UNIT OVERVIEW

Our universe and our world are awash in light. The Light Energy unit helps students explore the nature of light, the movement of light, natural and human-made sources of light, and the special behaviors and properties of light. It also explores how colors are formed and how the human eye enables us to see.

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

Many aspects of our lives are affected by or dependent upon light. In addition to learning about light, students may gain an appreciation for the varied roles that light plays in their lives.

Other topics

This unit also addresses topics such as: eye and skin protection from light, how animals use light, different types of telescopes, various forms of radiant energy, and how changes in light affect shadows.

SPARK

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

Materials

- bright flashlight
- several mirrors of any size

Activity

Shut off the lights in the classroom and make it as dark as possible. Turn on the flashlight and shine it on a wall. To keep it steady, set it on a table or counter pointed high enough to clear students' heads and reach the wall.

Below are questions to spark discussion.

How can we make the light shine on a different spot in the room without moving the light source?

Use a mirror (or other reflective surface) to reflect the light in a new direction.

Choose a volunteer to hold one mirror in the path of the light to redirect it to the new spot.

What if we wanted to redirect the light again, without moving the light?

Another mirror could be used to redirect the light to the desired spot.

Repeat the process as many times as you can make it work. At some point, it will become difficult to keep reflecting the light in new directions as the light loses energy, spreads, and fades. It will also be difficult to hold the mirrors steady enough to keep aiming the light at the next mirror. Let students suggest ways to improve the exploration, which may include changing the distance between mirrors or the pattern in which they are arranged.

Use this process to spark an introductory discussion about the properties of light: it reflects, it fades, it moves very fast, and so on. To demonstrate the speed of light, tell students you will say "now" when you shut off the light and again when you turn it back on. Ask them to say "off" when they notice the reflected light shut off and "on" when it reappears. They will observe that this occurs virtually instantaneously.

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 name sources of light. Discuss what would happen to Earth and its inhabitants if no light existed. Invite students to share any experiences they have had in situations with little or no light (exploring a cave, being blindfolded, having a power outage, and so on) as well as experiences when there was too much light (walking in front of a spotlight, having the Sun shining in their eyes, and so on).

Probing Questions to Think About

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

- What is light?
- Can you see light or just things that are lit up by light?
- Can you feel light?
- Is light colorful?
- Does light move? How do you know?
- Can light stand still?
- How fast does light travel?
- What happens when light hits a solid wall, a glass window, or a shiny mirror?
- How do people, other animals, and plants use light?

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 Light 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.

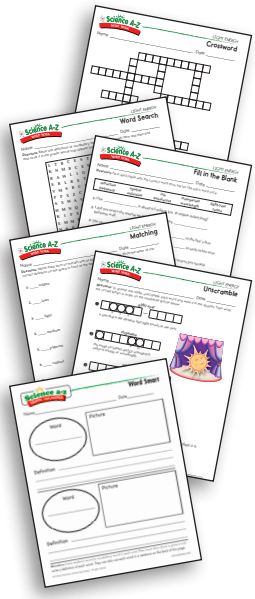
concave lens	a lens that is wider at the edges than in the middle, and that refracts light rays so they bend outward
convex lens	a lens that is wider in the middle than it is at the edges, and that refracts light rays so they come together
fluorescent bulb	a lightbulb in which electricity passes through a gas, that reacts with a coating inside the bulb to produce light
frequency	the number of waves that pass a point in a specific length of time
incandescent bulb	a lightbulb in which electricity passes through a wire, which heats up and produces light
light	a form of radiant energy that allows us to see objects
light-year	a unit that is the distance that light travels in one year
opaque	blocking all light from passing; not see-through
photon	the smallest particle of light energy
pigment	a substance that gives color by reflecting some colors of light, and absorbing other colors of light
reflection	the return of light as it bounces off something
refraction	the bending of light waves when they pass from one kind of matter to another

retina	a layer of light-sensitive cells at the back of the eye
spectrum	the range of radiant energy, arranged in order of energy or wavelength
translucent	allowing some light through; images are distorted
transparent	allowing all light through; images are not distorted
wavelength	the distance between two consecutive peaks or troughs of a wave
white light	all the colors of light mixed together

Other Key Science Terms

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

compound eyes	eyes of most insects, made up of many lenses
eclipse	when the Moon or Earth casts a shadow over the other
filament	a thin wire in a lightbulb that electricity makes heat up and glow
iris	the round, colored portion of the eye that opens and closes to let more or less light into the eye
laser	intense, focused light of similar wavelengths
medium	a substance through which something is carried or transmitted
peripheral vision	what enables a person or animal to see things all around it without turning its head
polarized	a characteristic of some sunglasses that lets them block sunlight entering from certain directions
pupil	the dark opening in the middle of the eye, through which light enters
radiant	moving out in all directions; shining
sunburn	damage to skin cells caused by UV radiation in sunlight
ultraviolet radiation	invisible energy more powerful than visible light that can damage skin and lead to skin cancer
visible	able to be seen



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 visible light the only type of light?*

A: No. In fact, visible light is a type of radiant energy that makes up just a tiny slice of the electromagnetic spectrum. (See the *Nonfiction Book Light* for more on the electromagnetic spectrum.) In order from lowest energy (longest wavelength/lowest frequency) to highest energy (shortest wavelength/highest frequency), the radiation types are: radio, microwave, infrared, visible light, ultraviolet, X-rays, and gamma rays.

Q: *How far can light travel?*

A: It may seem that light from a bulb only extends outward a certain distance and then stops. But light actually travels an infinite distance, and the distance it extends does not depend on the brightness of the bulb. Our eyes can only see light of a certain brightness; therefore, it is perceived to have stopped once its brightness is diminished.

Q: *When does light change direction?*

A: Anytime light travels through a substance, even air, it changes direction. It may be a large change of direction (such as through lenses or water), or it may be a small change of direction (such as through flat glass).

Q: *Does light only reflect off shiny surfaces?*

A: Reflections may be more noticeable on shiny surfaces, but light reflects off many surfaces, shiny and not. The colors that are reflected depend on the surface's colors.

Q: *Does visible light produce heat?*

A: Geothermal activity, chemical processes, electricity, friction, mechanical methods, and more can cause heat. Heat can also be caused by the transfer of other types of electromagnetic radiation besides visible light, such as infrared radiation. But visible light itself does not cause heat.

Q: *What are the colors of the rainbow?*

A: Students may be familiar with the seven colors of a rainbow (red, orange, yellow, green, blue, indigo, and violet). In fact, there are millions of colors in a rainbow. We classify them into seven main groups of colors that our eyes can see.

Q: *How does a prism make rainbowlike colors?*

A: When light passes through a prism, the colors that make up white light are separated and made visible to the human eye. Students may believe that the prism adds colors to the light.

Q: *How are colors of light different from colors of pigments?*

A: The primary colors of light are red, green, and blue. The primary colors of pigments are red, yellow, and blue. Mixing colors of pigments (such as paints) does not follow the same rules as mixing colors of lights. When combined, the primary colors of pigments produce a black pigment. This happens because pigments are made to absorb all light except for a few, specific wavelengths (colors), which are reflected. As more pigments are combined, more colors of light are absorbed until all colors are absorbed and none are reflected. The primary colors of light combine to produce white light, not black.

Q: *How do color filters produce colorful light?*

A: A white light source, such as an incandescent or fluorescent bulb, produces light made up of all colors. It only appears white because the colors are blended. When filters are added, the light appears to be a different color, but filters do not add color to the light. Actually, like other filtering materials, color filters allow only certain colors of light to pass through, and they absorb or reflect the others.

Q: *Which parts of the eye help me see in focus?*

A: The cornea, on the front of the eye, serves to focus the light entering the eye. It is further focused through the lens of the eye in order to form an image on the retina.

Q: *Is there a black spot on my eye?*

A: The pupil of the eye is not a black object or spot on the surface of the eye. It is an opening in the center of the iris. It helps control the amount of light entering the eye.

EXTENSION ACTIVITIES

Using the Internet

Most search engines will yield many results when *light* or *light education* is entered. Try pairing the word *light* with related terms from the unit. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- What is light?
- electromagnetic spectrum
- solar eclipse
- What is color?
- refraction
- sun safety

Projects and Activities

- **Project:** Order UV cards or sun sensor cards so students can measure the levels of UV radiation from the Sun. Test these levels and record data during clear versus cloudy conditions, hold the card under different fabric types used in clothing, and compare shady versus sunlit areas. To obtain cards, try an Internet search for *UV cards* or *sun sensor cards,* contact a skin cancer prevention organization, or utilize a science resource center.
- **Project:** Create a class museum of many different human-made light sources, including interesting lamps, flashlights, and candles.

- **Project:** Create or locate an investigation activity to experiment with how well plants grow in the light versus the dark. A good example is the *Plants, Water, and Sunlight Process Activity* from the Science A–Z Plants unit (K–2). You may also locate experiments that test certain animals' reactions to light. A good example is the *Pill Bugs Process Activity* from the Science A–Z Animals unit (K–2).
- **Guest:** Invite a visually impaired or blind guest speaker to class to address students' questions about how he or she copes without vision. Ask the speaker to discuss how well he or she can sense and use light, despite not being able to see.
- **Field Trip:** Plan a trip to a planetarium/science center in which students can learn about how scientists use light and other forms of radiant energy from space to observe and measure the universe. If possible, examine telescope and lens types.
- **Arts:** Have students clip pictures from magazines that show light sources and/or uses of light. They can glue these onto posterboard to create a collage.
- **Research:** Have students research and compile a list of sayings or expressions that pertain to light, seeing, the Sun, or other unit terms and concepts. Examples include: "You brightened my day," "Now I see the light," and "His motives were transparent."
- **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.