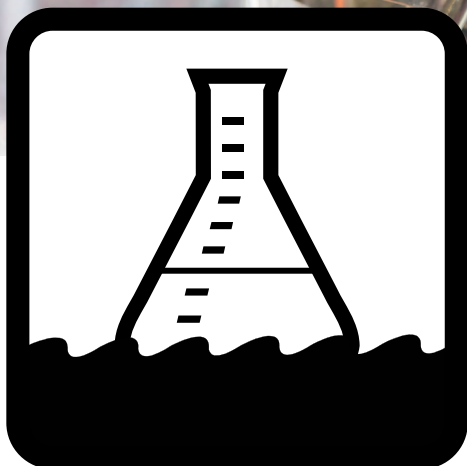


What Is Energy?

Teacher Guide

This guide includes background information and hands-on experiments that explore the fundamental concepts of energy. Students explore the science of motion, heat, sound, growth, and light while incorporating measurement skills and scientific process skills.



Grade Level:

Pri Primary

Elem Elementary

Subject Areas:



Science



Math



Language Arts



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NEED Mission Statement

The mission of The NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

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Teacher Advisory Board

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

Energy Data Used in NEED Materials

NEED believes in providing teachers and students with the most recently reported, available, and accurate energy data. Most statistics and data contained within this guide are derived from the U.S. Energy Information Administration. Data is compiled and updated annually where available. Where annual updates are not available, the most current, complete data year available at the time of updates is accessed and printed in NEED materials. To further research energy data, visit the EIA website at www.eia.gov.



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What Is Energy?

Teacher Guide

What Is Energy? Kit

- Balance with plastic stacking masses
- 4 Large balls
- Measuring tapes
- 6 Rulers
- 2 Plastic containers
- 1 Set of happy/sad spheres
- 4 400-mL Beakers
- 4 100-mL Beakers
- 2 Pitchers
- 1 Flip top bottle
- 2 Small balls—rubber and metal
- 2 100 mL Graduated cylinders with stands
- 1 Packet of clay
- 10 Safety thermometers (C and F)*
- 1 Radiometer
- 2 Flashlights
- 1 Wooden spool
- 1 Slinky
- 1 Mirror with clips
- 1 Spectroscope
- 2 Tuning forks (256 Hz and 1024 Hz)
- 2 Metal cans
- Mallet
- Rubber bands
- Magnifier
- 1 Set of Teacher and Student Guides

*Thermometers included in the *What Is Energy?* kit contain alcohol spirits and are safe for classroom use. They do not contain mercury.

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Standards Correlation Information

www.need.org/educators/curriculum-correlations/

Next Generation Science Standards

- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED's curriculum correlations website.

Common Core State Standards

- This guide has been correlated to the Common Core State Standards in both language arts and mathematics. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED curriculum correlations website.

Individual State Science Standards

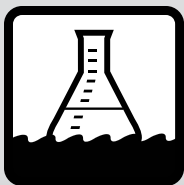
- This guide has been correlated to each state's individual science standards. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED website.

NEED Curriculum Correlations

NEED materials are correlated to the Disciplinary Core Ideas of the Next Generation Science Standards, the Common Core State Standards for English/Language Arts and Mathematics, and also correlated to each state's individual science standards.

Most files are in Excel format. NEED recommends downloading the file to your computer for use. Save resources, don't print!

- **NEED alignment to the Next Generation Science Standards**
- Navigating the NGSS? We Have What You NEED!
- NGSS and NEED: Fourth Grade Energy
- NGSS and NEED Guide
- Common Core State Standards for English and Language Arts
- Common Core Standards for Mathematics



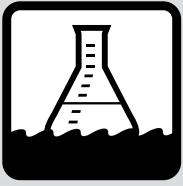
Materials

	ACTIVITY	MATERIALS IN KIT	ADDITIONAL MATERIALS NEEDED
WHAT IS ENERGY	Teacher Demonstration	Happy/sad spheres Rulers Plastic containers	Tongs Ice water Hot water
ALL LIVING THINGS GET ENERGY FROM FOOD	Food Has Energy From the Sun and Optional Activity		Food packaging with nutrition information Seeds (optional) Planters (optional)
SIMPLE TOOLS AND MOTION	Measuring Length		New pencils New crayons
	Measuring Mass	Balance with plastic stacking masses	New crayons
	Four Spheres - Observing and Measuring Size	4 Large spheres (A-D) Measuring tapes Rulers	
	Four Spheres - Measuring Mass	4 Large spheres (A-D) Balance with plastic stacking masses	
	Four Spheres - Sink or Float	4 Large spheres (A-D) Plastic Container	Water
	Four Spheres - Measuring Bounce	4 Large spheres (A-D) Rulers	
	Four Spheres - Measuring Roll	4 Large spheres (A-D) Measuring tapes Rulers	4 Books of identical thickness
	Metal and Plastic Spheres - Observing and Measuring	Metal sphere Plastic sphere Measuring tapes Rulers Balance with plastic stacking masses 3 400 mL Beakers	Warm water Ice water
STATES OF MATTER	Teacher Demonstration		Clear glass pan Hot plate or heat source Ice cubes Pot holder Perfume
SOLIDS AND LIQUIDS	Measuring Liquids	Pitcher 100 mL Beaker 100 mL Graduated cylinder	Water (room temperature)
	Volume of Solids	Clay 400 mL Beaker Pitcher	Water (room temperature)
	Teacher Demonstration	Balance 100 mL Beakers Flip top bottle	Ice cubes Hot water Water (room temperature)

HEAT IS ENERGY	Using a Thermometer	Thermometers	
	Measuring Temperature	400 mL Beakers Thermometers	Ice water Warm water
	Predicting and Measuring Temperature	100 mL Beakers 400 mL Beakers Pitchers Thermometers	Cold water Warm water
LIGHT IS ENERGY	Teacher Demonstration - Light is Energy	Radiometer Thermometers	Black construction paper White construction paper Sunlight
	Teacher Demonstration - Artificial Light	Thermometers	Black construction paper White construction paper Artificial light source**
	Light Travels in Straight Lines	Flashlight Wooden spool Ruler	
	Teacher Demonstration - Transverse Light Waves	Slinky	
	Light Can Be Refracted	Magnifier Ruler 100 mL Beaker Flashlight Pitcher	Blank wall Large glass bowl Water Pencil
	Light Can Be Reflected	Ruler Flashlight Mirror with clips	Full length mirror (optional)
	Teacher Demonstration - Light Can Be Diffracted	Spectroscope	Artificial light source Crayons Paper
SOUND IS ENERGY	Sound is Energy	Tuning forks Metal cans Mallet Pitcher Rubber bands	Plastic wrap Pepper shaker Water Paper
	Teacher Demonstration - Longitudinal Waves	Slinky	

*Thermometers included in the *What Is Energy?* kit contain alcohol spirits and are safe for classroom use. They do not contain mercury.

**This activity requires the use of a lightbulb that produces heat and light. A traditional incandescent, halogen, or heat lamp will work. Energy efficient bulbs, such as LEDs or CFLS, will not yield the results desired.



Differentiating Instruction K-3

Students' abilities in kindergarten through third grade are varied, as are the abilities of individual students within each classroom. Here are some suggestions for using this curriculum across the K-3 setting.

Kindergarten

As much as possible, students should be interacting with materials and investigating individually or with partners. Students can each have their own notebook or Student Guide, or teachers may choose to create one for the whole classroom. Drawing scientific or realistic pictures should be modeled to the students and attempted in their work. Students should be encouraged to label pictures with as many sounds as they can hear, even if this is only the initial consonant at first. Students' individual observations can be glued into a classroom notebook made of large construction paper or chart paper. The teacher should write a summary sentence or two in the class science notebook based on the students' discussion and observations. While the teacher can assess students' pictures, listening to students to gauge their understanding is important. Parent volunteers can be a valuable resource during this unit, helping with investigation management, preparing materials, and being a scribe for students.

First Grade

Depending on the time of year that you teach this unit, you may find yourself using some of the kindergarten strategies or moving toward second grade strategies. In general, students should be able to follow directions and work independently or with partners on investigations. Each student should have his/her own science notebook or Student Guide and be encouraged to communicate his/her thinking in pictures and words, although allowing dictation for non-writers is appropriate. Pictures should be realistic in nature and include labels as needed. It is suggested that teachers create a word wall with pertinent vocabulary for the unit that students can use as a resource. Parent volunteers continue to be a good support for investigation management and preparing materials.

Second Grade

As second graders become more comfortable with the inquiry process, teachers are encouraged to extend the investigations further, exploring student generated questions. Second graders should be given more opportunities to record measurable data and represent data in tables and graphs as appropriate.

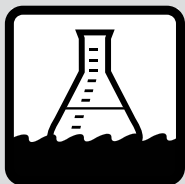
Third Grade

Most third graders should be able to complete the investigations in *What Is Energy?* independently, and even in stations. Students should be encouraged to ask additional questions such as, "I wonder what would happen if...?" Students should be given the opportunity at the end of the unit to choose one of their "I wonder" questions and develop their own investigation.

Science Notebooks

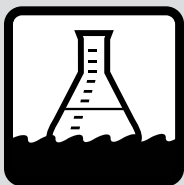
Science notebooks are a place for students to record their thinking. Over the course of this unit, pages may get ripped, folded, or spilled on, and this is okay! It is a sign of a real scientist at work! The worksheets in the *What Is Energy?* Student Guide are presented in a format that supports science notebooks while meeting the goals of the unit. You may choose to give students the Student Guide as their notebook, or copy single pages to fit your needs. Also, a science notebook template page that allows for students to record data in their own way is on page 32. You may copy this page as many times as needed to make a science notebook for each student. Included on page 31 is a *Science Notebook Skills Checklist*. Carrying the checklist with you as you circulate among your students will allow you to take notes for assessment and guide your conversation with students as they become more confident scientists.

NOTE: Throughout the guide you will see . This icon indicates a science notebook writing prompt that starts or assesses a new focus of study.



Overview

Topic	Description	Activities	Time	Page
What Is Energy?	Students learn what energy does and are introduced to common forms of energy.	1, with optional pre- and post-activities	20 minutes	9
All Living Things Get Energy From Food	Students explore how our bodies use energy, and where that energy originally comes from.	2-3, plus optional activity	40 minutes	11
The Energy Around You	Students discuss the ways that people use energy in their lives.	4-5	45 minutes	13
Simple Tools and Motion	Students use simple tools to measure length and mass as they explore motion as a form of energy.	6-13	3 hours and 20 minutes	14
States of Matter	Students learn about the states of matter.	14	15 minutes	19
Solids and Liquids	Students measure volume using the metric system and explore properties of solids.	15-17	1 hour and 5 minutes	20
Heat Is Energy	Students measure the temperature of liquids and explore the properties of heat.	18-20	1 hour and 20 minutes	22
Light Is Energy	Students learn that light is a form of energy that can be converted into other forms of energy and explore properties of light.	21-27	2 hours and 35 minutes	24
Sound Is Energy	Students learn that sound is a form of energy, explore properties of sound, and make instruments.	28-29, plus supplemental activity	1 hour and 30 minutes	28



Teacher Guide

Hands-on explorations, teacher demonstrations, and student activities introduce primary students to the basic concepts of science, energy, and measurement.

Grade Level

- Primary, Grades K-2
- Elementary, Grade 3

Time

- Two–six weeks depending on skill level of the students and the amount of time each day allotted to the unit

Additional Resources

Use www.NEED.org/shop to find additional materials to support and extend your energy unit:

- Primary Energy Infobook
- Primary Energy Infobook Activities
- Elementary Energy Infobook
- Elementary Energy Infobook Activities
- Energy Stories and More
- Today in Energy
- Science of Energy Curriculum and Kit

Water Temperatures

For several of the activities in this guide, multiple temperatures of water may be needed at once. To delineate, follow these guidelines:

- Hot — 50° - 55°C
- Warm — 35°C - 45°C
- Room Temperature — 23°C
- Cold — 5°C - 10°C
- Ice — 0°C - 2°C

Lab Safety Rules

It is never too early to begin discussing lab safety with students. While the items used in these activities are safe for students, it is recommended that students discuss proper protocols before beginning. See page 37 for a list of guidelines.

Background

Students use their senses and simple scientific tools—rulers, tape measures, thermometers, balances, and volumetric containers—to develop a basic understanding of the scientific method and energy through hands-on explorations.

NOTE: These activities are designed for students in grades 1–3. Many require reading skills. For younger students with limited reading skills, it is suggested that the teacher have an aide, parent helper, or upper elementary student at the center for center-based activities.

★ Concepts

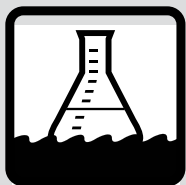
- Energy is part of everything that occurs. Energy makes change. Energy is the ability to do work.
- Energy is evidenced by heat, light, motion, sound, growth, and electricity.
- Living things need energy to survive. Living things get energy from the food they eat. The energy for living things comes from the sun.
- Our bodies use energy for many things, such as growing, moving, seeing, hearing, feeling, pumping blood, digesting food, thinking, breathing, and eliminating wastes.
- We can learn about things such as energy by using our five senses.
- Simple tools can help us learn more about our world and energy.
- Different substances have different characteristics and behave in different ways.
- We can sort substances according to like and different characteristics.
- Matter exists in three basic states—solid, liquid, and gas.

Preparation

- Familiarize yourself with the Teacher and Student Guides, and with the equipment in the kit.
- Choose the activities you want to conduct according to the skill level of your students, your grade level standards, and the time you can allot to the activities. Each activity is explained in detail beginning on page 9, with the materials needed and estimated time for completion.
- Make copies or digital masters of pages 37-47 that you can project or share with the entire class.
- Collect the materials that are needed for each activity, using the list on page 5.
- Label the four large, plastic spheres A - D with a permanent marker, in any order. Label the small plastic sphere with a P and the metal sphere with an M. Label the Happy/Sad spheres H and S with white-out. The H sphere will bounce.

Assessment

- Assess student understanding through the use of science notebooks for observations, drawings, and writing prompts. A skills checklist is found on page 31.
- Students can be assessed based on their discussion in the group setting.
- Student worksheets can be used as assessment tools. Answers can be found on page 52.



What Is Energy?

Background

Energy is the ability to do work or the ability to make a change. Everything that happens in the world involves the exchange of energy in some way, or a change of some kind. The total amount of energy in the universe remains the same. When we use energy, we do not use it up completely; we transform one form into other forms. Usually the transformation of energy produces some heat, which is considered the lowest form of energy. Thermal energy, or heat, dissipates into the surroundings and is difficult to capture and use again. Energy can be categorized in many ways—by the forms it takes, by what it does, by the changes it makes, and by the effects we can see, feel, or measure.

What Energy Does: Energy is recognized in the following ways (for more detailed information, see pages 48-51):

- Energy is light;
- Energy is heat;
- Energy is sound;
- Energy is motion;
- Energy is growth; and
- Energy is electricity to power technology.

Forms of Energy: Energy is recognized in many forms, all of which are potential or kinetic (for more detailed information see page 47):

- | | |
|--------------------|---------------------------------|
| ▪Thermal Energy | ▪Radiant Energy |
| ▪Elastic Energy | ▪Sound |
| ▪Chemical Energy | ▪Gravitational Potential Energy |
| ▪Electrical Energy | ▪Motion |
| ▪Nuclear Energy | |

Science Notebook Entry

Ask the students to complete this sentence orally or in their science notebooks:

- Energy is _____.

Pre and Post Activities

Objective

- Students will be able to list examples of ways they use energy in their lives.

Time

- 30 minutes per activity

Procedure

1. Choose one or more of the following activities:

- Make copies of *Energy Is...* on page 33. Discuss the things energy does and record them on the board. Lead the class in categorizing the list on the board according to the pictures. Many of the things listed will fall into more than one category. A television, for example, produces sound, light, heat, and motion, all powered by electricity.
- Go to *Light and What Else?* on page 34. Discuss each picture with students, explaining the additional things energy does in each picture, for example:
 - The sun produces light and other rays we can't see. The sun's energy produces heat when it touches things on or near Earth.
 - The light bulb produces light and heat.
 - The matches produce light, heat, and motion, as well as some sound.
 - The flashlight produces light and some heat, powered by electricity from batteries.
- Go to *Sound and What Else?* on page 35. Have students lead a discussion about the pictures and the things energy does in each picture.

2. Discuss student responses.

CONTINUED ON NEXT PAGE

Activity 1: Teacher Demonstration

🎯 Objective

- Students will be able to describe how energy can affect a bouncing ball.

🕒 Time

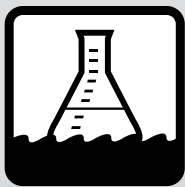
- 20 minutes

📋 Materials

- Happy/Sad spheres
- Ruler
- 2 Plastic containers
- Tongs
- Ice water
- Very hot water

✓ Procedure

1. Set up a demonstration center that all of the students can see with the spheres labeled H and S, a container of very hot water, a container of ice water, a ruler, and tongs.
2. Go to *Hot and Cold Bouncing* on page 2 of the Student Guide. Explain to the students that you will be demonstrating the experiment because of the danger of hot water. Explain that the objective of the experiment is to determine how adding and taking away heat energy changes the bouncing ability of the spheres.
3. Holding the ruler vertically, drop each of the spheres three times from the top of the ruler and measure how high they bounce. Have the students record the measurements.
4. Place the spheres in the container of ice water for one minute, then repeat the trial three times for each sphere. Have the students record the measurements.
5. Place the spheres in the very hot water for two minutes. Remove the spheres one at a time with the tongs. Repeat the trials with the hot spheres and have the students record the measurements.
6. Discuss the results with the students. Explain that the spheres bounced higher when they were hot because they contained more energy and that some of the heat energy was changed into motion energy (see pages 48-49 for more explanation).
7. Introduce energy as the topic of discussion and have students brainstorm to make a list of the things energy does. Write the ideas down for the class to see and revisit.



All Living Things Get Energy From Food

Background

Our bodies use energy to regulate temperature, breathe (take in oxygen and remove carbon dioxide), ingest and digest food, distribute nutrients, pump blood, send signals to tell our bodies what to do, see, move, feel, taste, hear, make sounds, smell, and think.

All living things get their energy from nutrients produced by plants. All of the energy in these nutrients originally came from the sun. Plants absorb the sun's radiant (light) energy and transform it into chemical energy through the process of photosynthesis. The plants use some of the energy to grow and store the rest in their cells. When we eat plants or animals that eat plants, we use some of the stored chemical energy and store the rest in our cells.

The chemical energy in food is measured in calories. The packaging for many foods lists the number of calories—the amount of energy—that the food contains per serving.

Science Notebook Entry

Ask students to answer this question orally or in their science notebooks using pictures and words:

- How does your body use energy?

Activity 2: Bodies Use Energy

Objective

- Students will be able to list ways that the body uses energy.

Time

- 10 minutes

Procedure

1. Have students close their eyes, stay very quiet, and hold very still for one minute. Tell them to imagine ways their bodies are using energy. Have students draw in their science notebooks an image of them doing an activity and write one sentence describing their bodies using energy.
2. Go to How Our Bodies Use Energy on page 4 of the Student Guide. As a group, or individually, have students label or explain each of the numbers. Review with the class. Answers are found on page 52.

OPTIONAL: Measure and graph student height once a month throughout the year to show growth.

Activity 3: Food Has Energy From The Sun

Objective

- Students will be able to explain how our bodies get the energy they need.

Time

- 30 minutes

Materials

- Various food packages with nutrition information

Procedure

1. Discuss how living things get the energy they need to survive, grow, and do the things they do from the food that they eat.
2. Go to *Energy From the Sun* on page 5 of the Student Guide. Have the students create a food web by drawing arrows to show the movement of energy. Review. Answers are found on page 52.
3. Discuss how all of the energy in food originally came from the sun.
4. Go to *Food Has Energy* on page 6 of the Student Guide. Have the students draw lines from the consumer to what it eats. Review. Answers can be found on page 52. You could also assess student understanding by cutting out the pictures and handing the pictures out randomly. Students must find their match.

Extensions

- Sing *The Food Chain Song* with the students found on page 36. Have the students draw pictures illustrating the song.
- Show the students several food packages with the number of calories indicated. Explain that calories are a measure of the amount of energy in the foods. Look at the food labels and point out ingredients that grew because of the sun's energy (e.g., whole grains). You can show a picture of the item. Have the students relate the food item to the energy transformation in the food web they drew.

Optional Activity: Growing Plants With And Without Sunlight

Objective

- Students will be able to explain that plants get their energy from the sun in the form of light.

Time

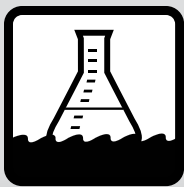
- 10 minutes for observation over 2-5 days

Materials

- Seeds and planters or small plants

Procedure

1. Have students germinate seeds or grow small plants with and without sunlight to demonstrate that plants get the energy they need to live and grow from the sun.



The Energy Around You

Background

Not only do our bodies use energy, we also use energy every day to do work or accomplish tasks. We use energy in many ways—to wake us up, cook and refrigerate our food, give us light, keep us warm, entertain us, teach us, and move us from one place to another.

Science Notebook Entry

Have students write and/or draw at least three ways they use energy on a daily basis in their science notebooks.

Activity 4: Using Energy To Do Work

Objective

- Students will be able to list ways that people use energy in their lives.

Time

- 30 minutes

Materials

- Download the *Today in Energy* guide from www.NEED.org/shop. Read the guide for additional materials and preparation of this activity.

Procedure

1. Have the students make a list of all the ways they use energy every day, either as a group or individually. Discuss.
2. Conduct the *Today in Energy* activity with the students.

Activity 5: The Five Senses

Background

Living creatures use all of their senses to survive and to learn more about their world. Scientists use their senses to learn new things about the world and the things in the world. Whenever we use our senses there is a transformation of energy. Our eyes see because reflected light energy stimulates cells at the back of our eyes, sending electrical messages to our brains. Our ears hear because vibrating air molecules make our eardrums and small bones in our ears vibrate, sending electrical signals to our brains. Our noses and tongues respond to chemical reactions. Our skin feels changes in heat and motion.

Science Notebook Entry

Have students explain or draw how their five senses are used to observe energy in their science notebooks.

Objective

- Students will be able to list the five senses and describe how we use them.

Time

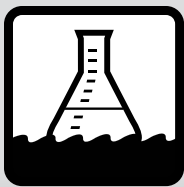
- 15 minutes

Procedure

1. Go to *Our Five Senses* on page 7 of the Student Guide. Discuss the five senses and how people use their senses to learn about the world.
2. Discuss the difficulties people encounter when they don't have the use of all of their senses. Discuss how energy is transformed whenever we use our senses.

Extension

- Use three shoe boxes to create a “mystery box of senses”. You may select objects such as smelly socks, flowers, cell phone, cookie, cotton ball, etc. Have students look in the boxes and decide what senses they used to determine what the object was. Students can document their answers in their science notebooks for evaluation.



Simple Tools and Motion

Background

People use tools to expand their senses and learn more about the world and about energy. Measuring tools give scientists and others ways to compare and categorize things in the world. We can measure the size of objects and the distance they move with rulers and measuring tapes. We can measure the mass of objects and substances with balances. We can measure the volume of liquids with beakers and graduated cylinders. We can measure the temperature of substances with thermometers. There are many scales for measurements. Scientists use the metric scale. People in the United States often use other scales. It is important to understand and be able to use several scales of measurement.

Science Notebook Entry

Have students write and/or draw at least three scientific tools that they know in their science notebooks.

Activity 6: Measuring Length

Objective

- Students will be able to measure length in English and metric measurement systems.

Time

- 10 minutes

Materials

- New pencils
- New crayons

Procedure

1. Use the *Ruler* master on page 38 to show students how length is measured in inches and centimeters.
2. Go to *Measuring Length* on page 8 of the Student Guide. Have students practice measuring and recording the length of a minimum of four objects in inches and centimeters.

Extension

- Students should trace their foot and measure their footprint in inches and in centimeters. Make a graph on the wall with the number of students at the different sizes.

Activity 7: Measuring Mass

Objective

- Students will be able to measure mass using a balance.

Time

- 30 minutes

Materials

- Balance with plastic stacking masses
- 20 New crayons

NOTE: If you do not have 20 new crayons available then you may use 20 standard objects (e.g., popsicle sticks, pennies, etc.).

✓ Procedure

1. Use the *Balance* master on page 39 and the balance itself to show students the parts of a balance and to explain how a balance works.
1. Use the *Balance Masses* master on page 41 and the masses themselves to show students the various masses in the balance drawer. Explain that a gram is a measure of mass used by scientists.
2. Go to *Measuring Mass* on page 9 of the Student Guide. Place students in small groups. Have the groups practice using the balance by finding the mass of 1, 5, 10, and 20 crayons as shown on the activity. Each student should record the number of each mass used in the column on the right. (Answers will vary.)

Extensions

- Students may brainstorm other items to measure mass.

Science Notebook Entry

- Have students draw and label the balance that is used to measure mass in their science notebooks. Ask them to explain verbally or in writing how it works.

Activity 8: Four Spheres—Observing And Measuring Size

Background

We can use our senses and simple tools to learn about objects and their motion. With our eyes, we can observe color, shape, patterns, texture, finish, etc. With our hands we can feel shape, temperature, texture, hardness, weight, etc. See page 48 for a detailed explanation of the scientific concepts of motion.

Objective

- Students will be able to use their senses and simple tools to observe and measure objects.

Time

- 30 minutes

Materials

- Spheres A, B, C, D
- 4 Rulers
- 4 Measuring tapes

✓ Procedure

1. Set up a center with the four similar size spheres (labeled A, B, C, D), four rulers, and four measuring tapes.
2. Go to *Four Spheres—Observing and Measuring Size* on pg 10 of the Student Guide. Explain the activity to the students. Under the “I see” section, the students should describe the spheres just using their eyes. They should touch the spheres to complete the “I feel” section. Demonstrate how to measure the circumference of the spheres using the measuring tape and the diameter of the spheres using the ruler. It is helpful in measuring the diameter to place the ruler against a wall, and the sphere in the groove of the ruler touching the wall.
3. Put students into small groups. Each group should go to the center and complete the activity.
4. Review the results, comparing and contrasting the characteristics of the four spheres.

Activity 9: Four Spheres—Measuring Mass

Objective

- Students will be able to determine the mass of objects using a balance.

Time

- 30 minutes

Materials

- Spheres A-D
- Balance
- Plastic stacking masses

Procedure

1. Set up a center with four spheres A-D and the balance with stacking masses.
2. Go to *Four Spheres—Measuring Mass* on page 11 of the Student Guide. Explain the activity to the students. The students should number the spheres from heaviest to lightest in the prediction column on the left. They will then measure and write the actual masses of the spheres in the square on the right side of the balance. Finally they will number the results in the results column on the right.
3. Put students into small groups. Each group should go to the center and complete the activity.
4. Review the activity with the class.

Activity 10: Four Spheres—Sink or Float

Objectives

- Students will be able to describe the difference between sinking and floating.
- Students will be able to list items that sink or float.

Time

- 20 minutes

Materials

- Spheres A-D
- Plastic container
- Water

Procedure

1. Set up a center with four spheres labeled A-D and a plastic container with 300 mL of water.
2. Go to *Four Spheres—Sink or Float* on page 12 of the Student Guide. Explain the activity to the students. The students should predict if the spheres will sink or float, conduct the experiment, and record the results. The students should draw how far each of the floating spheres sank into the water on the pictures of the containers in the observations section of the page. Students should also review their predictions and record what actually happened in the results section of the page. Make sure the students carefully place the spheres into the containers rather than dropping them. Check the foam sphere after each group to squeeze out any water.
3. Put students into small groups. Each group should go to the center and complete the activity.
4. Review the activity with the class. Students may then brainstorm alternative objects they would like to investigate.

Extension

- Create boats out of aluminum foil and float them in a kiddie pool or fish tank. You can choose to provide the students with a consistent size of foil or different sizes as variables. One by one, add marbles, stacking masses, and/or paper clips to investigate the number that will cause it to sink.

Activity 11: Four Spheres—Measuring Bounce

Objective

- Students will be able to measure height in English and metric measuring systems.

Time

- 20 minutes

Materials

- Spheres A-D
- 4 Rulers

Procedure

1. Set up a center with four spheres labeled A-D and four rulers.
2. Go to *Four Spheres—Measuring Bounce* on page 13 of the Student Guide. Explain the activity to the students. Demonstrate how to hold the ruler upright and drop the sphere from the top of the ruler, having a helper measure how high the sphere bounces. The students should record the height of the bounce in both centimeters and inches.
3. Put students into small groups. Each group should go to the center and complete the activity.
4. Have students graph the results using *Graphing Bounce* on page 14 of the Student Guide.
5. Review the activity with the class.

Extension

- Have the students drop the spheres one more time listening to hear which one makes the loudest sound when it hits the surface. Discuss the results and what makes one sphere louder than another.

Activity 12: Four Spheres—Measuring Roll

Objective

- Students will be able to measure length in English and metric measuring systems.

Time

- 20 minutes

Materials

- Spheres A-D
- Measuring tapes
- Rulers
- 4 Books of identical thickness

Procedure

1. Set up a center with four plastic spheres A-D, four rulers, four measuring tapes, and four books.
2. Go to *Four Spheres—Measuring Roll* on page 15 of the Student Guide. Explain the activity to the students. Demonstrate how to make a ramp with the rulers and books. It is suggested that this activity be conducted on carpet so the spheres don't roll too far. The students should record the distance each sphere rolls in centimeters and inches.
3. Put students into small groups. Each group should go to the center and complete the activity.

4. Have students graph the results using *Graphing Roll* on page 16 of the Student Guide.
5. Review the activity with the class. Explain that gravity is the force giving the spheres energy to move and that friction is the force slowing them down. Discuss why there might be more friction between some of the spheres and the carpet than with others (See page 48 for more explanation).

Extension

- Have students measure the roll of different objects, including the happy and sad spheres.

Activity 13: Metal and Plastic Spheres—Observing and Measuring

Objective

- Students will be able to compare and contrast the characteristics of plastic and metal objects.

Time

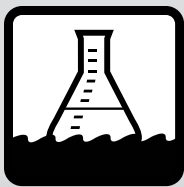
- 30 minutes

Materials

- | | | |
|------------------|---------------------------------------|-------------------|
| ▪Metal sphere | ▪Rulers | ▪3 400 mL Beakers |
| ▪Plastic sphere | ▪Balance with plastic stacking masses | ▪Warm water |
| ▪Measuring Tapes | | ▪Ice water |

Procedure

1. Set up a center with the metal and plastic spheres labeled M and P, two rulers, two measuring tapes, the balance with stacking masses, a 400 mL beaker with 300 mL of room temperature water, a 400 mL beaker with ice water, and a 400 mL beaker with warm water.
2. Go to *Observing and Measuring Metal and Plastic Spheres* on page 17 of the Student Guide. Explain the activity to the students.
3. Put students into small groups. Each group should go to the center and complete the activity.
4. Review the activity with the students. Explain that both of the spheres in the beginning are at the same temperature, as is every non-living, non-electrical object. Some substances, such as metals, conduct (or move) energy better than others. Substances, such as plastics, that don't conduct energy well, are called insulators. The metal sphere feels colder because it conducts the heat in your hands away from your hands. Have the students feel objects made of different materials in the classroom to see if they are conductors or insulators (see page 48 for more explanation).



States of Matter

Background

Matter exists in three basic states—solids, liquids, and gases. Solids have a definite size and shape. Liquids have a definite size but take the shape of the container they are in. Liquids are held in a container by the force of gravity. Gases have no definite size or shape, but they fill the space in which they are contained because their molecules are so far apart that gravity has little effect on them. Gravity is defined as the force of attraction between objects. For a more detailed explanation, see the background information on heat on page 49.

Science Notebook Entry

■ Ask students to write or draw in their notebooks something they think is solid, something they think is gas, and something they think is a liquid.

Activity 14: Teacher Demonstration—States of Matter

Objective

■ Students will be able to name the three states of matter using water as an example.

Time

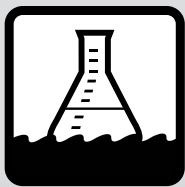
■ 15 minutes

Materials

- Clear glass pan
- Hot plate or heat source
- Ice cubes
- Pot holder
- Perfume

Procedure

1. Set up a demonstration center with a clear, glass, heat-resistant pan, a heat source such as a hot plate or Bunsen burner, several ice cubes, a pot holder, and a few drops of perfume.
2. Go to *States of Matter* on page 18 of the Student Guide. Students should record the states of water as you go through the demonstration.
3. Place the ice cubes in the pan and explain that the ice cubes are solids—their shape remains the same in any container.
4. Place the pan on the heat source and slowly melt the ice cubes. Explain that you are adding heat energy to the ice cubes. Remove the pan from the heat source and demonstrate how the water stays in the pan but can change its shape if the pan is tilted. The water is a liquid.
5. Place a few drops of perfume in the pan and place it back on the heat source. Allow the water to boil until a noticeable amount has turned into steam, escaped the pan, and filled the room. The students all over the room should be able to smell the perfume molecules that have attached themselves to the steam, or water vapor molecules. Explain that adding energy to the water molecules made them bounce against each other with enough force to break the bonds that were between the molecules attracting them to each other (see page 49).



Solids and Liquids

Background

We can measure some solids with regular shapes using rulers to determine the amount of space they take up. Solids are measured in cubic centimeters (cc). With irregularly-shaped solids, we can determine their volume by placing them in a liquid and measuring the amount of the liquid that is displaced. The volume of liquids is measured using several scales. In the United States, sometimes we use ounces, cups, pints, quarts, and gallons. Scientists use metric measurements such as milliliters and liters to measure the volume of liquids. One cubic centimeter (cc) is equal to one milliliter (mL).

Activity 15: Measuring Liquids

Objective

- Students will be able to measure liquids in English and metric measurement systems.

Time

- 20 minutes

Materials

- Pitcher
- 100 mL Beaker
- 100 mL Graduated cylinder
- Water

Procedure

1. Set up a center with a pitcher of water, 100 mL beaker, and 100 mL graduated cylinder.
2. Use the *Beakers and Graduated Cylinder 100 mL* masters on pages 41-42 to demonstrate how to measure the volume of liquids.
3. Go to *Volume* on page 19 of the Student Guide. Have the students complete the activity by coloring the pictures of the beakers to indicate the volume.
4. Go to *Liquids* on page 20 of the Student Guide. Explain the procedure to the students.
5. Put students into small groups. Each group should visit the center and complete the activity.
6. Review the activity, emphasizing that liquids have definite volume, but not definite shape.

Activity 16: Volume of Solids

Objective

- Students will be able to explain that a flexible solid has the same volume no matter what its shape may be.

Time

- 30 minutes

Materials

- Clay
- 400 mL Beaker
- Pitcher
- Water

✓ Procedure

1. Set up a center with a pitcher of water, a lump of clay, and a 400 mL beaker.
2. Go to *Volume of Solids* on page 21 of the Student Guide. Explain to the students that they will find the volume of the piece of clay by measuring how much water is displaced (how much the water in the beaker rises when the clay is added). Explain that solids are measured in cubic centimeters and liquids in milliliters, and that one cubic centimeter equals one milliliter.
3. Put students into small groups. Each group should go to the center to complete the activity.
4. Give the students the following instructions for the center:
 - Fill the beaker with 200 mL of water, then draw a line on the top picture A to show the exact volume of water in the beaker.
 - Form the clay into a ball and place in the beaker of water.
 - Draw a line on the top picture B to show the volume of water in the beaker with the clay.
 - Remove the clay and flatten it to fit the bottom of the beaker.
 - Repeat the experiment and record the results on the bottom pictures.
 - Calculate the volume of the clay in each experiment, using the formula $B - A = \text{Volume of Clay}$. (Younger students may need assistance with this calculation. The important concept is that the clay contains the same amount of matter (and volume) regardless of its shape.)
5. Review the activity, emphasizing that the clay will have the same volume, regardless of its shape, because it has the same amount of matter. The clay is considered a solid because it retains its shape until it is changed by force.

Activity 17: Teacher Demonstration—Solids and Liquids

🎯 Objective

- Students will be able to describe that the mass of substances stays the same, no matter what its state of matter.

🕒 Time

- 15 minutes

📋 Materials

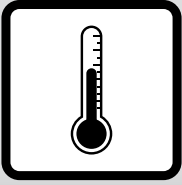
- Balance
- 2-100 mL Beakers
- Flip top bottle of water
- Ice cubes
- Hot water

✓ Procedure

1. Set up a demonstration center with the balance, 2–100 mL beakers, flip top bottle of room temperature water, ice cubes, and a bowl of hot water.
2. Go to *Solids and Liquids* on page 22 of the Student Guide. Ask students, “Does the mass of ice change when it melts?”
3. Place two ice cubes into a 100 mL beaker. Have the students predict how much water the ice cubes will make when they melt by drawing a line on Picture 2 Prediction.
4. Place the beaker of ice into one bucket of the balance. Place the second 100 mL beaker in the other bucket. Fill this beaker with water from the flip top bottle until it balances the ice. Have the students record the volume of water in the beaker by drawing a line on Picture 4.
5. Place the beaker with the ice cubes into a bowl of hot water to speed up the melting. Once the ice has melted, have the students record the volume on Picture 3 Result.
6. Place the beakers back into the balance. Do they still weigh the same? Have the students compare the volumes of Pictures 3 and 4. Are they equal? How well did the students predict?
7. Have students explain what they learned.

📖 Science Notebook Entry

- Ask students to compare and contrast solids and liquids in their science notebooks. They can use words, phrases, or draw and fill in a T-chart.



Heat is Energy

Background

All substances contain heat, the internal energy in substances. We can measure the temperature of substances—the average amount of heat energy—using thermometers. Thermometers measure temperature using different scales. In the United States, we use the Fahrenheit scale in our daily lives and the Celsius scale for scientific measurements. For more detailed information about heat, see page 49.

Science Notebook Entry

▪Have students write or draw in their notebooks: What do we do with a thermometer?

Activity 18: Using A Thermometer

Objective

▪Students will be able to measure temperature in Fahrenheit and Celsius.

Time

▪30 minutes

Materials

▪5 Thermometers

Procedure

1. Set up a center with five thermometers.
2. Use the *Thermometer—Fahrenheit and Celsius* master on page 43 to demonstrate how to measure temperature with a thermometer.
3. Go to *Recording Temperatures* on page 23 of the Student Guide. Have the students color in the tubes of the pictures to indicate the temperatures given in Fahrenheit; then, determine the equivalent Celsius reading and write it in the circles of the thermometers.
4. Go to *Thermometer* on page 24 of the Student Guide. Explain the activity to the students, demonstrating how to gently hold the thermometer bulb between the palms of their hands.
5. Place the students into small groups. Each group should visit the center to complete the activity.
6. Review the activity with the students.

NOTE: The thermometers in the kit may look slightly different than the images in the Student Guide.

Activity 19: Measuring Temperature

Objective

- Students will be able to measure the temperature of liquids with a thermometer in both Fahrenheit and Celsius.

Time

- 20 minutes

Materials

- 2–400 mL Beakers
- 2 Thermometers
- Ice water
- Warm water

Procedure

1. Set up a center with two thermometers, and 400 mL beakers of ice water and warm water.
2. Go to *Temperature 1* on page 25 of the Student Guide. Explain the activity to the students.
3. Place the students into small groups. Each group should visit the center to complete the activity.
4. Review the activity with the students. Discuss their results. Was the temperature of the warm water the same for the last group as for the first? What might have made it lower?

Activity 20: Predicting And Measuring Temperature

Objective

- Students will be able to measure the temperature of liquids with a thermometer in both Fahrenheit and Celsius.

Time

- 30 minutes

Materials

- 2–100 mL Beakers
- 1–400 mL Beaker
- 2 Pitchers
- 2 Thermometers
- Warm water
- Cold water

Procedure

1. Set up a center with 2–100 mL beakers, 1–400 mL beaker, a pitcher of cold water, a pitcher of warm water, and two thermometers.
2. Go to *Temperature 2* on page 26 of the Student Guide. Explain the activity to the students.
3. Place the students into small groups. Each group should visit the center to complete the activity. After each group visits the center, empty the 400 mL beaker and make sure the pitchers have enough warm and cold water.
4. Review the activity with the students, emphasizing that the heat lost by the warm water equaled the heat gained by the cold water.

Science Notebook Entry

- Have students use words and pictures to explain what tools are used to measure heat in their science notebooks.
- Have students draw a diagram of a thermometer in their science notebooks.



Light Is Energy

Background

Light is a form of radiant energy—electromagnetic energy that moves in transverse waves. The radiant energy we use to see, called visible light, is only a small part of the radiant energy in the universe. Although we cannot see light energy, we can see and feel its effect when the light waves encounter our bodies or other objects. When light waves encounter objects, they are reflected, refracted, and/or absorbed. Dark objects tend to absorb light and light objects tend to reflect light. When light energy is absorbed, some of that energy is converted into heat. For more detailed information about light, see page 50.

Science Notebook Entry

■ Ask students to answer this question in their science notebooks: How is light transformed into other forms of energy?

Activity 21: Teacher Demonstration—Light Is Energy

Objectives

- Students will be able to:
 - Explain that light is energy;
 - Describe how light energy can be changed into motion and heat energy; and
 - Explain that the color of objects affects the amount of light energy that is absorbed and reflected.

Time

- 30 minutes

Materials

- Radiometer
- 2 Thermometers
- Black and white construction paper
- Sunlight

Procedure

1. Set up a demonstration center in a sunny window with the radiometer, two thermometers, and 3" x 3" squares of black and white construction paper.
2. Place the radiometer in a bright light—either in bright sun or under a lamp. Have the students observe the speed of the vanes spinning. The vanes will begin to spin as the black sides of the vanes absorb the light and become warm, while the white sides reflect the light. The air molecules near the black sides absorb heat and move with more energy. These molecules bump into the black sides of the vanes and give them a push.
3. Reduce the amount of light energy striking the radiometer by covering a small part of it with your hand or moving it away from the light. Show the students how the radiometer spins more slowly when less light energy is striking it. If you have a very bright flashlight, you can try holding it at different angles and at different distances from the radiometer to further demonstrate the relationship between the amount of light energy striking the radiometer and the speed of its spin.
4. Go to *Light 1* on page 27 of the Student Guide. Explain the demonstration to the students. Have the students predict which thermometer will record the higher temperature by numbering the pictures 1 and 2, with 1 being the hottest, in the prediction section of the pictures.
5. Place the thermometers in the sun. Cover the bulb of one with black paper and the other with white paper. Wait five minutes. While waiting, discuss with the class why people in tropical climates wear white or light colors. Discuss why people feel cooler in the shade on a hot day, when the air temperature is the same as in the sun. When in the sun, the skin is absorbing some light energy and changing it into heat.
6. Read the temperatures and have the students record the readings on the pictures. Have the students number the thermometers 1 and 2, with 1 being the hottest, in the result section of the pictures, as indicated.

7. Discuss the activity with the students, explaining that the black paper absorbs light energy while the white paper reflects it. The energy from the sun is light energy and changes into heat when it is absorbed by a substance.
8. Have the students hold one hand in the sun and one away from the sun and see if they can feel a difference in temperature.
9. Vary the amount of light in the classroom and demonstrate how much better the students can see when there is more light—when more energy is reaching their eyes. Point out that colors are harder to see as the amount of light decreases. Discuss why it is dangerous to look directly at the sun. It is dangerous because our eyes will absorb too much light, turn it into heat, and our eyes will burn.

Activity 22: Teacher Demonstration—Artificial Light

Objective

- Students will be able to compare and contrast the energy in sunlight and energy in artificial light.

Time

- 15 minutes

Materials

- 2 Thermometers
- Black and white construction paper
- Artificial light source (incandescent bulb, halogen bulb, or heat lamp bulb)

Procedure

1. Set up a demonstration center with a bright artificial light, two thermometers, and 3"x3" squares of black and white construction paper.
NOTE: This must be done with a bulb that produces heat (thermal energy). Energy efficient LED or CFL bulbs do not produce heat and only light, and therefore will not yield the results desired for this activity.
2. Go to *Light 2* on page 28 of the Student Guide. Explain the demonstration to the students. Have the students predict whether the artificial light will provide as much energy as the sun. Will the thermometer readings be higher, lower, or the same as in the last activity? Have them record their predictions in the prediction section of the pictures.
3. Place the thermometers approximately 18 inches from the artificial light source. Cover the bulb of one with black paper and the bulb of the other with white paper. Wait five minutes. While waiting, discuss different ways we produce artificial light—candles, lanterns, electric lights, etc. Also discuss how artificial lights make it possible for people to do things at night and in places where no sunlight reaches, such as in caves, basements, mines, and submarines.
4. Read the temperatures and have the students record the readings in the result section of the pictures. Have the students compare the thermometer readings with the ones from the previous activity.

Science Notebook Entry

- Ask students to answer this question in their science notebooks: What color would you wear outside on a hot sunny day, black or white?

Activity 23: Light Travels in Straight Lines

Objective

- Students will be able to describe or show that light travels in a straight line.

Time

- 30 minutes

Materials

- Flashlight
- Wooden spool
- Ruler

Procedure

1. Set up a center with a table beside a blank wall, a flashlight, a ruler, and a wooden spool.
2. Go to *Light 3* on page 29 of the Student Guide. Explain the activity to the students.
3. Place students into small groups. Each group should go to the center to complete the activity.
4. Review the activity with the students.
5. Use the *Light Energy—Transverse Waves* master on page 44 to show students that light travels in transverse waves and that visible light is only a small part of the electromagnetic (radiant energy) spectrum.
6. Use the *Shadows* master on page 45 to explain the formation of shadows, or areas without light. Explain that the closer the object is to the light source, the more light is blocked by the object and the larger the shadow is. Show that the umbra is the area where there is no light from the light source. The penumbra is the area where there is some light because of the angle of the light. Emphasize the fact that the light travels in straight lines and cannot bend around an object.

Activity 24: Teacher Demonstration—Transverse Light Waves

🔄 Objective

- Students will be able to describe how transverse waves move.

🕒 Time

- 15 minutes

📋 Materials

- | | | |
|-------------------|-------------|----------------|
| ▪Large glass bowl | ▪Flashlight | ▪100 mL Beaker |
| ▪Water | ▪Magnifier | ▪Pitcher |
| ▪Blank wall | ▪Ruler | ▪Pencil |

- Slinky

✓ Procedure

1. Set up a long table and the slinky.
2. Hold one end of the slinky at one end of the table and have a student volunteer hold the other end of the slinky at the other end of the table. Have the student hold his/her end of the slinky still while you move the slinky up and down with some energy, creating crests and troughs along the length of the slinky. Explain the parts of the wave to the class, revisiting the light energy master, if needed.

📖 Science Notebook Entry

- Ask students to draw a diagram of a wave of light and label the crest and trough.

Activity 25: Light Can Be Refracted

🔄 Objective

- Students will be able to describe how light waves can bend (be refracted) when they pass through a substance other than air.

🕒 Time

- | | |
|-------------|--------------------------------|
| ▪Ruler | ▪Mirror with clips |
| ▪Flashlight | ▪Full-length mirror (optional) |
| ▪30 minutes | |

📋 Materials

✓ Procedure

1. Fill a large glass bowl with room temperature or warm water in a place where all of the students can see. Hold a pencil in the water so that the students can see how its image is distorted. Place one hand in the water so that students can see the distortion. Pour out the water and place one hand in the empty bowl so that the students can see the distortion. Explain that the water and the glass bend the light waves because they are made of different materials than air.
2. Set up a center with a table beside a blank wall, the flashlight, magnifier, a ruler, a 100 mL beaker, and water in a pitcher.
3. Go to *Light 4* on page 30 of the Student Guide. Explain the activity to the students.

4. Place students into small groups. Each group should go to the center to complete the activity.
5. Review the activity with the students.

Activity 26: Light Can Be Reflected

Objective

- Students will be able to explain how light can be reflected.

Time

- | | |
|--|----------|
| ▪Spectroscope | ▪Crayons |
| ▪Bright artificial light source (incandescent or halogen bulb) | ▪Paper |

- 20 minutes

Materials

Procedure

1. Set up a center with a flashlight, a mirror, and a ruler.
2. Make lists on the board of the things in the classroom that can reflect light and the things that don't. Discuss the properties of things that reflect light—most are flat and smooth. Rough objects can reflect light, too, but the light is scattered because it bounces off surfaces at so many different angles that it is more difficult to notice.
3. Go to *Light 5* on page 31 of the Student Guide. Explain the activity to the students.
4. Place students into small groups. Each group should go to the center to complete the activity.
5. Review the activity with the students.

Extension

If a full-length mirror is accessible, have 10–14 students form a straight line about five feet from the mirror and parallel to it. Ask students



Sound Is Energy

to 'see who they can see' in the mirror, depending upon the angle. By drawing a diagram of the mirror and the students, you can show how the angle of incidence equals the angle of reflection.

Activity 27: Teacher Demonstration—Light Can Be Diffracted

🎯 Objective

- Students will be able to describe how light can be diffracted (separated) into the colors of the spectrum.

🕒 Time

- | | | |
|--------------------------------------|----------------|---------------|
| ▪2 Tuning forks (256 Hz and 1024 Hz) | ▪Rubber bands | ▪Plastic wrap |
| ▪2 Metal cans | ▪Mallet | ▪Water |
| ▪Pitcher | ▪Pepper shaker | ▪Paper |
- 15 minutes

📖 Materials

✓ Procedure

1. Have each student look at a bright light through the spectroscope and use crayons to draw the colors they see, in the same order they view them. Explain that white (visible) light is made of all colors and that the white light can be separated into its individual colors by a spectroscope or a prism.

📝 Science Notebook Entry

- Have students complete the following sentence in their notebooks: Light travels in _____.
- Have students draw pictures to demonstrate reflection and refraction.

📖 Background

Sound is a special kind of mechanical energy; it is the back-and-forth vibration of the molecules through a substance caused by the application of a force on the substance. Sound travels in longitudinal waves—waves in which there are compressions and expansions as the molecules vibrate back and forth. For more detailed information about sound, see page 51.

📝 Science Notebook Entry

- Have students answer the following question in their science notebooks: How does sound travel?

Activity 28: Sound is Energy

🎯 Objective

- Students will be able to explain that sound is caused by vibrations.

🕒 Time

- 30 minutes

📖 Materials

- Tuning forks
- Metal cans
- Mallet
- Pitcher
- Rubber bands

✓ Procedure

1. Set up a center with two tuning forks, a rubber mallet, an empty metal can, a metal can covered tightly with plastic wrap held in place

CONTINUED ON NEXT PAGE

with a rubber band, water, paper, and a pepper shaker.

2. Have the students place their fingers lightly on the sides of their throats and hum at different pitches to feel the vibrations.
3. Have the students tap their desks several times, each time with more energy, and observe that the more energy they put into their motion, the more energy is produced as sound. Their motion energy is changing into sound energy.
4. Go to the activities *Sound 1-4* on pages 32-35 of the Student Guide. Explain the activities to the students and demonstrate how to hold and strike the tuning forks with the mallet. Explain that the tuning forks vibrate at different frequencies—they move back and forth, or vibrate, a number of times each second. The number of times they vibrate each second is written on the tuning fork. The number of vibrations each second determines the pitch of the sound—how high or low the sound is.
5. Place students into small groups. Each group should go to the center to complete the activity.
6. Review the activities with the students.

Activity 29: Teacher Demonstration—Longitudinal Waves

Objective

- Students will be able to describe or show how sound waves move.

Time

- 30 minutes

Materials

- Slinky

Procedure

1. Set up a long table with the slinky.
2. Holding one end of the slinky at one end of the table, have a student volunteer hold the other end of the slinky at the other end of the table. Have the student hold his/her end of the slinky still while the teacher moves the slinky forward and back along the table with some energy, creating compressions and expansions along the length of the slinky. Explain the parts of the longitudinal wave to each student.
3. Use the *Longitudinal Sound Wave* master on page 46 to explain the parts of a longitudinal wave.
NOTE: Do not lift the slinky off the table to be sure students see the difference in the shape of sound waves from light waves in Activity 24.

Supplemental Activity: Producing and Demonstrating Sound

Objective

- Students will be able to design and create objects that produce sound.

Time

- 30 minutes

Procedure

1. Have students make musical instruments with objects they find at home, on the playground, or in the classroom. Have students demonstrate and explain their instruments to the class. Have students experiment with musical instruments in the music room or classroom.
2. Ask students to answer the following question out loud or in their science notebooks:
 - What are some ways living things make sounds?
3. Discuss student responses.

Science Notebook Entry



Designed to be a formative assessment tool, you may find this checklist useful as you work with students. Put all of your students' names down the left hand side. When you look at a child's Student Guide or science notebook and see a skill demonstrated, put a dot in the box. Decide how many times (typically 3–5) you want to see the student use the skill independently before checking off the box as a sign that the student has mastered this skill.

[illegible]

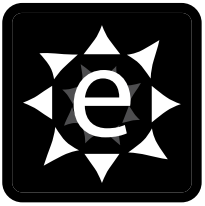
Date _____ Page _____

SCIENCE NOTEBOOK

Question _____

▪Have students complete the following sentence in their science notebooks. Sound travels in _____.

Data and Observations



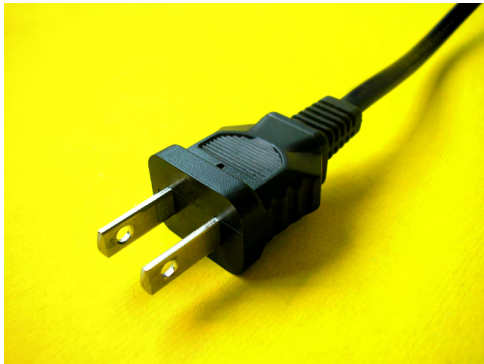
Energy Is...



Light



Growth



Electricity



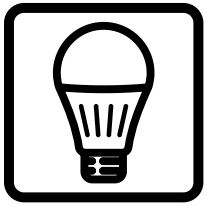
Motion



Heat



Sound



Light and What Else?



Sun



Light Bulb



Matches



Flashlight



Campfire



Grill



Candle



Lantern



Sound and What Else?



Television



Fire Cracker



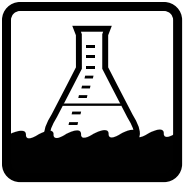
Radio



Piano



Fire Truck



The Food Chain Song

(To the tune of There's a Hole in the Bottom of the Sea)

There's a plant at the bottom of the lake

There's a plant at the bottom of the lake

There's a plant

There's a plant

There's a plant at the bottom of the lake

There's a leaf on the plant at the bottom of the lake...

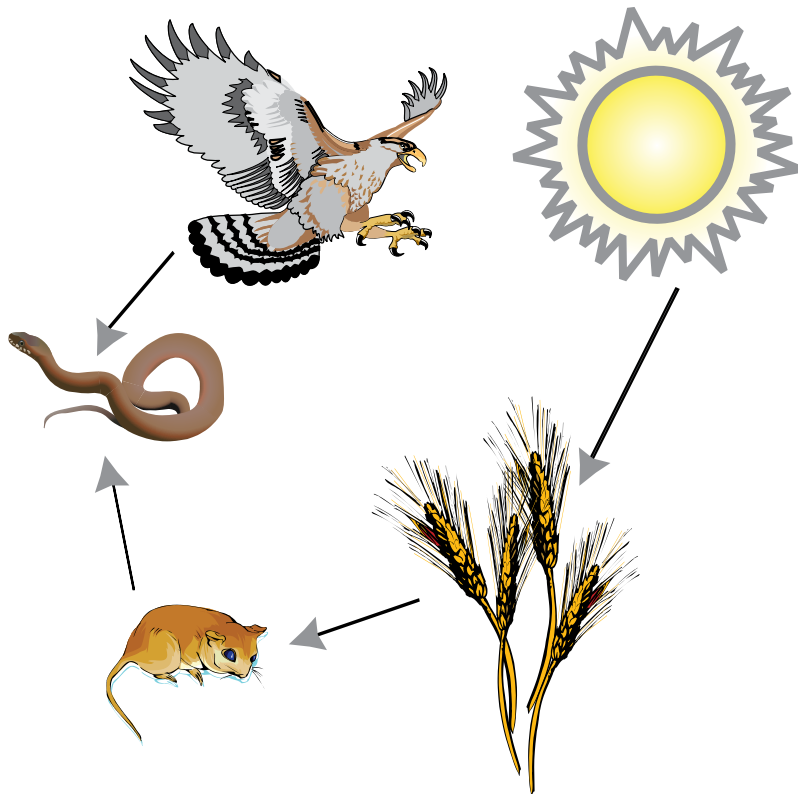
There's a bug that eats the leaf on the plant at the bottom of the lake...

There's a fish that eats the bug that eats the leaf on the plant at the bottom of the lake...

There's a kid who eats the fish that eats the bug that eats the leaf on the plant at the bottom of the lake...

There's a bear ... optional

A Food Chain (Food Web)





Lab Safety Rules

Eye Safety

- Always wear safety glasses when performing experiments.

Fire Safety

- Do not heat any substance or piece of equipment unless specifically instructed to do so.
- Be careful of loose clothing. Do not reach across or over a flame.
- Keep long hair pulled back and secured.
- Do not heat any substance in a closed container.
- Always use tongs or protective gloves when handling hot objects. Do not touch hot objects with your hands.
- Keep all lab equipment, chemicals, papers, and personal effects away from the flame.
- Extinguish any flame as soon as you are finished with the experiment and move it away from the immediate work area.

Heat Safety

- Always use tongs or protective gloves when handling hot objects and substances.
- Keep hot objects away from the edge of the lab table, in a place where no one will accidentally come into contact with them.
- Remember that many objects will remain hot for a long time after the heat source is removed or turned off.

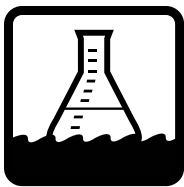
Glass Safety

- Never use a piece of glass equipment that appears cracked or broken.
- Handle glass equipment carefully. If a piece of glassware breaks, do not attempt to clean it up yourself. Inform your teacher.
- Glass equipment can become very hot. Use tongs if glassware has been heated.
- Clean glass equipment carefully before packing it away.

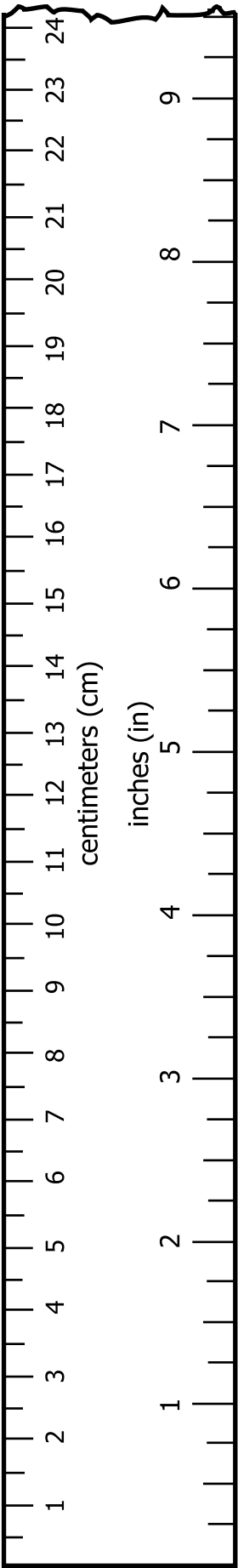
Chemical Safety

- Do not smell, touch, or taste chemicals unless instructed to do so.
- Keep chemical containers closed except when using them.
- Do not mix chemicals without specific instructions.
- Do not shake or heat chemicals without specific instructions.
- Dispose of used chemicals as instructed. Do not pour chemicals back into containers without specific instructions to do so from your teacher.
- If a chemical accidentally touches your skin, immediately wash the affected area with water and inform your teacher.

Thermometer Safety: Thermometers included in the Primary Science of Energy kit contain alcohol spirits and are safe for classroom use. They do not contain mercury.

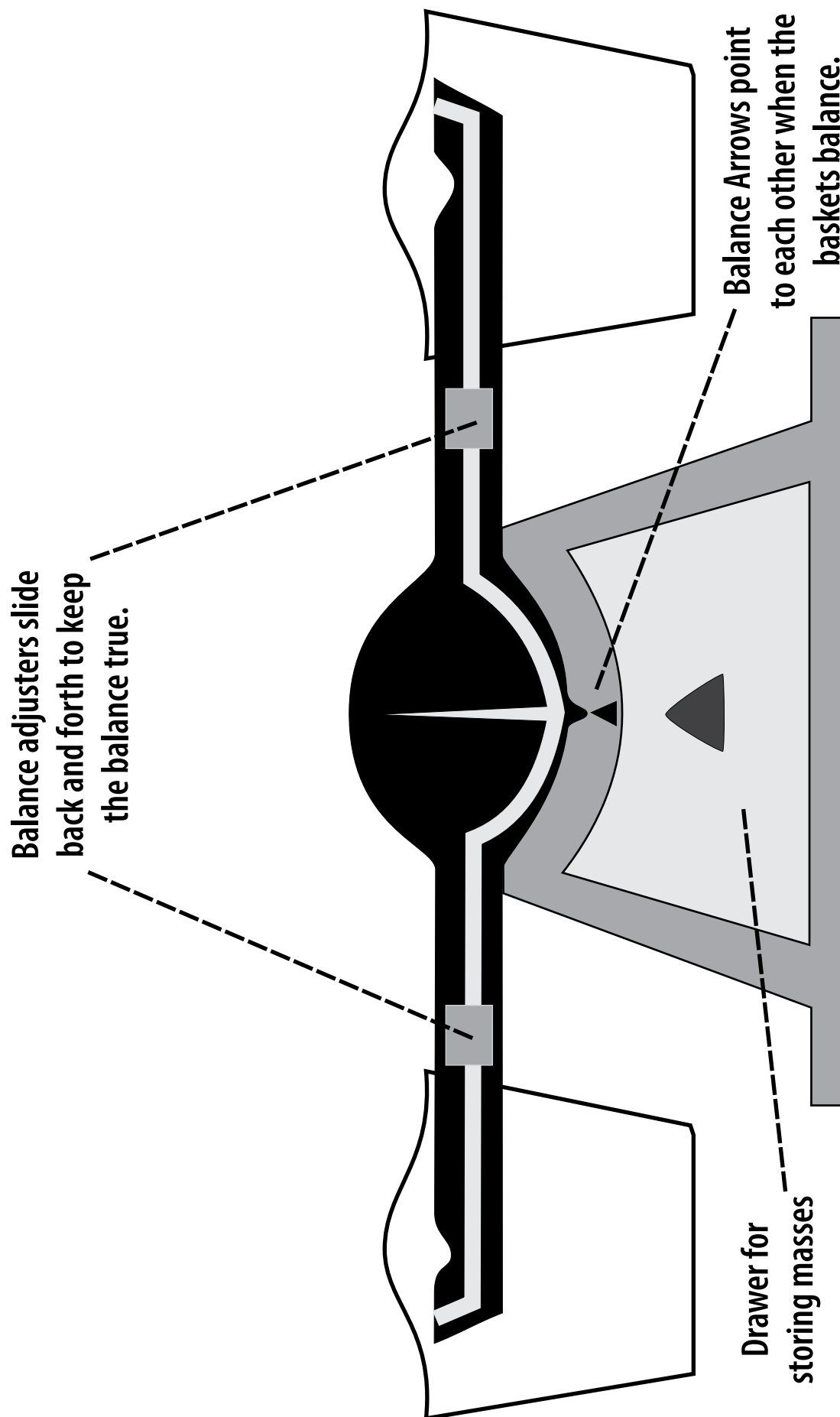


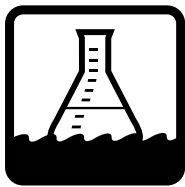
Ruler





Balance





Balance Masses



pink



purple



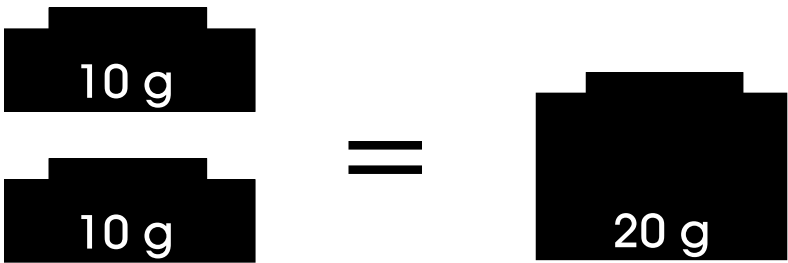
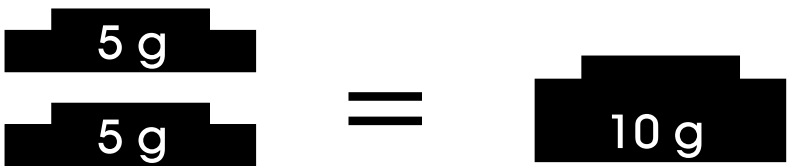
orange

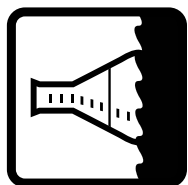


yellow



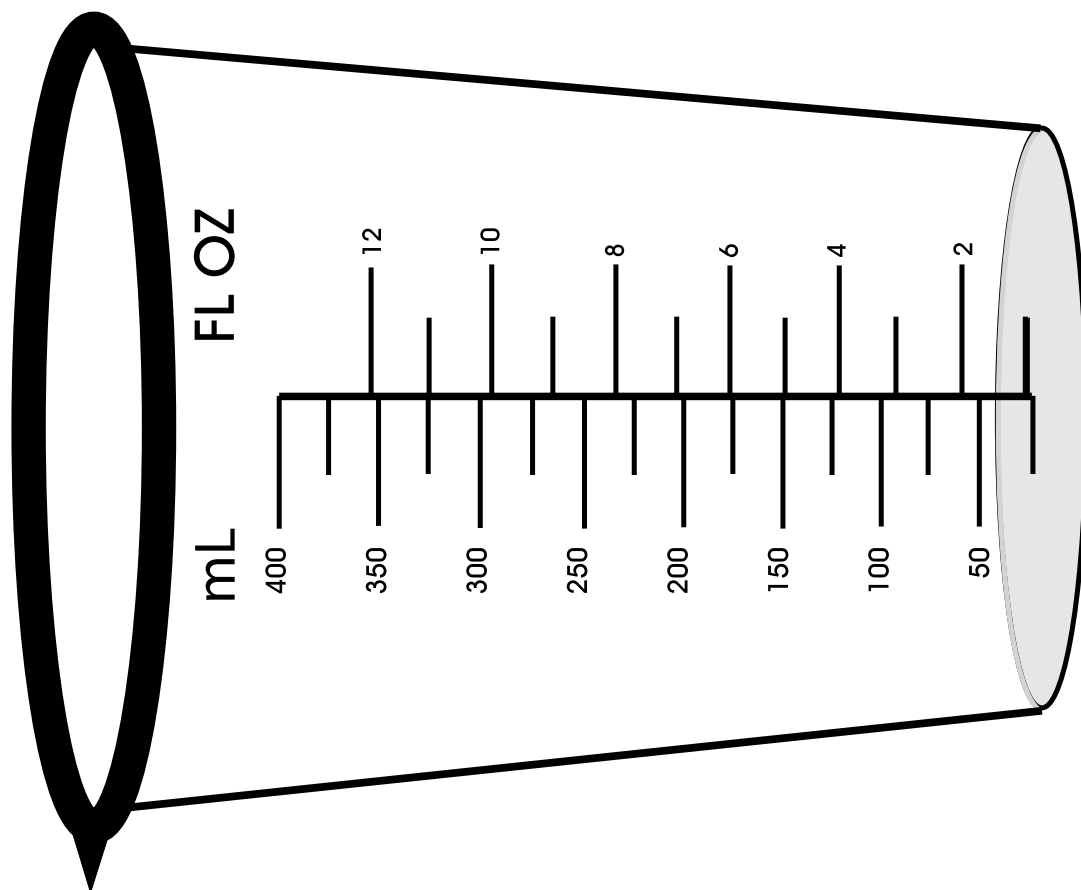
multi



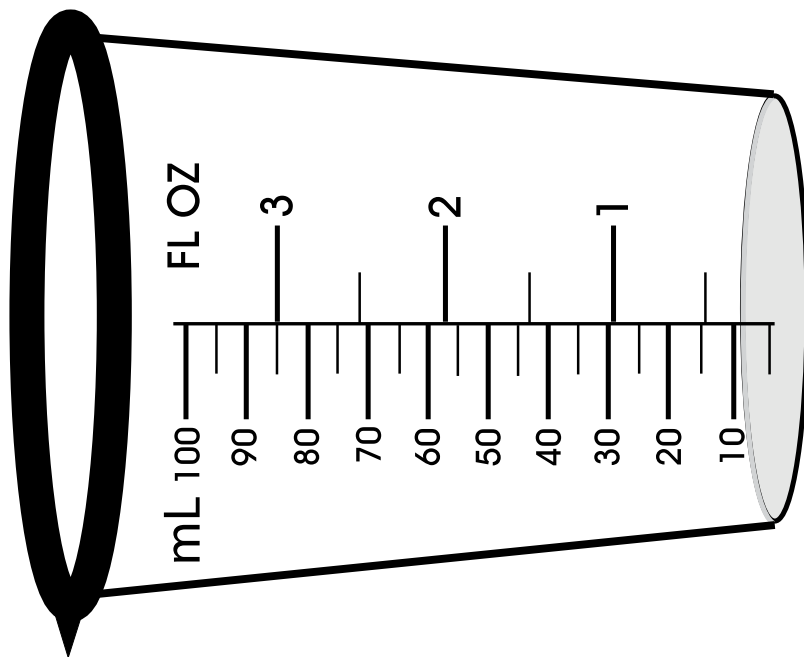


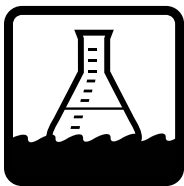
Beakers

400 mL BEAKER

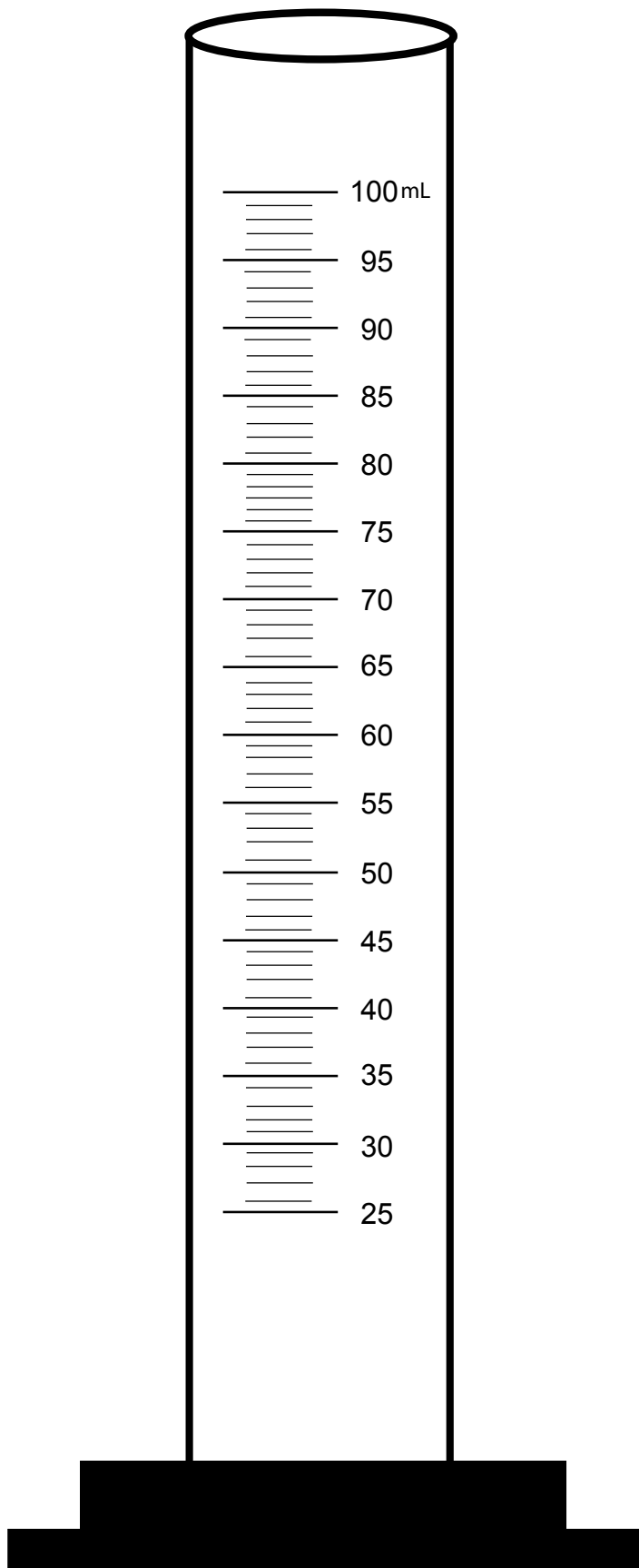


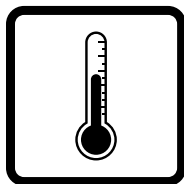
100 mL BEAKER



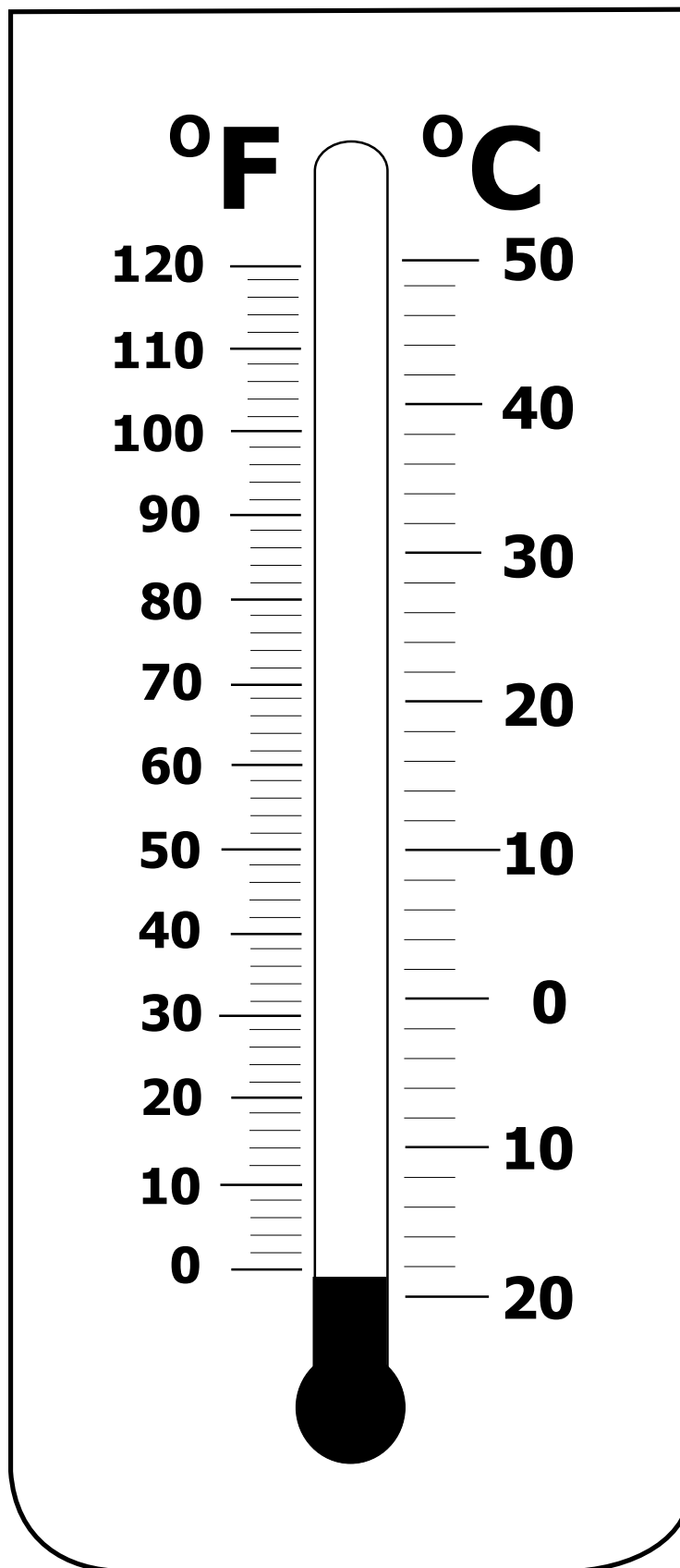


Graduated Cylinder 100 mL



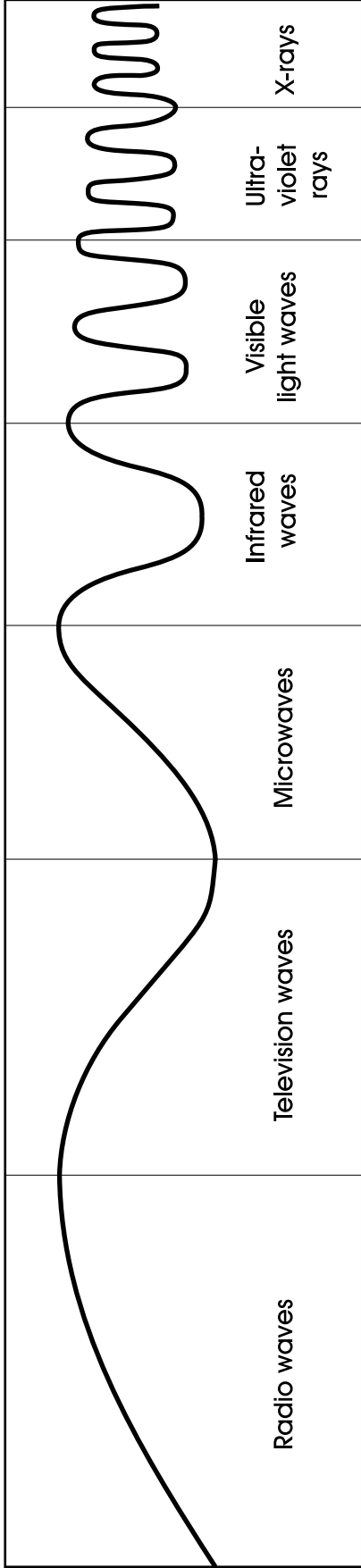


Thermometer—Fahrenheit and Celsius

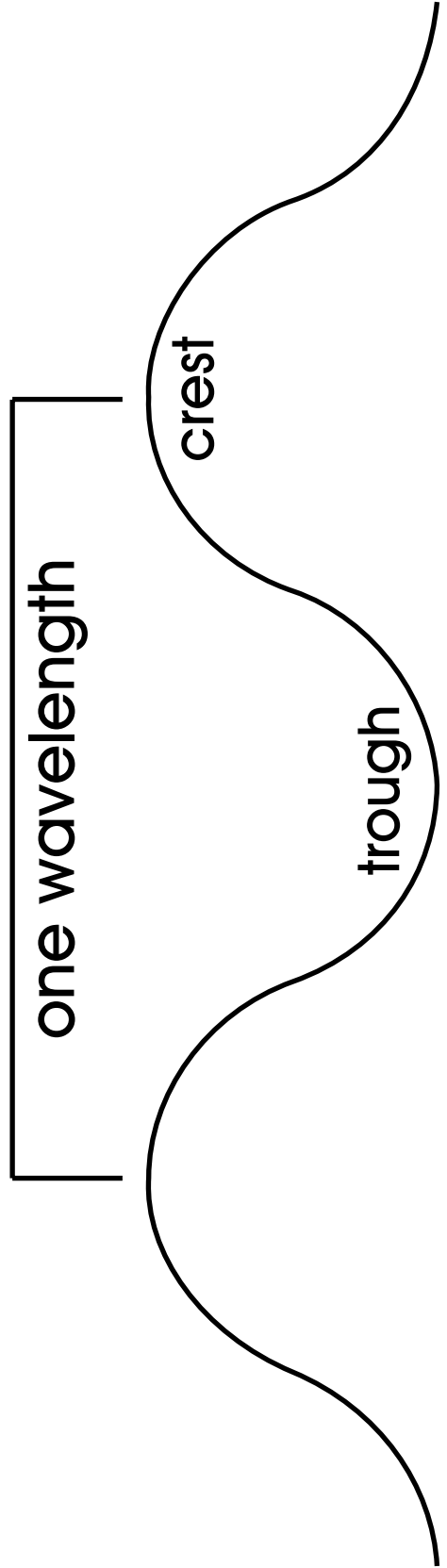


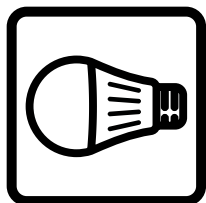


Light Energy—Transverse Waves

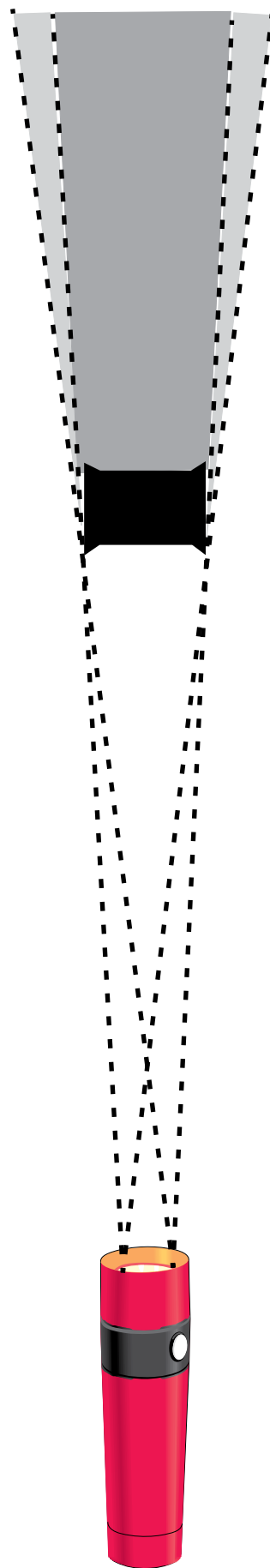
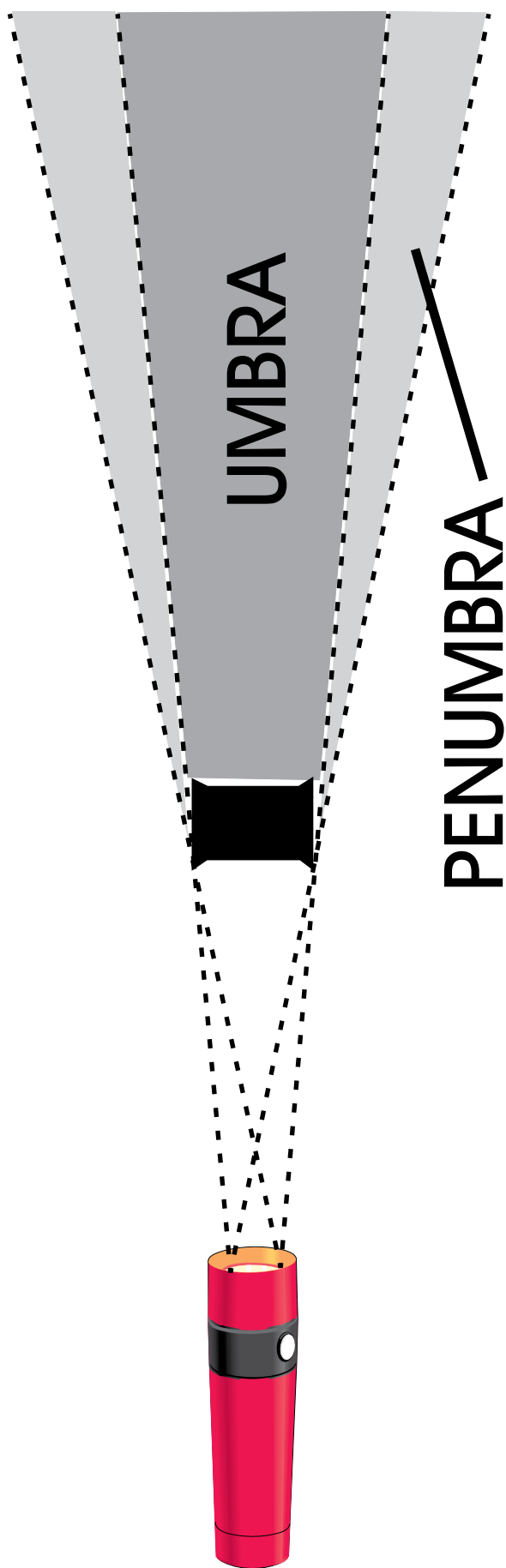


The shorter the wavelength, the more energy a wave has.





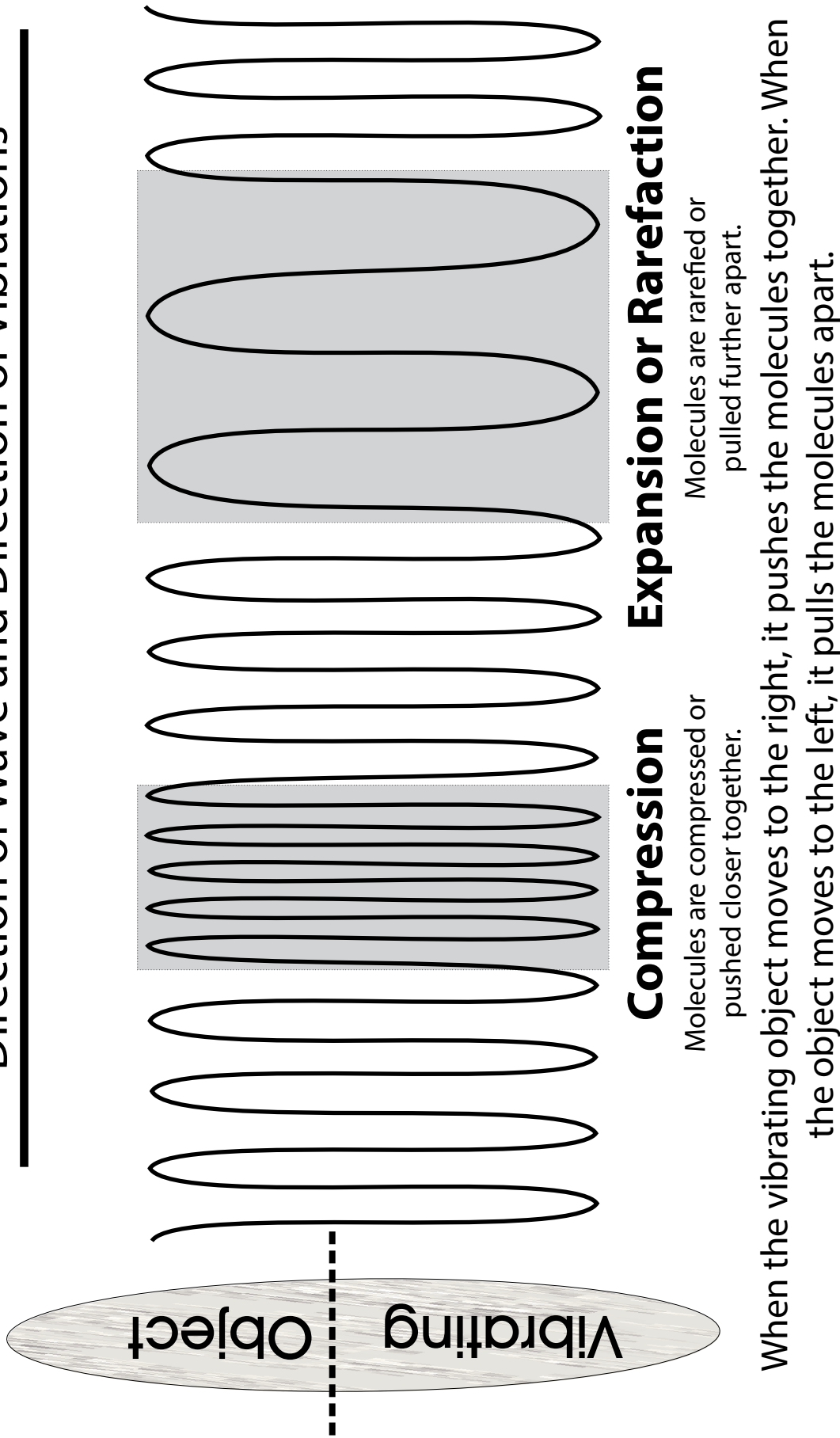
Shadows

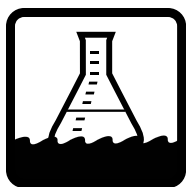




Longitudinal Sound Wave

Direction of Wave and Direction of Vibrations





Forms of Energy

All forms of energy fall under two categories:



POTENTIAL

Stored energy and the energy of position (gravitational).

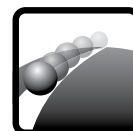


CHEMICAL ENERGY is the energy stored in the bonds of atoms and molecules. Gasoline and a piece of pizza are examples.

NUCLEAR ENERGY is the energy stored in the nucleus of an atom – the energy that holds the nucleus together. The energy in the nucleus of a plutonium atom is an example.

ELASTIC ENERGY is energy stored in objects by the application of force. Compressed springs and stretched rubber bands are examples.

GRAVITATIONAL POTENTIAL ENERGY is the energy of place or position. A child at the top of a slide is an example.



KINETIC

The motion of waves, electrons, atoms, molecules, and substances.



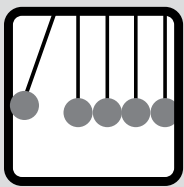
RADIANT ENERGY is electromagnetic energy that travels in transverse waves. Light and x-rays are examples.

THERMAL ENERGY or heat is the internal energy in substances – the vibration or movement of atoms and molecules in substances. The heat from a fire is an example.

MOTION is the movement of a substance from one place to another. Wind and moving water are examples.

SOUND is the movement of energy through substances in longitudinal waves. Echoes and music are examples.

ELECTRICAL ENERGY is the movement of electrons. Lightning and electricity are examples.



Motion Background Information

Kinetic and potential energy: The energy of motion is called kinetic energy. All moving objects have kinetic energy. Many objects also have energy because of the place they are in—their position. The energy of place or position is called potential energy. A rock on the top of a hill has energy. It is not moving—it has no kinetic energy. But it has energy because of its position on the hill. It has potential energy. If the rock begins to roll down the hill, its energy changes. The potential energy changes into kinetic energy as it rolls. When the rock stops rolling at the bottom of the hill, it has no more kinetic or potential energy.

Potential energy is also energy that is stored in an object. When you blow up a balloon, you are putting air into it. You are also putting energy into it—potential energy. If you tie the balloon and place it on the floor, it will not move. It has no kinetic energy. But it has potential energy—stored energy. If you untie the balloon, the stored energy is released. The air rushes out in one direction. The balloon moves in the other direction. The potential energy stored in the balloon changes to kinetic energy—the energy of motion.

Newton's laws of motion: Objects move in orderly ways, in ways we can predict. They move according to laws of motion that were developed by Sir Isaac Newton and are called Newton's Laws of Motion.

Inertia: Newton's first law is about inertia. It says that a moving object will keep moving until a force changes its motion. A force is a push or a pull. A force changes the energy level in an object. Inertia explains that an object at rest—that is not moving—will stay that way until a force moves it. A moving object will keep moving in the same direction at the same speed until a force changes its motion.

The first part of the law is easy to understand—an object at rest will remain at rest. An object that is not moving will not start moving by itself. If we see an object start to move, we always look to see what force is moving it. If we don't see a force, we might get nervous. The second part of the law is harder to understand—an object in motion will remain in motion until a force changes its motion. On Earth, we never see an object stay in motion forever. If we throw a ball into the air, it doesn't keep going—it falls to the ground. If we roll a ball down the street, it stops after a while. Nothing on Earth stays in motion forever. Does this mean that Newton's Law is wrong? Or is there an invisible force acting on the ball?

Gravity: There is a force that changes the motion of all moving objects on Earth. It is the force of gravity. Gravity is the force of attraction between all objects. The more matter an object has, the greater its force of gravity. The amount of matter an object has is called its mass. Mass is measured in grams or kilograms.

The Earth is large. It has a lot of mass. Its force of gravity pulls the objects on Earth toward it. Gravity holds us to the Earth. The sun has a huge mass. The force of attraction between the sun and the planets keeps the planets in orbit around the sun. The Earth has more mass than the moon. The Earth has a stronger force of gravity. The force of attraction between the two keeps the moon in orbit around the Earth. Your body would have the same mass on the Earth and the moon. But you would weigh more on Earth. Weight is a measure of the force of gravity on an object.

Friction changes the motion of objects: Another force that acts on objects is friction. Friction is the force that slows two objects rubbing together. Friction is a force that slows down the motion of objects. When a ball flies through the air, it rubs against air molecules. The air molecules and the molecules of the ball catch on each other. Some of the kinetic energy in the ball changes into heat. The ball doesn't have as much energy. It slows down.

If you roll a ball on a wood floor, it will roll a long way. If you roll the same ball with the same force on a carpet, it won't roll nearly as far. The ball sinks down into the carpet. More molecules of the carpet and the ball are touching each other. There is more friction between the ball and the carpet. More of the energy in the ball is turning into heat.

Newton's second law of motion: Newton's second law says that the motion of an object will change when a force is applied. If an object is moving, a force will speed it up, slow it down, or change its direction. If an object is not moving, a force will put it into motion. If a ball is lying on the floor without moving and you give it a push, it will begin to roll in the direction you pushed it. It will move in the direction of the force. If you push it again in the same direction, it will go faster. If you push against it, it will slow down. If the ball is rolling along the floor and you push it from the side, it will change its direction. Every force will change the motion of an object in some way.

Newton's third law of motion: Newton's third law states that for every action, there is an equal and opposite reaction. If an object is pushed or pulled, it will push or pull with equal force in the opposite direction. When you walk, you apply a force to the ground. The ground applies an equal and opposite force against you. It holds you up. If the ground didn't apply as much force, you would sink into the ground. If the ground applied more force, you would be pushed into the air. Here's another way to think about it. Forces are always found in pairs. If you apply a force to an object, the object applies a force to you.



Heat Background Information

Heat is the motion of molecules: Scientists say heat is the kinetic energy in a substance. Kinetic energy is the energy of motion. Heat is the motion of the molecules in a substance, not the motion of the substance itself. Even though we can't see them, the molecules in substances are never still. They are always moving. That motion is the kinetic energy called heat.

Molecules vibrate, spin, and move: The molecules in solids—like rocks, wood, or ice—cannot move much at all. They are held in one position and cannot flow through the substance. They do move back and forth in their positions. They vibrate. The more heat they have, the faster they vibrate. Liquids and gases are called fluids. The molecules in fluids move more freely than in solids. They flow through the fluids. The more heat fluids have, the faster their molecules move. What happens when you heat an ice cube? Ice is a solid. A solid has a definite shape. Its molecules vibrate in one position. When you add heat, the molecules vibrate faster and faster. They push against each other with more force. Finally, they start to break the intermolecular bonds that attract them to each other. They become a liquid—water. The molecules begin to move and spin. They are still bonded together, but not as tightly as in a solid. A liquid flows to take the shape of its container. It has a definite volume, but can take any shape. Volume is the amount of space a fluid occupies. If you add more heat energy to the molecules, they move faster and faster. They crash into each other and move away. Finally, they break the bonds that attracted them to each other. They become a gas—steam. A gas does not have a definite shape or volume. It spreads out and fills whatever space it occupies.

Heat seeks balance: Everything in nature seeks balance. Heat seeks balance, too. Heat flows from hotter places to colder places and from hotter substances to colder substances. What happens if you pour hot water into a tub of cold water? The molecules of hot water have more energy. They move fast. They crash into the colder molecules and give them some of their energy. The molecules of hot water slow down. The molecules of cold water move more quickly. The cold water gets warmer. The hot water gets cooler. Soon all of the water is the same temperature. All of the water molecules are moving at the same speed. The heat in the water is in balance. The same thing happens in a home, warm air rises and cool air sinks. This is called convection. Air moves until it finds balance.

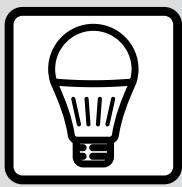
Heat energy moves: Heat is always on the move. It moves to seek balance. Heat moves by conduction in solids. In a hot object, the molecules vibrate fast. The molecules in a cold object vibrate more slowly. If you touch a hot object to a cold object, the molecules in the hot object push against the molecules in the cold object. The fast molecules give up some energy. The molecules in the cold object gain some energy. They vibrate faster. When the energy is in balance, all the molecules vibrate at the same speed.

Conductors and insulators: In some materials, heat flows easily from molecule to molecule. These materials are called conductors. They conduct—or move—heat energy well. Materials that don't conduct heat well are called insulators. The molecules in good conductors are close together. There is very little space between them. When they vibrate, they push against the molecules near them. The energy flows between them easily. The molecules in insulators are not so close together. It is harder for energy to flow from one molecule to another in insulators.

Heat and temperature: Heat and temperature are different things. Two cups of boiling water would have twice as much thermal energy or heat as one cup, but the water would be at the same temperature. A giant iceberg would have more heat energy than a cup of boiling water, even though its temperature is lower. Heat is the total amount of kinetic energy in a substance. Temperature is a measure of the average kinetic energy of the molecules in a substance. Temperature is also the measure of the hotness or coldness of a substance. Think about a pan in a hot oven. The pan and the air in the oven are the same temperature. You can put your hand into the oven without getting burned. You can't touch the pan. The pan has more heat energy than the air, even though it is the same temperature.

Measuring temperature: We use thermometers to measure temperature. In the United States, we use the Fahrenheit (F) scale in our daily lives. Scientists usually use the Celsius (C) scale, as do people in most other countries. On the Fahrenheit scale, the boiling point of water is 212 degrees. The freezing point of water is 32 degrees. On the Celsius scale, the boiling point of water is 100 degrees. The freezing point of water is 0 degrees.

Solids, liquids, and gases: The molecules in solids have strong bonds attracting them to each other. They are held tightly in one position. They cannot move around—they can only vibrate. When heat energy is added, they vibrate faster. They push against each other with more energy. The space between them gets a little bigger. But they are still held in position. The molecules in liquids are held together, but not in one position. They are free to spin and move around each other. When heat energy is added to liquids, they expand more than solids. The bonds that attract them together are not as strong. They can push away from each other. There is a lot of space between the molecules in gases. The bonds that attract them together are very weak. When heat energy is added to gases, they expand a lot. Sometimes they break the bonds completely and float away from each other.



Light Background Information

Light is energy in waves: What is light? Light is energy that travels in waves. All the energy we get from the sun travels in waves. Some of that energy is in light waves we can see—it is visible light. Some is in waves we can't see. We can't see infrared waves, but they can warm us when they touch our skin. We can't see ultraviolet waves, but they can burn our skin. Some waves of energy, like radio waves, are very long. Radio waves can be a mile long. Other waves are very short, like light waves and x-rays. There are about 50,000 light waves in an inch.

Visible light: Visible light, the wave energy we can see, is made of many colors. Every color has a different wavelength. The longest wavelengths are reds. The medium wavelengths are yellows. The shortest wavelengths are violets. All of the colors mixed together make white light. We measure waves by the distance from the top, or crest, of one wave to the top of the next. This distance is called its wavelength. The shorter the wavelength, the more energy the wave has.

Light waves travel in straight lines. When light waves hit something, three things can happen. The light can travel through a substance and bend—be refracted. Light passing through transparent substances like water is bent, or refracted. Light waves can enter a substance and be absorbed. Plants absorb some light waves and convert them into sugars. Light waves can also bounce off a substance—be reflected. A mirror reflects light waves. Many substances absorb some light waves and reflect others.

A prism separates light waves: A prism is a piece of clear glass or plastic that bends light waves as they pass through it. A prism is often shaped like a triangle. A prism can separate visible light into its different wavelengths. It can separate all of the colors that make up white light. A prism bends—or refracts—light waves. The wavelengths of each color bend at a different angle. The light that goes into the prism spreads out as it leaves the prism.

We can use pieces of glass in different shapes—called lenses—to bend light. A convex lens is thicker in the middle than on the ends. It bends light waves toward a point. A convex lens can make objects look larger. A concave lens is thinner in the middle than on the ends. It spreads out light waves that pass through it. A concave lens can make objects look smaller.

Light waves can be reflected: How do we see things? We see the light waves that bounce off things—the light that is reflected by substances. When there are no light waves, you can't see anything. When you look in the mirror, the image you see is made by light waves. Light from all around you bounces off of you. Some of the light waves travel toward the mirror. The mirror reflects the light waves. Your eyes see these reflected light waves.

Light waves don't just bounce around. They are reflected at angles we can predict. When a light wave hits an object and is reflected, it will be reflected in a straight line. If the light wave hits an object at an angle, it will be reflected at the same angle.

Light waves can be absorbed: Light waves can also enter a substance and change into other forms of energy. The light energy can be absorbed by the substance. When we are in the sun, some of the light waves enter our skin and turn into heat. Our bodies absorb some of the light waves. Most substances reflect some light waves and absorb others. That's why we see colors!

Visible light: Visible light is made of every color. Every color has a different wavelength. When a substance absorbs all wavelengths of visible light, the substance looks black. No light waves are reflected to reach our eyes. The light waves—which are waves of energy—enter the substance. The substance changes the light energy to other forms of energy. When a substance reflects all wavelengths of visible light, the substance looks white.

Seeing colors: We see many colors because most substances absorb some wavelengths of light and reflect others. We see the colors that are reflected by the substances. A rose looks red because it is reflecting the red light waves and absorbing the oranges, yellows, blues, greens, and violets. A blue bird looks blue because it is reflecting blue light waves and absorbing the others. The dirt looks brown because it is reflecting several light waves that together look brown and absorbing other light waves.

Using light energy: We use light energy every day to see. We use it in many other ways, too. The leaves of plants reflect green light waves and absorb others. The energy they absorb is used by the plants to make sugars. These sugars feed the plants and the plants we eat give energy to us. All the energy we get to move and grow comes from plants.

We can use the energy in light to make heat in many ways. We can color things black to absorb the light waves. We can use mirrors to reflect many light waves onto an object that absorbs them and turns them into heat. We can use this heat to warm houses and water or to cook food. We can also use light energy to make electricity. Solar cells can absorb light waves and turn the energy into electricity.



Sound Background Information

Sound is energy moving in longitudinal waves: Sound is a special kind of kinetic, or motion, energy. Sound is energy vibrating through substances. All sounds are caused by vibrations—the back and forth motion of molecules. The molecules collide with each other and pass on energy as a moving wave. Sound waves can travel through gases, liquids, and solids. The sounds you hear are usually moving through air. When a sound wave moves through air, the air molecules vibrate back and forth in the same direction as the sound. The vibrations push the air molecules close together, then pull them apart. These waves are called longitudinal waves. Longitudinal waves move in the same direction as the force making them.

The part of a longitudinal wave in which the molecules are squeezed together is called a compression. The molecules are compressed, or squeezed together, into a smaller space. The part of a longitudinal wave in which the molecules are pulled apart is called an expansion or rarefaction. There are the same number of molecules as in a compression, but they are farther apart.

Transverse waves: Energy also travels in other kinds of waves. When you throw a stone into water, waves of energy move across the surface. The waves move away from the place where the stone hit the water. The water molecules vibrate up and down, at a right angle to the direction of the wave. A wave in which the molecules vibrate in one direction and the wave of energy moves in another is called a transverse wave. If you've ever been to the ocean, you've probably floated on transverse waves. If you go out beyond the breakers, you can float on the waves without moving closer to shore.

Amplitude of sound waves: The loudness of a sound wave is called its amplitude. The amplitude of a wave depends on its size—the height of a wave from its crest to its trough. The crest is the highest point of the wave; the trough is the lowest point. The louder a sound is, the higher its amplitude. The higher the amplitude of a sound wave, the more energy it has. If you turn up the volume on your radio, you increase the amplitude of the sound waves. The frequency of the sound waves remains the same. If you push more air past your vocal cords, the sound you make will be louder. You will increase the amplitude of the sound. You will put more energy into the sound.

Frequency of sound waves: The pitch of a sound is how high or low it is. The pitch of a sound depends on the wavelength of its vibrations. The number of wavelengths that pass a point in one second is called the frequency of the wave. The more wavelengths, the higher the frequency. Objects that vibrate quickly have a high frequency. Sound waves with a high frequency produce a high-pitched sound, like a whistle. Sound waves with a low frequency produce a low-pitched sound, like a tuba. By changing the muscle tension on our vocal cords, we can change the frequency of the sound waves we make. We can change the pitch of the sounds.

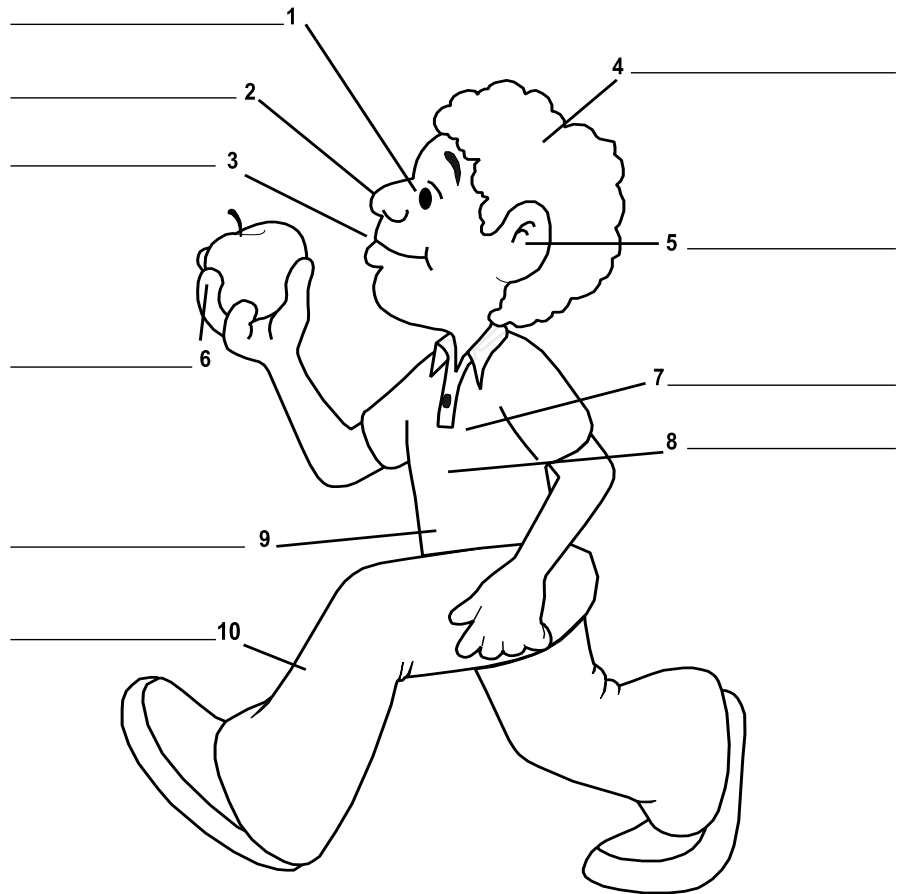
Hearing sound: Our ears are amazing organs that change sound waves into electrical signals and send them to our brains. Sound waves enter the ear canal and travel back to the eardrum. The eardrum is a thin layer of skin that is stretched tightly over the end of the ear canal, much like the skin of a drum. The sound waves transfer their energy to the eardrum, which begins to vibrate. As the eardrum vibrates, it moves a tiny bone called the hammer back and forth. The hammer moves against the anvil—another tiny bone—which vibrates a third bone called the stirrup. The stirrup transfers the vibrations to the cochlea, which is filled with liquid and lined with hundreds of tiny hairs. The hairs vibrate, sending signals to the auditory nerve, which carries the signals to the brain. Our brains can also tell the direction of the sound by differences in the amplitude of the sound and when it reaches the ear. A sound on the left, for example, will reach the left eardrum before it reaches the right one. It will also be louder on the left than on the right.

Sound can move through liquids and solids: Sound travels faster and farther through liquids than through air. The molecules of liquids are closer together than the molecules of gases. It is easier for energy to move from one molecule to another when the molecules are close together. Sound travels best in solids because the molecules are so close together. Sound travels about five times faster in water than in air, and almost 20 times faster in steel. In air, sound travels at 1,130 feet per second (343 meters per second). It takes almost five seconds for sound to travel one mile. In water, it only takes about one second for sound to travel a mile.

Whales and dolphins use sound to navigate and communicate with each other. Scientists believe whales sing songs underwater that are heard by other whales hundreds of miles away. The builders of the underwater tunnel between England and France communicated by tapping signals on the steel tunnel. The signals traveled quickly to the other end of the tunnel.

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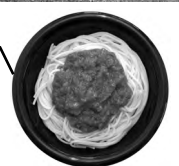
1. seeing
2. smelling
3. tasting
4. thinking
5. hearing
6. feeling
7. moving blood
8. breathing
9. digesting food
10. moving



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YOUTH AWARDS PROGRAM FOR ENERGY ACHIEVEMENT

NEED's annual Youth Awards Program for Energy Achievement rewards students for their efforts in energy outreach and student leadership.

The Youth Awards Program is great for all schools—new to energy education, or veteran. Projects and outreach completed for the program provide opportunity for enrichment and engagement, as well as an opportunity for your students, classroom, and school to shine. Youth Awards projects can be completed by afterschool/out-of-school time programs, community groups, and even families!

What's involved?

Students and teachers set goals and objectives and keep a record of their activities. Students create a digital project to submit for judging. In April, digital projects are uploaded to the online submission site.

Check out:

For more information and project submission details, we invite you to visit <https://youthawards.need.org>. Be sure to explore the site to view past winning projects and garner inspiration!

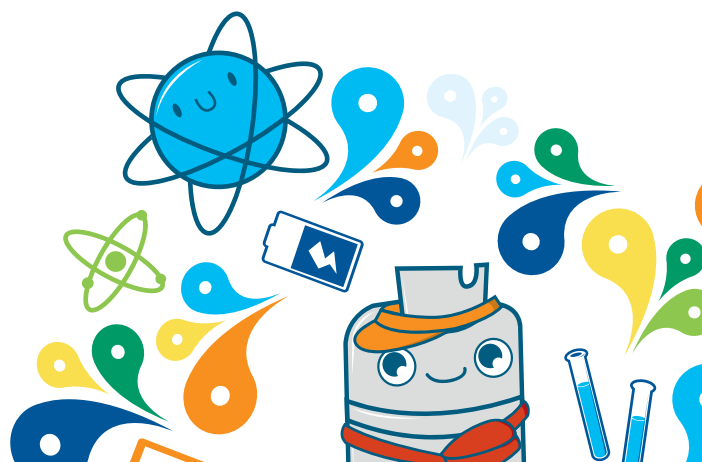
YOUTH ENERGY CONFERENCE & AWARDS

The NEED Youth Energy Conference and Awards gives students more opportunities to learn about energy and to explore energy in STEM (science, technology, engineering, and math).

The annual June conference has students from across the country working in groups on an Energy Challenge designed to stretch their minds and energy knowledge. The conference culminates with the Youth Awards Ceremony recognizing student work throughout the year and during the conference.

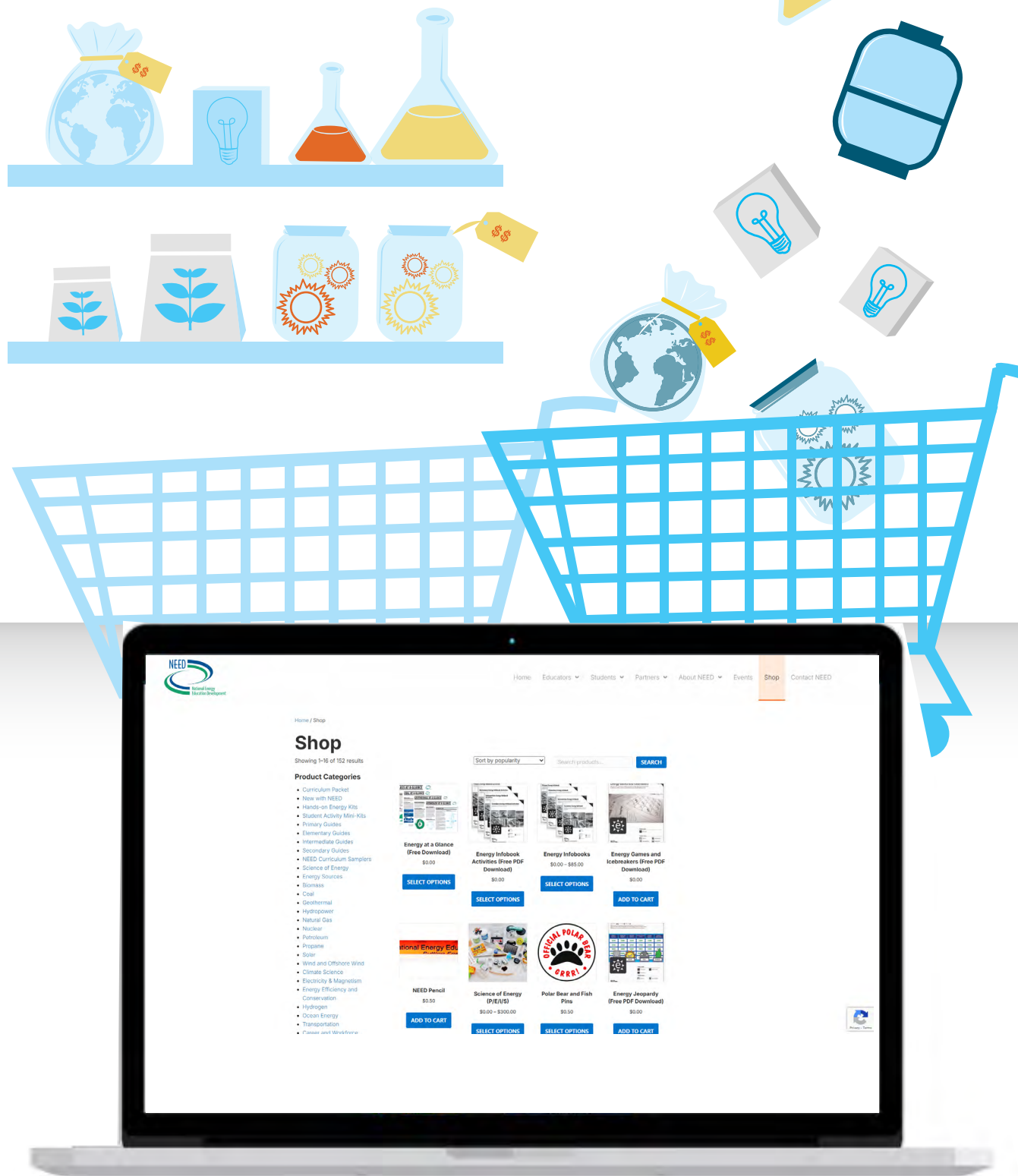
For More Info:

www.need.org/youthenergyconference



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What Is Energy? Evaluation Form

State: _____ Grade Level: _____ Number of Students: _____

- | | | |
|--|------------------------------|-----------------------------|
| 1. Did you conduct the entire unit? | ☐ Yes | ☐ No |
| 2. Were the instructions clear and easy to follow? | ☐ Yes | ☐ No |
| 3. Did the activities meet your academic objectives? | ☐ Yes | ☐ No |
| 4. Were the activities age appropriate? | ☐ Yes | ☐ No |
| 5. Were the allotted times sufficient to conduct the activities? | ☐ Yes | ☐ No |
| 6. Were the activities easy to use? | ☐ Yes | ☐ No |
| 7. Was the preparation required acceptable for the activities? | ☐ Yes | ☐ No |
| 8. Were the students interested and motivated? | ☐ Yes | ☐ No |
| 9. Was the energy knowledge content age appropriate? | ☐ Yes | ☐ No |
| 10. Would you teach this unit again? | ☐ Yes | ☐ No |

Please explain any 'no' statement below.

How would you rate the unit overall? ☐ excellent ☐ good ☐ fair ☐ poor

How would your students rate the unit overall? ☐ excellent ☐ good ☐ fair ☐ poor

What would make the unit more useful to you?

Other Comments:

Please fax or mail to: **The NEED Project**

8408 Kao Circle
Manassas, VA 20110

FAX: 1-800-847-1820

Email: info@need.org



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