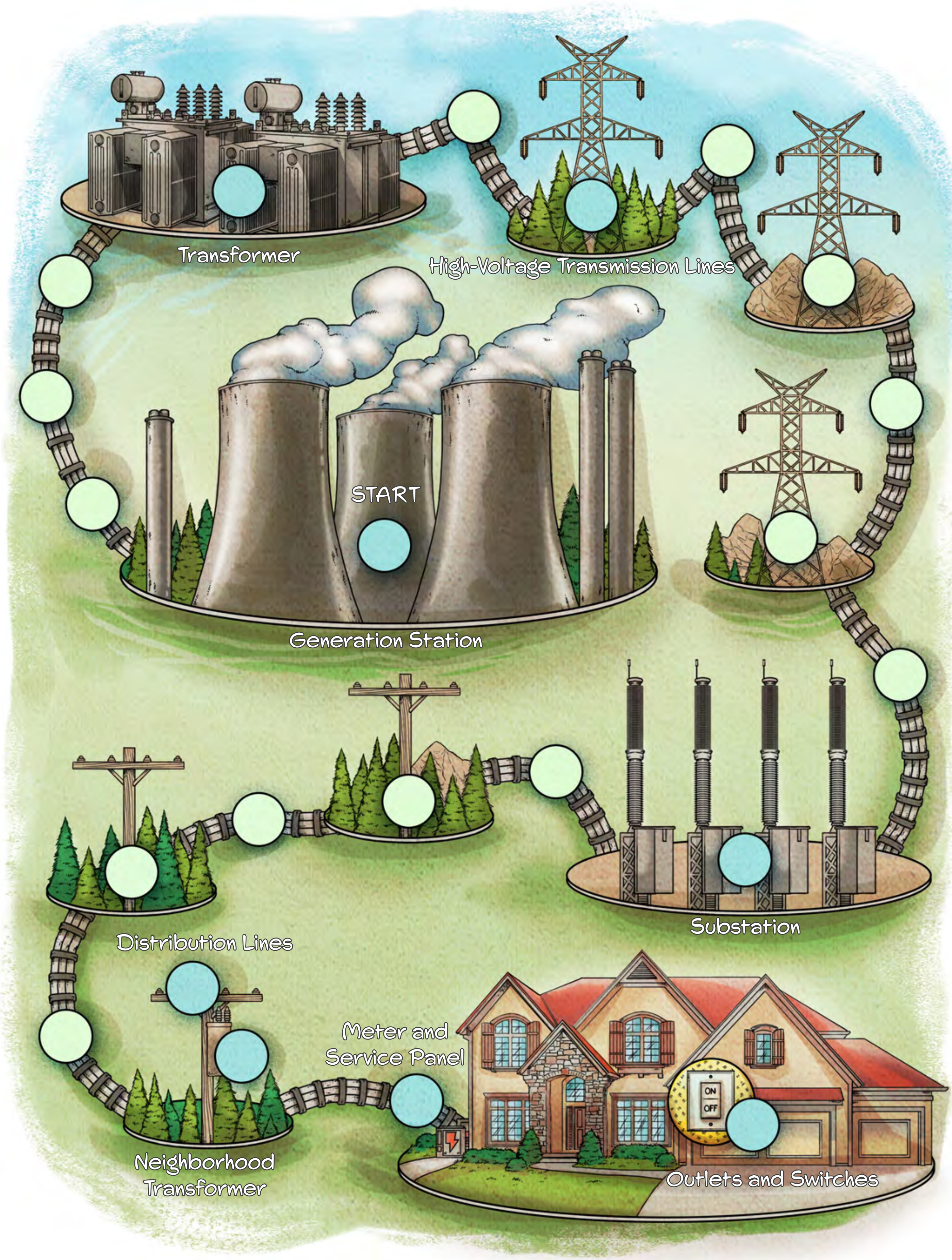
Outlets & Switches

The electrical wires hidden in the walls of the house carry the electricity to the outlets and switches. The voltage of the electricity at this stage is still very greodnaus to touch, but it is low enough to operate within the wires of the house and to power the electronic appliances.

WORD BANK

voltage	produced	distances
dangerous	underground	energy loss
house	electricity	

POWER LINE GAME



Renewable and Nonrenewable Energy

Objective Help the children identify the difference between renewable and nonrenewable energy, identify the nine categories of energy resources, and learn about common sources of renewable energy.

Preparation:

- [ ] Cut out the "Renewable and Nonrenewable Energy Cards."

Activity Supplies:

- A straw for each child

☐ Renewable Energy in Art

Have the children turn to the painting titled "Landscape with Waterwheel and Boy Fishing" by George Caleb Bingham in Lesson 12 of their student journals to observe and describe what they see.

Read to the children: Imagine you are fishing, just like the boy in the painting. What are you sitting next to? [a waterwheel] Waterwheels like this one harness a ***renewable energy*** resource: flowing water. Renewable energy resources are reusable and sustainable because they never run out, they originate from the earth, and they do not emit harmful by-products into the earth's environment. ***Nonrenewable energy*** resources are also sourced from the earth, but they can and do run out. Most of them were created by plants and animals a very long time ago. They are not sustainable because they may take many years to replace or not be available at all once we use them. Nonrenewable resources also often emit harmful by-products into the environment when we use them. Let's play a game to figure out more about renewable and nonrenewable resources.

☐ Renewable and Nonrenewable Game

Place the "Nonrenewable" and "Renewable" labels at opposite ends of a table. Place the cards in a stack with the pictures facing up.

Read to the children: We are going to draw cards and decide if the resource described is renewable and can be used again or nonrenewable and will eventually


Solar

Wind

Water

Biomass

Geothermal

Coal

Petroleum

Natural Gas

Nuclear

Energy and Design

Objective

Help the children design something that uses energy to accomplish a specific task.

Preparation:

- ☐ None

Solar Oven Supplies:

- Small box with attached lid
- Aluminum foil
- Plastic wrap
- 2 sticks, rulers, or pencils
- Crackers
- Pizza sauce
- Cheese
- Pepperoni
- Transparent tape

Pinwheel Supplies (for each child):

- 1 square piece of paper
- Pushpin
- Straw
- Ruler
- Pencil or pen
- Scissors

☐ Energy Project

Read to the children: Now that we have learned so much about energy, we can put our knowledge to use. Today we get to design something that uses energy! **Help the children complete the project you selected using the directions below.**

☐ Solar Oven

Read to the children: Solar ovens are a great way to use the energy from the sun to cook food. Although they do not cook as hot or hold the same temperature as a home oven, solar ovens can be used to sustainably boil water and cook food. Let's get started on making one of our own.

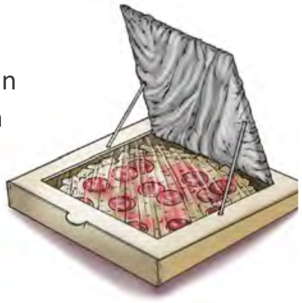
Gather the necessary supplies listed above. Note that this project will work better on a warm, sunny day. Read the steps below and help the children construct the solar oven.

1. Line the entire inside of the box and lid securely with aluminum foil.
2. Tape to seal off any openings in the foil.
3. Place crackers, topped with pizza sauce, cheese, and a piece of pepperoni, inside the box.
4. Leave the lid open and cover the snack by taping plastic wrap over the opening to seal in the air.

5. Take the box outside and place it in the sun where it won't be disturbed.
6. Carefully open and close the lid until you find the correct angle to have the sunlight reflected on the food. Prop it open at the desired angle with rulers, sticks, or pencils.

7. Wait about an hour to check and see if your cheese has melted. If it hasn't, don't give up. Wait another hour and check again.
8. Remove your delicious snack and eat it!

Read to the children: What type of energy did we use to cook our snack? [We used solar energy.] Is solar energy renewable and why? [It is renewable because we can use it again and again.] What can we learn about energy from our solar oven? [Answers can vary but may include that the sun is a powerful source of energy. Light reflection and absorption impact how well heat is captured and retained.]



☐ Pinwheel

Read to the children: A pinwheel is a toy, but it works on the same principle as a windmill, which has been used for many generations to provide power for jobs like grinding grain or pumping water. The kinetic energy of wind can power pinwheels and so much more. Let's make a pinwheel of our own.

Gather the necessary supplies listed at the beginning of the lesson. This project can be successful during all seasons. If it is not a windy day, the children can still make their pinwheels work by blowing on them.

1. Use a ruler to find and mark the center of your piece of paper with a dot.
2. Next, use your ruler to draw a line from each corner halfway to the center dot.

3. Use scissors to cut along the diagonal lines you just drew on your paper.

4. Fold every other point to the center dot and secure the four points with the pushpin. Do not crease. **This step may be tricky for younger children, so they may need help holding all the points together and securing them.**

5. Pick up the pinwheel and make sure the pushpin goes through all the layers of paper. Then push the pushpin into one side of the straw. **It may be best for an adult to do this step.**

6. Decorate your pinwheel, if desired.
7. Take your pinwheel outside to catch the breeze or blow on it to make it spin!

Read to the children: What type of energy does our pinwheel use? [wind energy] Is wind energy renewable and why? [Yes, it is renewable because we can use the wind again and again. It never runs out permanently.] What can we learn about energy from our pinwheel? [Answers can vary but may include that wind can create energy. Wind energy is variable and dependent on weather conditions.]

Lesson 14 Extension

7–8

Have children grades 7–8 complete the self-directed Lesson 14 extension titled "Conserving Energy: How Can I Help?" in their student journals.

WONDERS OF ENERGY

Grades 3-6

STUDENT JOURNAL

This journal belongs to:

THE GOOD AND THE BEAUTIFUL

INSTRUCTIONS

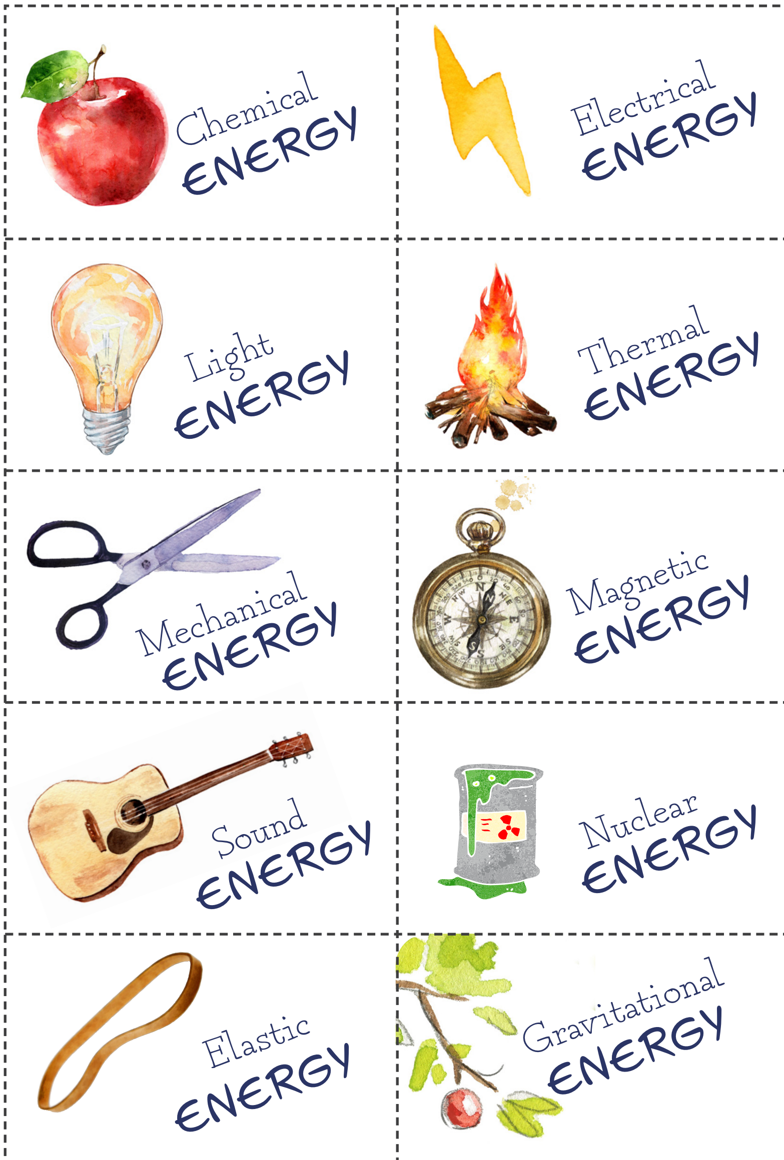
This student journal accompanies *The Good and the Beautiful Wonders of Energy* science unit. It contains all the activity and journal pages that are needed to complete the unit. Each student will need a copy of the science journal.

Have each student spend enough time to create high-quality work as the activities and worksheets are completed. Students may enjoy looking back on their past discoveries after they've finished.

TABLE OF CONTENTS

ENERGY DETECTIVE Cutouts

Cut out the cards below. Listen to the clues and figure out which card matches each clue. You will be told how many cards are correctly placed after each round of clues. There will be four rounds. See how many clues you need to get them right.

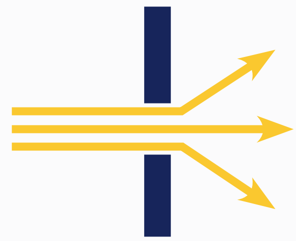


HOW LIGHT MOVES

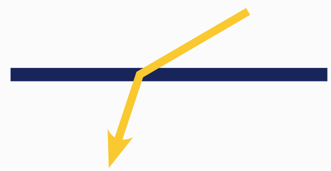
Match each type of light behavior to the correct picture.

Reflection

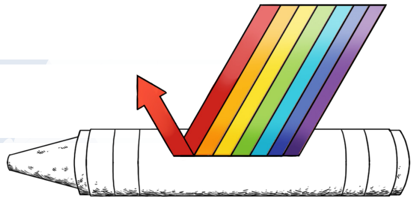
Refraction

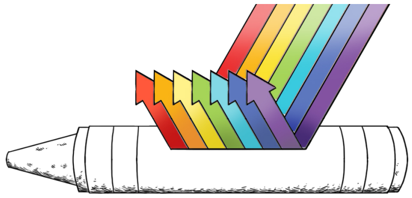


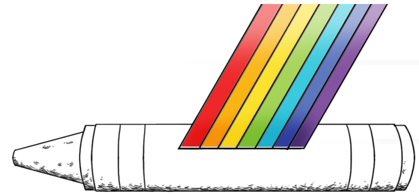
Diffraction



Examine the way light is reflecting in each image below.
Color each crayon the color it would appear, or leave it blank for white.



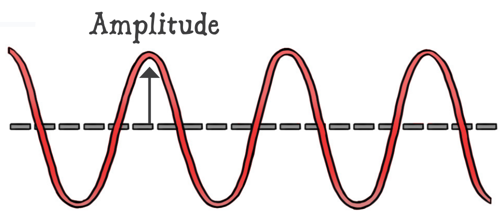




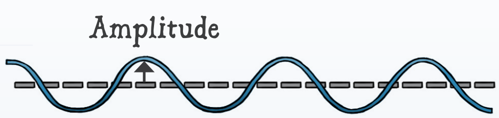
Lesson 8

SOUND WAVES

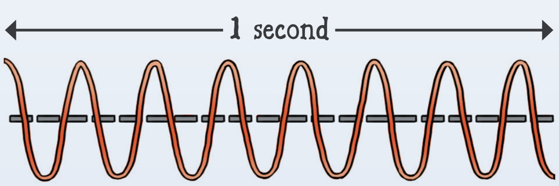
Match the “Sound Waves Cutouts” with the correct types of sound in real life.



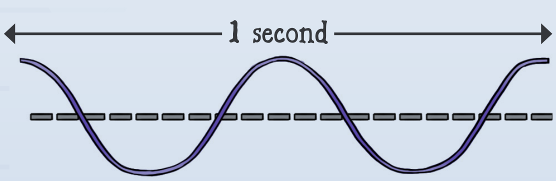
High Amplitude - Loud Sound



Low Amplitude - Quiet Sound



High Frequency - High Pitch - High Sound



Low Frequency - Low Pitch - Low Sound

CIRCUIT EXPERIMENT

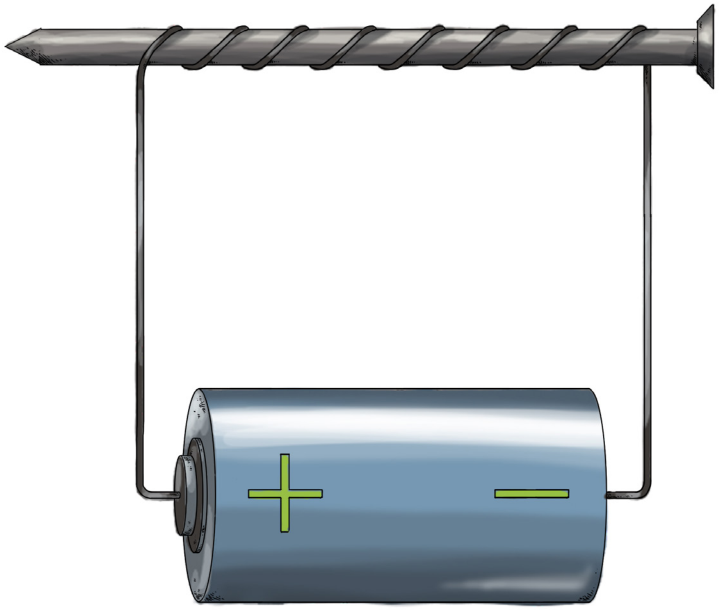
Write your predictions and results for each activity below.

	MY PREDICTIONS	RESULTS
Extra Bulb + 	I predict that when I add the extra bulb, the light will . . .	When I added the extra bulb, the light . . .
Extra Battery + 	I predict that when I add the extra battery, the light will . . .	When I added the extra battery, the light . . .
Parallel Circuit - 	I predict that when I unscrew a light from the circuit, the other light will . . .	When I unscrewed a light from the circuit, the other light . . .

ELECTROMAGNET ACTIVITY

Draw a line from each part of the electromagnet to the correct part name in the word bank.

SIMPLE ELECTROMAGNET



WORD BANK

Coiled wire

Battery

Iron nail

Wire

Reconfigure your electromagnet by changing the number of times you wrap the wire around the nail. Circle the number of wraps around the nail you predict will pick up the most. See how many paper clips or safety pins each configuration will actually pick up. Record your results below.

Coils wrapped around nail	Paper clips or safety pins picked up
30	______
5	______
45	______
10	______

How many wraps of the wire picked up the most paper clips or safety pins? Why do you think that happened? Circle the correct response below.

A. 45 wraps around the nail picked up more paper clips or safety pins because the wire has contact with the nail in more places and creates a stronger magnet.

B. 5 wraps around the nail picked up more paper clips or safety pins because the wire has less contact with the nail and creates a stronger magnet.

WONDERS OF ENERGY

Grades 7-8

STUDENT JOURNAL

This journal belongs to:

THE GOOD AND THE BEAUTIFUL

INSTRUCTIONS

This student journal accompanies *The Good and the Beautiful Wonders of Energy* science unit. It contains all the activity and journal pages that are needed to complete the unit. Each student will need a copy of the science journal.

The lesson extensions are also found here. These extensions are optional for older students (grades 7–8) to complete on their own. Each extension is accompanied by lined paper so the student can keep his or her work in one place.

Have each student spend enough time to create high-quality work as the activities and worksheets are completed. Students may enjoy looking back on their past discoveries after they've finished.

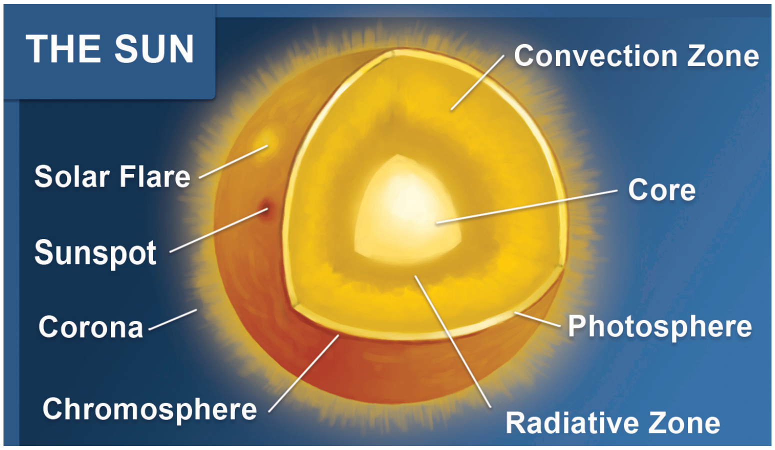
TABLE OF CONTENTS

EXTENSION

Instructions:

1. On the blank page, draw an image of the sun like the one below.
2. Read the article and use the information to label the parts of the sun you drew on your journal page. Write one fact about each layer below its label. You may enhance your picture with color and other graphics if you wish.

Earth's Energy-Producing Star



Energy is a part of everything we do each day, and that energy ultimately comes from the sun. Our sun is known as a yellow dwarf star. It is about 1.4 million km (860,000 mi) in diameter. This giant star makes energy on Earth possible.

The sun's energy output begins in the ***core***. The center of the core is about 15 million °C (28 million °F). Energy is released when four hydrogen atoms in the core join to create a helium atom. This is called nuclear fusion.

The released energy then travels to the ***radiative zone***. This layer is made of a dense plasma that causes the radiation to bounce around in a zigzag path for a very long time until it reaches the next layer.

This layer is called the ***convection zone***. Cooler temperatures in the convection zone make the plasma too thick for radiation to pass through; so instead, large bubbles of hot plasma form and move up to the surface of the sun, much like a pot of boiling water.

The visible surface of the sun is called the ***photosphere***, and it's about 5,500 °C (10,000 °F).

Just above the photosphere is the ***chromosphere***, which is part of the atmosphere of the sun. It looks like it glows red in certain light. There is a transition region between the chromosphere and the next layer, the ***corona***, where the temperature drastically increases within a short distance. The corona is made of hot plasma that's even hotter than the surface of the sun at over 1 million °C (1.8 million °F). Scientists are still not sure why this solar atmosphere gets so hot when it is farther from the sun. You can see the corona only during a total solar eclipse or with a special tool called a coronagraph. Past the corona, the sun's electromagnetic waves travel to the earth at light speed—299,792 km (186,282 mi) per second.

SOLAR Fun Facts

- The sun is an almost perfect sphere with only a 10 km (6.2 mi) difference between the diameter at the poles and the equator. It is the closest thing to a perfect sphere that has been found in nature.
- The sun appears white to our eyes because it has all the colors of the visible light spectrum mixed together.
- The distance from the sun to Earth changes throughout the year because Earth travels on an elliptical orbit around the sun. The distance between the two bodies varies from 147 to 152 million km (91 to 94 million mi).
- The sun generates ***solar wind***, which is a flow of extremely fast-moving particles (about 450 km [280 mi] per second) through the solar system.
- The sun has a strong magnetic field, and when its energy is intensified, areas of cooler temperatures, called ***sunspots***, are created, as well as ***solar flares*** that spin like giant tornadoes. Very large solar flares are called coronal mass ejections.

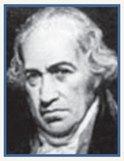
Lesson 3 | Grades 7-8

EXTENSION

Instructions:

1. Read the information below.
2. Write at least one fact about each inventor.
3. Calculate the following, using a calculator if desired. Determine if each temperature is hot or cold. 25 °C = _____°F 327 K = _____°C 10 °F = _____°C

Inventors of the Modern Temperature Scales

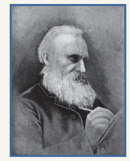


Daniel Gabriel Fahrenheit

Fahrenheit, a German physicist, invented the temperature scale that bears his name in 1724 after designing the first alcohol and mercury thermometers. The scale was based on three fixed temperatures: body temperature; the melting point of ice; and the freezing point of equal parts water, ice, and salt, which he gave the value of 0° F. He thought his scale would make things mathematically simpler, but the numbers had to be tweaked to work out right. He ended up with 32° F as the freezing point of water and 212° F as the boiling point of water. Using a Fahrenheit scale, there are exactly 180 degrees between the freezing temperature and boiling temperature of water.

Anders Celsius

Celsius was a Swedish astronomer who created the Celsius scale in 1742. People first called the scale centigrade (meaning "hundred steps"), but it was renamed to Celsius after being confused with other mathematical measurements, such as centimeters. Celsius wanted a scale that simplified the boiling and melting points of water and avoided using negative numbers or fractions as much as possible. When he first invented his scale, the boiling point of water was set at 0° C, and the freezing point was 100° C. Somewhere along the line, the two measurements were switched, and now we use 0° C as the freezing point of water and 100° C as the boiling point of water.



Lord William Thomson Kelvin

Kelvin was a British scientist who invented his scale in 1848 as a means of measuring the extremes of hot and cold. Zero on the Kelvin scale is called ***absolute zero*** and is equal to -273.15 °C. Scientists believed that the volume of a purely theoretical ideal gas would become zero at this temperature. This is only a theory though, as a gas has never reached absolute zero before becoming a liquid or solid. The Kelvin scale helps scientists make calculations with an absolute zero starting point. Like the Celsius scale, there are 100 kelvins between the temperatures of boiling and freezing water. The symbol for kelvin is K and does not use a degree sign.

Did you know?

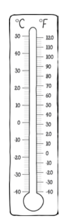
Many English-speaking countries used the Fahrenheit scale until they converted to the metric system, including the Celsius scale, in the 1970s. The United States is one of the few countries that does not use the metric system and still uses the Fahrenheit scale. Scientists mostly use the Kelvin scale because the numbers are always positive, and it is easy to convert to and from Celsius degrees—simply add or subtract 273.15.

Converting Between Scales

Celsius and Fahrenheit

°C = (°F − 32)/1.8

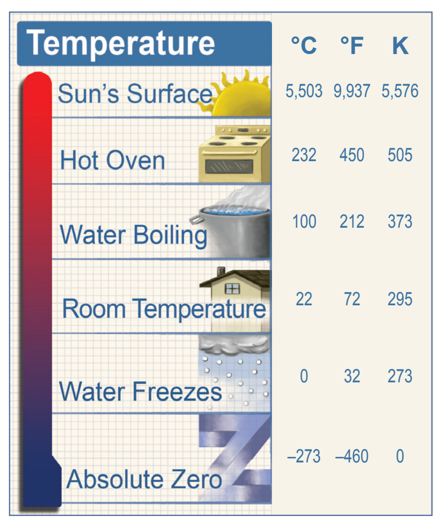
°F = °C × 1.8 + 32



Celsius and Kelvin

K = °C + 273.15

°C = K − 273.15



ART STUDY

"A Raging Waterfall, Laatefossen in Hardanger, Norway" by Vilhelm Melbye (1824–1882), 1863

Lesson 4 | Grades 7-8

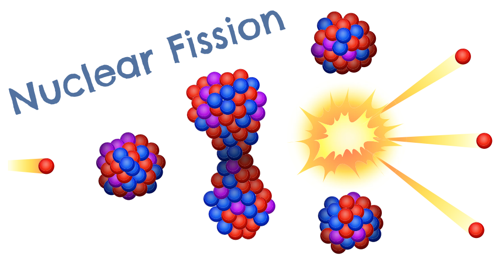
EXTENSION

Instructions:

1. Read the information below.
2. Draw a copy of the nuclear fission diagram, and then explain below your drawing what is happening in it.
3. Write one reason nuclear power is useful and one way it is dangerous.

Nuclear Power

Nuclear energy is a very efficient form of power that generates a large amount of electricity. Power plants produce this energy through a process called nuclear fission. Look at the picture below to see the process.



Often, uranium atoms are split when they are hit by a neutron. The small red ball in the image above is a neutron. The first big ball it hits represents a uranium atom. When the neutron hits the atom, it releases heat and radiation and creates more neutrons that spread out from the original. In nuclear power plants, this process is used to produce heat, which is then combined with water to produce steam. The steam is then used to generate electricity for household and industrial use.

While nuclear power generates electricity that we need, it is not without its challenges. Nuclear power plants produce radioactive waste, which comes mainly from uranium fuel that has been used but no longer produces electricity. This dangerous waste sends out radioactive emissions and must be carefully stored until the emissions stop. Radioactive emissions come from atoms wanting to emit extra energy, and that kind of energy can cause humans to get sick. Normally, the radioactive waste is kept at the nuclear power plant where it was made, but if a nuclear power plant is shut down, the radioactive waste has to be safely disposed of as well. This process can take many years to complete.

Nuclear power plants have many safety systems and security procedures in place that are closely monitored by the Nuclear Regulatory Commission (NRC). A single accident at a nuclear power plant can be devastating. If dangerous radiation levels are released over an area, it can cause widespread damage and contamination to the surrounding people, buildings, food and water supply, and livestock.

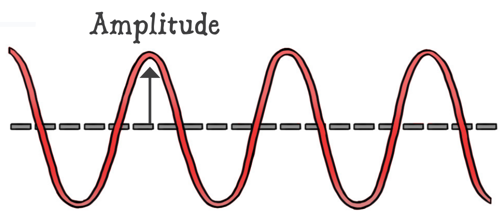
Chernobyl

When: April 1986
Where: Pripyat, Ukraine

Considered the world's worst nuclear disaster, the Chernobyl nuclear disaster occurred on April 26, 1986. Before the accident, the Chernobyl nuclear power plant had scheduled a planned power reduction. By midmorning the power level at the plant had reduced to 50%, at which time one of the power stations in the region unexpectedly lost communication. It was then requested that any further power reduction within the plant be put on hold. However, despite this request, the power reduction and preparations for an accompanying test continued. The accident occurred when one of the nuclear reactors had a sudden power surge that resulted in an explosion and fire. This caused massive amounts of radioactive fallout (fuel and other materials) to be released into the environment, which spread across the western Soviet Union and Europe. It is estimated that 30–50 people died as an immediate result of the Chernobyl nuclear disaster, but it is predicted that up to 4,000 more might eventually die from the long-lasting effects of radiation exposure.

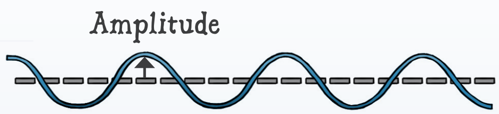
SOUND WAVES

Write at least three examples of each type of sound in real life.



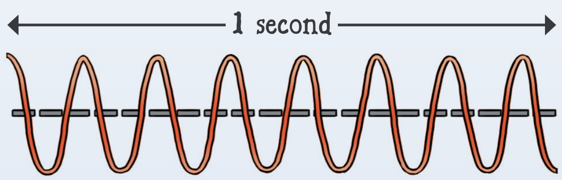
High Amplitude - Loud Sound

1. ______
2. ______
3. ______



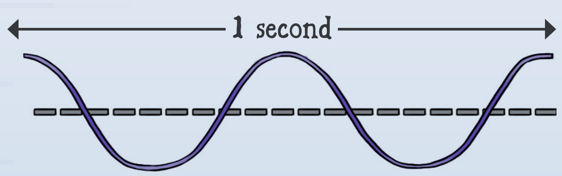
Low Amplitude - Quiet Sound

1. ______
2. ______
3. ______



High Frequency - High Pitch - High Sound

1. ______
2. ______
3. ______



Low Frequency - Low Pitch - Low Sound

1. ______
2. ______
3. ______

EXTENSION

Instructions:

1. Read the information below.
2. Follow the directions to calculate energy usage for 3–4 appliances from the example.
3. If desired, calculate energy usage for 2–3 appliances in your own home, using the directions in the right-hand column of the article.

Electricity Use Case Study

Electricity is really fascinating to learn about, but what does it mean to you directly? During this research assignment, you will see just how many ways you use electricity in your daily life and how much electrical energy you consume. Today you will figure out how much power is used by various appliances in a household by following the directions below.

1. Choose three or four appliances from the samples below.
2. Record the usage in watts (W) or multiply volts times amps (V × A) to get the wattage.
3. Then estimate how many hours you might use the appliance per day in your home (use decimal points if less than an hour).

Refrigerator	500 watts
Hair Dryer	120 volts x 12.5 amps
Washing Machine	2,200 watts
Dishwasher	220 volts x 10 amps
Television	58 watts

Optional: Now, let's figure out how much you pay for having electrical conveniences in your home. Get out your calculator, because science and math go hand in hand.

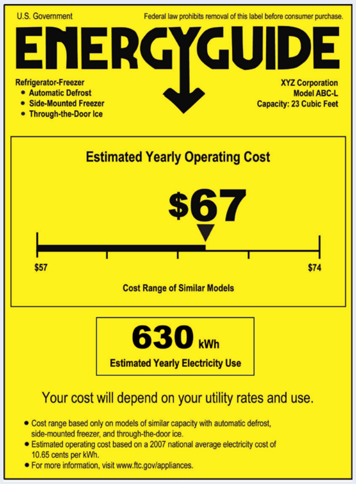
1. Find out how much you would pay per unit of energy by looking at the sample electric bill. This will be in kilowatt-hours (kWh).
2. Using the previously chosen appliances to the left, multiply the appliance's wattage (found during the last section) by the number of hours it is used in a day, and then divide by 1,000. This will give you the total number of kilowatt-hours used in a day.
3. Multiply the kilowatt-hours by your cost per kWh. This is your cost per day for using that appliance.
4. To calculate your cost per month, multiply your cost per day by the number of days that you typically use the appliance in a month.
5. To calculate your cost per year, multiply your monthly cost by 12.

Did you know?

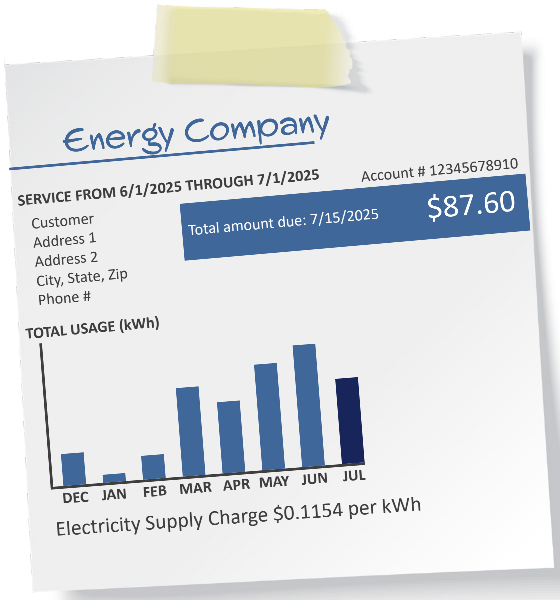
Your refrigerator accounts for an average of 13% of your monthly electric bill.

Did you know?

Appliance stores have yellow EnergyGuide labels because people want to know how much energy an appliance uses, how it compares to similar appliances, and about how much per year it costs to use.



Source: consumer.ftc.gov



Lesson 10 | Grades 7-8

EXTENSION

Instructions:

1. Read the information below.
2. Copy the information from the left column and list one example of each.
3. Explain how the discovery of semiconductors has impacted your life.

Conductors

» Materials that heat or electricity can pass through without difficulty

Insulators

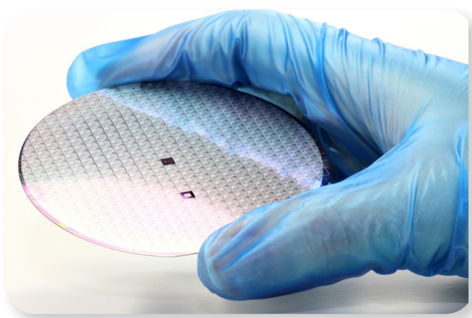
» Materials that heat or electricity cannot pass through easily

Semiconductors

» Materials that heat or electricity can sometimes pass through easily, but other times cannot

Semiconductors: The Key to Modern Technology

We have learned about conductors and insulators of both heat energy and electricity, but there is actually another category of materials that exists. These materials do not conduct energy as well as metals, though sometimes they can be conductive. Read the section to the left to learn more. Semiconductors are considerably more conductive than insulators, but sometimes they act as insulators as well. These are called ***semiconductive materials***, and they have transformed technology as we know it.



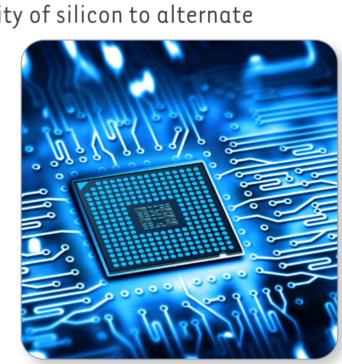
Silicon is the most common semiconductive material and the most important material in creating today's electronics, so we will focus on this element. There are other materials that could work better as semiconductors. However, those materials are expensive, and silicon is inexpensive and abundant, so using it makes electronics more affordable.

You may have heard the term "Silicon Valley," which refers to the area in California, USA, where a lot of technology companies launch their products and have their headquarters. There is a search across the world for even better materials that can be used in electronics.

Semiconductive materials like silicon can be altered to function like a kind of switch that controls the conduction of energy. Through the use of electrical fields, silicon can be switched on to act as a conductor like a metal or switched off to act as an insulator like glass. Semiconductors are able to do this at room temperature, while other materials need temperature extremes, and still others cannot work as a switch at all. With the discovery of the ability to control electrical flow through computer processors with silicon, a new world of information transfer opened and introduced important computer components such as transistors, memory chips, computer processors, and many other electronic components. Silicon is also used in the integrated circuits found in cell phones, computers, scanners, DVD players, and LED lights. Without silicon, communication as we know it would not be possible.

A computer chip is a pure silicon plate with impurities inserted into it at strategic points. Chips are created in super-clean facilities by people wearing full-body suits and gloves to avoid contaminating these chips—even a microscopic flaw like a tiny bit of dust could make the chip malfunction. Added to this silicon plate are transistors and gates that tell electricity where to go and what to do.

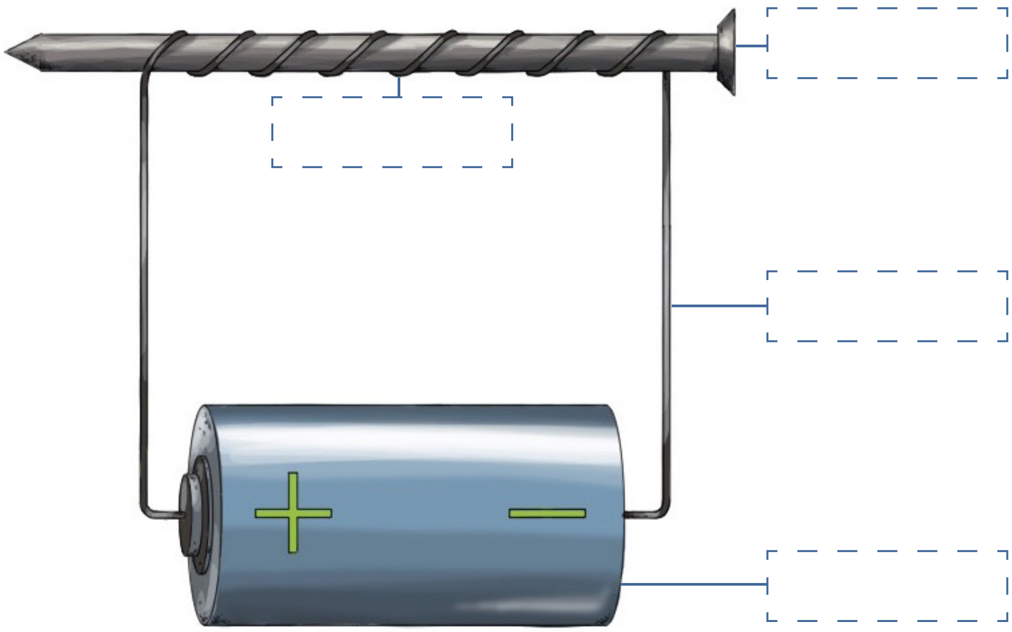
It is an extremely complex process, but it all rests on the ability of silicon to alternate between conducting and insulating. Today's electronics would not exist without semiconductors.



ELECTROMAGNET ACTIVITY

Label the parts of the electromagnet using the word bank to the right.

SIMPLE ELECTROMAGNET



WORD BANK

- Coiled wire
- Battery
- Iron nail
- Wire

Reconfigure your electromagnet by changing the number of times you wrap the wire around the nail. Circle the number of wraps around the nail you predict will pick up the most. See how many paper clips or safety pins each configuration will actually pick up. Record your results below.

Coils wrapped around nail	Paper clips or safety pins picked up
30	
5	
45	
10	

How many wraps of the wire picked up the most paper clips or safety pins? Why do you think that happened? Explain why below.

EXTENSION

Instructions:

1. Read the information below.
2. Describe each type of home listed and how it conserves energy.
3. Pick one type of home you would enjoy living in and explain why.

Homes Around the World and Building Off-Grid

Does the type of home we build affect our conservation of energy? Yes. Homes around the world leave different imprints depending on what materials they are made of, how well they insulate heat, and how often they will need repairs. Let's take a tour of homes that have been built around the world and see how homes have been adapted to better conserve energy and suit the local people.

Northern Africa: Ancient cave homes have been carved out of rock to keep their dwellers out of the hot African sun and strong desert winds. These homes are carved into the rock, so they are naturally well insulated, causing them to stay cooler in summer and warmer in winter when the outside temperatures are a stark contrast to what would be comfortable inside. Homes farther south called rondavels are built as round, single-cell huts from local sources of natural material, such as rock and grass. These dwellings are still popular today.

Southwest Asia: Here, you can find whole communities of houses built on stilts. This building technique is due to high rainfall and flooding. It also protects inhabitants from common invaders, such as snakes! Well-slanted rooflines allow heavy rains to run off, which would otherwise cause damage and utilize more resources to repair if not designed with this purpose in mind.

Korea: A *hanok* house is a traditional Korean-built home that was culturally designed with a river in the front and a mountain in the back. Even the seasons were evaluated in the planning of these structures, so the houses use less energy to heat and cool them. As with the other homes listed at left, the building materials were heavily influenced by what was available locally.

Construction has become an ever-expanding industry. New designs that can be quickly replicated have been made to make construction more cost effective, but that doesn't always mean these homes are cheaper in the long run. Using technology to plan both residential and commercial properties, researchers continually examine what types of building materials, as well as sources of energy, can be used to supply our modern need for housing while considering the cost of maintaining our comfort in these homes long term. Individuals also look at how to source their building supplies locally and consider methods of building that pay off in the long run.

One example of energy conservation that can be used on existing or new homes is solar panels. Solar panels can be installed on the roofs of existing homes and even supplement the energy they are already consuming from local energy companies. Even modern homes can be sustained fully off-grid, meaning they don't use any energy outside of what they can collect themselves from sources like the sun, wind, and moving water like a stream or creek. With solar panels and batteries to hold the charge or wind and watermills, these options make excellent sources of renewable energy depending on location and environment. It is exciting to see how this industry continues to grow, making alternate forms of electricity available in the future.

Scripture points us to counting the cost with our resources and plans. Whether we are building a home or executing our school assignments, counting the cost will give us an understanding of what it takes to be efficient in the long run!

Luke 14:28

"For which of you, intending to build a tower, sitteth not down first, and counteth the cost . . ."