UNIT OVERVIEW

One of the most important types of energy on Earth is heat energy. A great deal of heat energy comes from the Sun's light hitting Earth. Other sources include geothermal energy, friction, and even living things. The Heat Energy unit helps students understand what heat energy is, how it is transferred, how it is measured, and how insulation can keep heat in or out.

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

- low reading level
- middle reading level
- high reading level

THE BIG IDEA

Heat energy is the driving force behind everything we do. This energy gives us the ability to run, dance, sing, and play. We also use heat energy to warm our homes, cook our food, power our vehicles, and create electricity.

Other topics

This unit also addresses topics such as: natural and human-made heat sources, friction, heat from inside Earth, and the effect of heat on our bodies.

SPARK

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

Materials

- paper towels
- water

Activity

Have students place their hands on their face. Discuss how the temperature of their hands feels compared to the temperature of their face (probably about the same).

Tell students to rub their hands together firmly and quickly, and have them describe what they feel (their hands will feel warm). Ask students to place their hands on their face again and discuss how their hands feel now compared to their face (warmer than their face). Invite students to explain why they think their hands warmed up. (The friction of their hands rubbing together created heat.)

Now moisten paper towels with water and have students rub their hands with one of them. Then tell students to move their hands in the air or blow on them, and have them describe what they feel (their hands will feel cool). Ask students to place their hands on their face again and discuss how their hands feel now compared to their face (cooler than their face). Invite students to explain why they think their hands feel cool. (Evaporation uses heat energy, removing heat from the skin and making it feel cooler.)

Below are questions to spark discussion.

How could you use either of these methods to keep cool on a hot day or to stay warm on a cold day?

How warm or cold do you think your hands could get by trying these methods?

Do you think the inside of your hands changed temperature very much when you tried each method? Why or why not?

Do you know any other ways to warm or cool your skin? Describe your method and explain why it works.

Have you ever felt a bicycle tire after you've ridden awhile? It gets warm. Why do you think this is so?

Why do you feel cold when you are wet?

How do animals stay warm or cool?

Use this activity to begin an introductory discussion about heat energy. Explain that heat is essential to all living things. The Sun's energy provides us with heat every day, and other sources of heat are easy to find and use. Throughout the unit, students will learn more about heat energy.

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

PRIOR KNOWLEDGE

Invite students to explain their understanding of what energy is and where it comes from, and to list types of energy. Also ask students to explain what heat is, where it comes from, and how it passes from one thing to another.

Probing Questions to Think About

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

- Why do people need energy?
- What do you think heat energy is?
- Where does heat come from?
- Which do you think gives us more heat, the Sun or Earth?
- When have you wished you had more heat? Less heat?

- What happens to a pot of water when you put it on a hot stove? Why?
- What happens to the water in an ice cube tray when you put it in a freezer? Why?
- How do you stay warm on a cold day? Cool on a hot day?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

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

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

Selected unit resources are available in more than one language.

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

VOCABULARY

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

Core Science Terms

These terms are crucial to understanding the unit.

conduction	the transfer of heat from one object to another
conductor	a material, usually a metal, that transfers heat, electricity, or sound from one object to another
convection	the transfer of heat by movement in a liquid or gas
evaporate	to change from a liquid state to a gas state
friction	a force that builds up and creates heat when two objects rub against each other
fuel	any material used to produce heat or power
geothermal heat	heat energy from inside Earth in the form of steam or hot water that is sometimes used to produce power
geyser	a hot spring that boils from time to time, sending a column of water and steam into the air
heat energy	a form of energy that is transferred from an object with a higher temperature to an object with a lower temperature

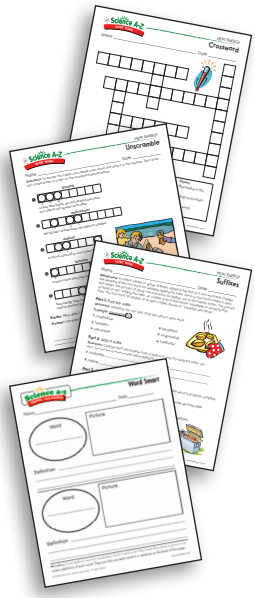
insulator	a material that reduces or prevents the transfer of heat
matter	anything that takes up space and has weight
radiant energy	energy that travels in waves
radiate	to travel outward in every direction
temperature	the measure of hot and cold, usually measured on a thermometer
thermometer	a tool used for measuring temperature
transfer	to move from one place to another

Other Key Science Terms

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

accelerant	a substance that makes a fire grow faster
Celsius	a system for measuring temperature in which water freezes at zero degrees and boils at 100 degrees
energy	the ability to do work
Fahrenheit	a system for measuring temperature in which water freezes at 32 degrees and boils at 212 degrees
furnace	a large appliance in which fuel is burned, which can heat buildings, burn trash, or melt raw materials
hot spot	a place in Earth's crust where hot, molten rock rises close to the surface
hot spring	water that is naturally heated underground and comes out of the surface of Earth
lightning	a flash of light in the sky made when electricity passes from one cloud to another or between a cloud and the ground
molten	the liquid state of rock when heated to a high temperature
volcanologist	a scientist who studies volcanoes

Vocabulary Activities



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

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

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

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

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

BACKGROUND AND MISCONCEPTIONS

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

Q: *Is heat a substance?*

A: Students may believe that since they can feel heat and can feel a soccer ball, both are tangible objects. However, heat is a form of energy, not a physical substance. Heat affects substances but is not made of matter.

Q: *Are heat and temperature the same thing?*

A: The two terms are closely related, but there is a distinction. Adding *heat* to something will raise its *temperature*. Heat is a description of the total energy in a substance. Temperature is a measurement of the average amount of heat energy in a substance, regardless of the volume measured. Larger volumes have a greater total amount of heat but may have the same temperature. A children's pool and an Olympic pool may have the same water temperature, but the larger pool has more overall heat. In other words, temperature does not depend on size; heat does.

Q: *Does the heat of the Sun make things hot on Earth?*

A: No, not directly. The heat energy that the Sun puts out does not generally reach Earth. But the Sun's light does reach Earth. When the land, the water, and the air absorb that light, it gets released as heat. Much of that heat is trapped within our atmosphere, making this planet inhabitable.

Q: *Is the weather hot in the summer and cold in the winter because Earth is closer to the Sun?*

A: The Sun does not transfer its heat to Earth. Instead, its light reaches Earth and is converted into heat. If this misconception were true, the entire planet would have summer at the same time of year, which is not the case. The seasons are caused by the tilt of Earth's axis compared to its revolution around the Sun. When the Northern Hemisphere is tilted toward the Sun, it's summer there, and it's winter in the Southern Hemisphere. Six months later, the Northern Hemisphere is tilted away from the Sun (winter), and the Southern Hemisphere is tilted toward the Sun (summer). When the Sun is at a higher angle in the sky, its energy is transferred more directly to Earth, resulting in warmer temperatures (summer). When the Sun is at a low angle, less of its energy reaches Earth's surface, resulting in cooler temperatures (winter).

Q: *Is ice water cold because the ice cubes transfer their coldness to the warmer water?*

A: It would seem so, but no. Actually, changing ice from a solid to a liquid requires energy. Some of the heat energy in the liquid water transfers to the ice, thus reducing the temperature of the liquid water and raising the temperature of the ice until it changes states to a liquid. Similarly, refrigerators and air conditioners do not add cold but instead remove heat, leaving the contents colder.

Q: *Why does my skin feel cool when it's wet?*

A: Like melting ice, evaporation requires energy to change water from a liquid to a gas. In the case of wet skin, heat energy is withdrawn from the skin to make the water evaporate, leaving the skin cooler.

Q: *Why do thermal blankets keep me warm if they're full of holes?*

A: Although other blankets can keep you warm, thermal blankets work particularly well by trapping warm air in all those holes. The same principle makes fiberglass an effective insulator for houses.

Q: *I have heard that heat always rises. Is that the only direction it can move?*

A: No, heat does not only move upward. Heat does rise in a gas, such as air. But through conduction, friction, and other forms of heat energy transfer, heat can move in any direction.

Q: *Are clothes sources of heat?*

A: Clothing does not provide us with heat but rather acts as insulation, keeping us from losing the heat we already have. This is why clothing is said to *keep* you warm, not make you warm.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when the term *heat, energy,* or *heat energy* is entered. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- conduction
- insulation
- friction
- solar energy
- convection
- radiation
- geothermal heat
- temperature

Projects and Activities

- **Writing:** Have students write a procedural composition explaining how to keep warm on a cold day or how to keep cool on a hot day. See Writing A-Z for extensive writing instruction.
- **Guest:** Invite a firefighter to discuss fire safety, fire prevention, and escape plans with students.
- **Project:** Help students build solar ovens and let students try cooking with them. Numerous sites on the Web provide instructions, designs, and recipes. Only certain foods should be cooked at the relatively low temperatures reached in solar ovens.
- **Project/Home Connection:** Create a class museum of many different human-made heat sources, including interesting lamps, flashlights, and candles. Supervise these for safe use and storage.
- **Math/Home Connection:** Invite students to keep a log of the air temperature inside and outside their home over a one-week period. Then collect the data and create a class graph, or have students each graph their own data.
- **Research:** Help students learn how convection currents in warm ocean water cause weather patterns such as El Niño and La Niña.
- **Research/Arts:** Help students research the signs and treatments of heat-related health problems or heat-related safety concerns. Then have them make a brochure that teaches others how to stay healthy and safe around heat.

- **Arts:** Have students clip pictures from magazines that show heat energy. Have them classify the images and make a poster, mobile, or bulletin board with the pictures.
- **Research/Home Connection:** Students can conduct research as a family/home project or in the library/media center to extend the learning about a topic in one of the *Quick Reads* or other unit resources.