Wolf Creek Public Schools
Creating Success For All Learners

Health in Action Project

Alberta Health Services

Bending Light, Twisting Bodies

Pillar: Active Living
Division: II
Grade Level: 4
Core Curriculum Connections: Science

I. Rationale:

In this lesson, students will learn about the characteristics of light and then use their bodies to represent how light rays travel. Students will rotate through stations to observe the interaction of light rays with various materials and infer the pathway of light beams as they travel through different mediums. Students will recognize that, although light travels in a straight line, it bends as it passes from a medium of one density to a medium of differing density. Finally, the students will demonstrate the movement pattern by using their bodies to replicate the various pathways of light for the rest of the class.

II. Active Living Focus:

Students will collaborate to complete cooperative learning tasks and then use their bodies to demonstrate this learning.

III. Curriculum Outcomes: Science 4

Topic D: Light and Shadows
General Learner Expectations *Students will:* **4–9** Identify sources of light, describe the interaction of light with different materials, and infer the pathway of a light beam.
4-10. Recognize that light can be bent (refracted) and that such objects as aquaria, prisms and lenses can be used to show that light beams can be bent.

IV. Materials:

- *Hatchet* by Gary Paulsen
- science journals or notebooks
- pencils
- an aquarium or clear, deep dish
- water
- milk (1 Tablespoon)
- flashlight
- spoon
- 2 clear drinking glasses
- opaque bowl
- penny
- prism
- coloured cellophane and/or coloured glass in the primary colors (red, green, yellow and possibly a few others)

- magnifying glasses or laminate cut-offs
- print pictures

Background For Teachers:
Refraction is one of many characteristics of light. Usually light travels in straight lines, but it bends as it passes from a medium of one density to a medium of differing density. Light bends because it travels at different speeds through mediums of differing densities. Light, as it moves through air, travels 186,000 miles per second. However, the denser the material that light is traveling through, the slower the speed will be. Light passes a lot slower through water, for example. Refraction of light can be seen by using a prism. The white light is separated into all of the colors of the rainbow. Mirages are also caused by refraction of light.

*The book **Hatchet** is about a boy named Brian who becomes stranded in the Canadian wilderness when the plane he is on crashes. The excerpt that is used in this lesson is about Brian trying to fish and realizing that the fish are not where he thinks they are in the lake because of refraction.*

V. Procedure:

I. Anticipatory Set:

Use the novel, Hatchet, as an introduction to the term: refraction. Read pgs. 110-112 of Hatchet, stopping at the end of the second paragraph on page 112 ('...Maybe it was always that way, discoveries happened because they needed to happen.'). Start reading again on page 124, the last paragraph that starts 'Mistakes...' and stop on page 125 at the end of the third paragraph ('...wiggling against the blue sky.'). Once you have finished reading this section, discuss why Brian was having a hard time catching fish. Put the word refraction on the board and define it as the bending of light as light passes through materials of differing densities. Have students record the definition and write about the example found in Hatchet.

Part 1: Class Demonstration

1. Use an aquarium, flashlight, milk, and water to demonstrate refraction for the whole class.
2. Fill the aquarium with water. Add enough milk to the water to give a cloudy appearance. The milk makes the light beam more visible as it passes through the water.
3. Shine a flashlight into the water, varying the angle of light entering the water.
4. The students should be able to see that the light bends as it enters the water.
5. Ask the students: What causes the light to bend? Discuss their ideas.
6. Encourage students to relate this demonstration back to the definition and realize that light will bend if it travels from a substance that is less dense to a substance that is more dense.
7. Have them record the results in their science notebooks, making sure that they explain why the light bent.

Part 2: Learning Centers

1. Divide the students into groups of 4-5 students. They will rotate through various learning centers: **"Magic Spoon"**, **"Lenses and Light"**, **"Bending Rays",** and **"Colors in Light".**
2. Give the students about 5-10 minutes at each station and have them make notes to record the results and their observations of each experiment.
3. Once students have completed each center, they will choose one of the four experiments to demonstrate for the class. They can only use their bodies to represent the materials, objects, and most importantly the pathway of refracted light. The students will simulate their experiments for the class the first time in silence. The class must attempt to guess which center they are acting out. The group will walk the class through their demonstration by describing the role of each of its members. The class will provide feedback and suggestions to each group.

Center #1: Lenses and Light

Students will investigate the use of concave and convex lenses and how each affects the bending of light rays by looking at print through lenses.

Materials: magnifying glasses, cut-offs from laminating, flashlight, water, dropper, paper with print on it

a. Use magnifying glasses. What type of lens do they have?

b. Put the print underneath the clear plastic (overhead). Drop a few droplets of water onto the clear plastic. Examine the print through the droplets of water on clear plastic (overhead, or cut-offs from laminating). What do you see? How does the size of the water droplet change the size of print?

c. Shine light from a flashlight through different lenses. What happens to the light?

d. What are some other ways that lenses are used today? Record your ideas.

(Lenses are often used in glasses, binoculars, cameras, telescopes, microscopes, watches, headlights of vehicles, periscopes, magnifiers, etc.)

Center #2: Colors in Light

Students will use prisms in a darkened room to observe and understand the bending and separating of light rays into their distinct colours.

Materials: cellophane (red, green, yellow), 2-3 flashlights, prism, darkened room

a. Shine only a small beam of light on the prism.

b. Find the band of colours on the wall. What colours do you see?

c. Look through each of the different colours of glass or cellophane at your colour spectrum. What do you notice? Explain.

c. Use the primary colours of light (red, green, blue) pieces of cellophane, overlap corners of each to create secondary colours. Discuss what happened. What colour do you get when all three colours are together?

d. Use two (or three) flashlights and primary coloured cellophane pieces to experiment with combining colours. Predict results before you do the experiment. Cover the ends of the flashlights with red and blue cellophane. Shine them individually first and later together so that the light is on the same piece of white paper. What colour do you see? Repeat with red and green? blue and green? Are the combined colours of light the same as the combined colours with paint? Discuss. Record results.

e. If you have other colours of cellophane, experiment by combining other colours. Are you able to create white?

Center #3: Magic Spoon

Students will observe what happens when a spoon is placed in a glass of water

Materials: A spoon, a clear glass, and some water.

a. Fill a clear, drinking glass full of water.

b. Put a spoon into the water and let the handle rest on the side of the glass.

c. Look into the glass from the side and describe what happened to the spoon. Why did that happen?

d. Record observations and conclusions in your notebook.

Center #4: Bending Rays

Students will observe the bending of light rays by observing the image of a drawing through a glass.

Materials: A piece of paper, a pencil, a clear glass, ruler, and water.

a. Use a ruler to draw a vertical line on a piece of paper, about 4-5 inches long.

b. Place the bottom of the glass on top of the line, so the line separates the bottom of the glass in half as you look at it from the top of the glass.

c. Keeping your head in the same place, pour water into the glass and record what happens to the line. Write down your observations in your notebook.

Conclusion:

After the students have rotated through all 3 learning centers, bring them together to summarize what they observed in each demonstration and how refraction was involved. Make sure the students understand refraction of light. You may also want to discuss where they have seen refraction of light in their own lives. For example, mirages are caused by refraction, as well as rainbows.

VI. Extensions and Variations:

1. Periscopes are an example of how light travelling in straight lines can be bent using mirrors. Use a milk carton and two mirrors to build a periscope. Open the long side of the milk carton to tape in the first mirror resting it on an angle against the bottom and back side of the milk carton. Tape it in place. Cut a small 2 cm square as a peep hole in the front side of the milk carton near the bottom so that it looks in at the slanted mirror. Place the second mirror at the top of the carton at the same angle but with the looking surface facing the first mirror. Tape it in place. Cut a two cm peep hole in the back of the milk carton near the top facing the second mirror. Close the milk carton and tape it shut. Try viewing things from a crouched down position behind a wall or desk. Will it work around a corner?

2. An enjoyable art activity which allows for the use of light and colour to create a modified sun catcher. Using large dinner plates and supervision at each centre, have students take turns dampening the plate surface and laying a round coffee filter on the plate so that the moisture is absorbed by the filter. Warning--don't have the plate too wet. Place several drops of food colouring at different points on the dampened filter. The colours will run, so do not overdo the colours. Carefully lift the filter and lay it on newsprint to dry. Later laminate the coloured filters. Cut out the filter circles. Hole punch and tie a string to hang in the window. It is beautiful!

VII. Assessment Ideas:

- Use a Science Journal Rubric to assess student journal entries. The link below contains a sample rubric including prompts: Science Journal Prompts and Rubric.