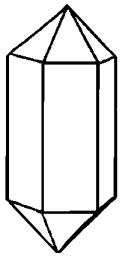
LIGHT BENDERS



BENCHMARK and TASK

SC.B.1.2.2 The student recognizes various forms of energy (e.g., heat, light, and electricity).

- The student demonstrates that light travels very rapidly in straight lines. When it strikes an object, light is reflected, absorbed, or it passes through, causing it to be refracted.

KEY QUESTION

What happens when light travels from one material to another?

BACKGROUND INFORMATION

A swimming pool appears shallower than it really is. A pencil in a glass of water appears bent. These effects are caused by the change in the speed of **light** and the change in the direction of light when it passes from one material to another. These effects are due to the **refraction** (bending) of light. Refraction occurs when light enters a medium, like oil or water, at a slant (at any angle other than a right angle). Each time the light enters or leaves one clear substance and travels diagonally into another, the slanted light beam penetrates the next clear substance at a slightly different angle. This gives the illusion that the object is broken or bent. The degree of refraction depends on the type of material. Light slows down when it enters a more viscous (slower-flowing) medium and speeds up when it leaves the medium. The difference in speed at surfaces also causes light to bend. Refraction may also make objects in liquids appear closer and/or bigger than they really are.

Light is refracted, or bent, as it passes through a prism, a transparent object with flat faces that refracts light. A prism breaks visible, white light, into a spectrum, a light arrangement separated according to wave length, frequency and **energy**. Color is the way the human eye perceives various wavelengths of light. If the wavelengths are in the visible portion of the family of wavelengths and all the same kind, a color of the spectrum is seen: red, orange, yellow, green, blue, indigo, or violet (ROY G BIV). A mixture of visible light wavelengths produces other colors such as brown, purple, olive green, etc.

MATERIALS

Per group

tape
1 flashlight
1 shoe box
scissors
1 prism
1 comb
1 sheet of white paper
Light Benders data sheet

Per pair of students

1 Styrofoam cup
1 pencil or straw
water
1 coin
small amount of vegetable oil
1 clear plastic cup

TEACHING TIP

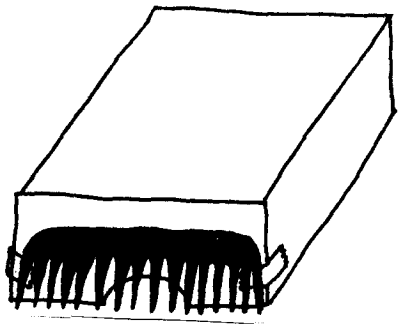
The prisms that are used should be colorless and transparent, have flat sides, and no sharp edges.

ENGAGE

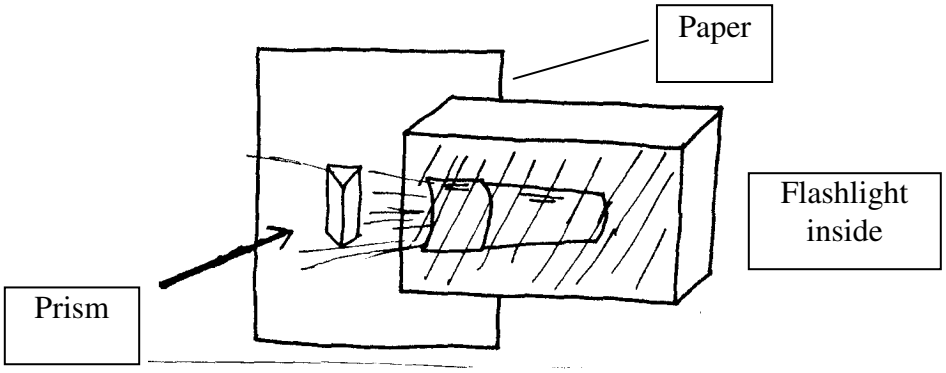
1. Distribute a Styrofoam cup and a coin to each pair of students. Tell students to place the cup with the coin in it on a flat surface.
2. Have students look at the coin and then slowly move the cup away until the coin is beyond their line of vision.
3. Leaving the cup in place, one partner should begin to slowly pour water into it, until the student who is observing can see the coin once again. (Both students should try this.)
4. Ask: *When were you able to see the coin again?* (when the water rose to a certain level in the cup)
5. Students should remove the coin and pour the water into the clear plastic cup. Have them add a small amount of oil to the cup of water. Have students observe the layers of water and oil and discuss the layer of air that is on top of the oil. Discuss how the three layers are different from each other. Ask: *Do you think light will travel through all three layers in the same way?*
6. Have students place a straw or pencil into the water and oil so that it is resting in a diagonal position. Encourage them to share their observations. (The straw will look as though it has been broken. This is called refraction, the bending of light.)

EXPLORE

1. Tell students that they are going to investigate bending white light (visible light).
2. Divide the students into groups. Have one student in each group pick up the materials and the *Light Benders* activity sheet.
3. One student in each group should draw and cut out a semi-circle about 3 cm high on the shoe box.
4. A comb should be taped across the opening of the box.



5. Tell each group to place a flashlight on the desk, turn it on, and place the box over it.
6. Have students slip white paper under the edge of the box and adjust the flashlight until light rays can be seen clearly on the paper.
7. Tell students to place the prism about 5 cm in front of the opening of the box.



8. Darken the room and let the students place the prism at various positions in front of the light box to observe how the bending of the light is affected.
9. Have students place their prisms at three different angles. On the *Light Benders* activity sheets, they should draw where the prism was placed and how the light rays reacted each time.

EXPLAIN

1. Discuss students' observations.
2. Explain that light is refracted, or bent, as it passes through a prism. A prism breaks visible, white light, into a spectrum, a light arrangement separated according to wave length, frequency and energy. Color is the way the human eye perceives various wavelengths of light. If the wavelengths are in the visible portion of the family of wavelengths and all the same kind, a color of the spectrum is seen: red, orange, yellow, green, blue, indigo, or violet. When light passes through a prism, each wavelength, or color, is bent at a different angle. This is because the color of light is an indication of its energy; blue light is more powerful than red light, so it bends more than red light. Green light, in the middle of the spectrum, refracts at a greater angle than red light, but at a lesser angle than blue light.

EXTEND/APPLY

Discuss rainbows.
Where have you seen rainbows?
What may have caused the rainbows to appear? (When conditions are right, water in the air, such as raindrops, can act as prisms and refract the sunlight as it passes through, causing the light to separate into the spectrum of colors.)

EXTENSION

Bend white light by shining a light onto a mirror submerged in water. Tilt the mirror so that reflected light strikes a white surface. *What do you see on the white surface?*

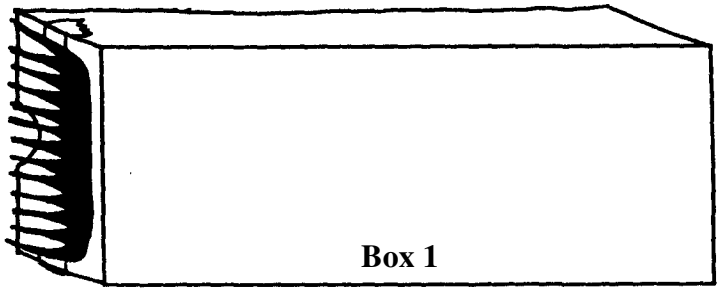
ASSESSMENT

In their science journals, have students explain what causes light to sometimes be refracted.

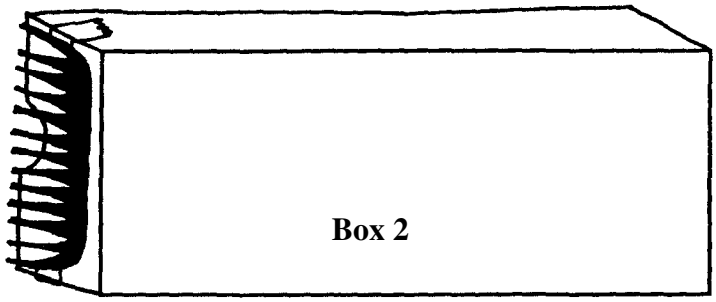
LIGHT BENDERS

Names _____

Draw your prism in position in front of Box 1. Show how the light bent.



Place your prism in another position. Draw your prism in that position and show how the light bent in Box 2.



Choose a third position for the prism. Draw your prism in that position and show how the light bent in Box 3.