

SIEMENS STEM DAY ACTIVITY

UP PERISCOPE!

REAL-WORLD SCIENCE TOPICS

- An exploration of a periscope design
- An exploration of the law of reflection

ADDRESSES NGSS

LEVEL OF DIFFICULTY

3

GRADE RANGE

3–5

OVERVIEW

In this activity, students will design their own periscope. They will determine the path light takes through the periscope tube.

TOPIC

Law of reflection

OBJECTIVE

Students will gain an understanding of the law of reflection by tracing the path that light travels, and designing a periscope to demonstrate understanding.

MATERIALS NEEDED FOR STUDENT ACTIVITY

Materials Needed for Demonstration:

- tennis ball
- flashlight
- laser pointer (optional)
- four rectangular plastic pocket mirrors

Materials Needed for Each Team of 3-4 Students:

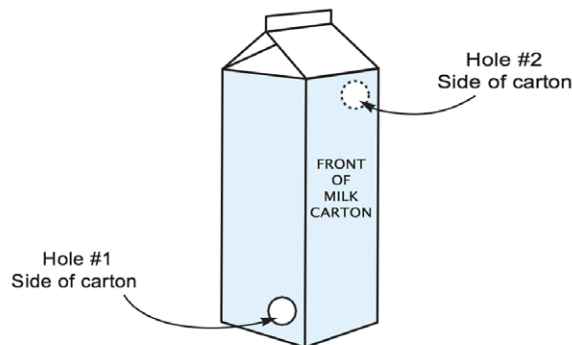
- flashlight
- two rectangular plastic pocket mirrors
- quart milk carton
- tape
- marker
- scissors

NGSS THREE-DIMENSIONS

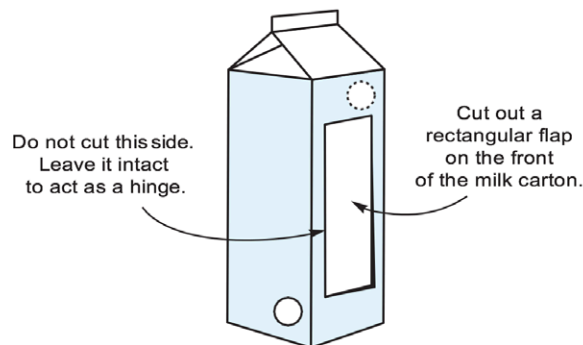
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>Developing and Using Models Develop and use a model to describe phenomena.</p>	<p>PS4.B: Electromagnetic Radiation An object can be seen when light reflected from its surface enters the eyes.</p>	<p>Cause and Effect Events have causes that generate observable patterns.</p>

TEACHER PREPARATION

Before students arrive you will need to prepare the milk cartons for the activity. First, place the milk carton with the front facing you. Consult the diagram below. Using a craft knife or extremely sharp scissors, cut a dime-sized hole on the lower part of the left side of the milk carton. Next, cut a second hole of the same size on the upper part of the right side of the milk carton.



Then, cut a rectangular flap on the front of the milk carton. Consult the diagram below. The rectangle should be big enough to allow the students to tape the mirrors on the inside. Be sure to leave the left side of the rectangle intact.



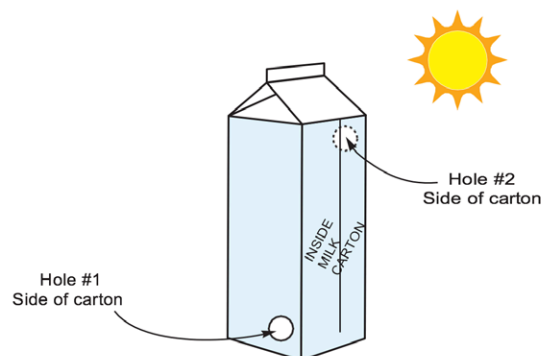
- 1. Warm-up Activity:** Start the lesson by bouncing the tennis ball. Bounce it on the floor, on a desk, and on the wall. Ask the students to describe what is occurring. They most likely will tell you that the ball is bouncing. Have them brainstorm and describe things that bounce. Explain that when we study science we use more precise terms to explain what the ball is doing. Another way to describe the action of the ball is that it is reflecting off of the surface that it strikes. Ask them to tell you of something else that reflects or uses a reflection. Most will identify a mirror. Show the students a mirror and ask them to think about what is bouncing or reflecting on the mirror. Students may say their face or their picture. Students may not understand that the mirror is reflecting light. Explain that the mirror reflects or bounces light. You can demonstrate this by shining a flashlight or a laser pointer at a mirror and allowing it to reflect to hit objects in the room. If you do use a laser pointer please take care to not allow it to enter the eye of a student.
- Explain to the students that a periscope is a device that allows the user to see above or around things. Inside the periscope mirrors are used to reflect light so that the user's eye can see things that are hidden. Using a periscope, sailors on a submarine can see what is on the surface of the ocean without bringing the submarine to the surface.
If students are not familiar with submarines, show them images from one of the US Navy websites: you can find a variety of images to show them online.
The US Navy has a wealth of pictures: <http://www.navy.mil/navydata/images/imagesub.html> or <https://www.flickr.com/photos/56594044@N06/8671745589/>
Explain to the students that today they will make a periscope to see above their desk while sitting below it.
- Distribute the Up Periscope! handout and materials to each group of two to four students.
- Students will you use the handout to design their periscope. They will determine the best placement for the mirrors.

Ask:

When you place the mirrors in the milk carton, what do you think is the best placement?

What do you think the results will be if you place the mirrors flat? What do you think the results be if you place the mirrors at angles?

Have each student draw a diagram showing where they will place two mirrors in their milk cartons so that light coming in the top hole will reflect so that they can see it in the bottom hole. After the students have completed their diagram, have them discuss their diagrams in the group. Have them decide on the best design to try for their group periscope.



5. Once the students have drawn their diagram have them talk about their designs with their groups. The group should decide on one diagram to construct. Have the students tape the mirrors inside the milk carton in place according to their group design.
6. Have the students test their periscopes. They should sit below their desks and peer above the surface of the desk. If they cannot see above the desk, then they should troubleshoot and adjust the mirrors. Suggest that they experiment with the angles of the mirrors. They should also check to make sure that the tape does not obstruct their view.
7. Once the students have adjusted the mirrors so that they can look above their desk, they should tape the milk carton flaps shut.
8. **Wrap-up Activity:** Collect all of the Up Periscope diagrams and hang them up on the board. Have students walk up to the board and examine the diagrams. Ask students if they see a pattern between all of the angles on the diagrams. Have students complete the questions on the Student Handout. They should notice that the angles in which the mirrors are placed are similar. The law of reflection describes the behavior of many different things they may observe. It also describes the way light reflects off of a mirror or sound reflects off of a wall.

UP PERISCOPE EXTENSION ACTIVITY

Students on each team can brainstorm and sketch additional periscopes that include 3 or 4 mirrors. They can then build and test these new periscopes.

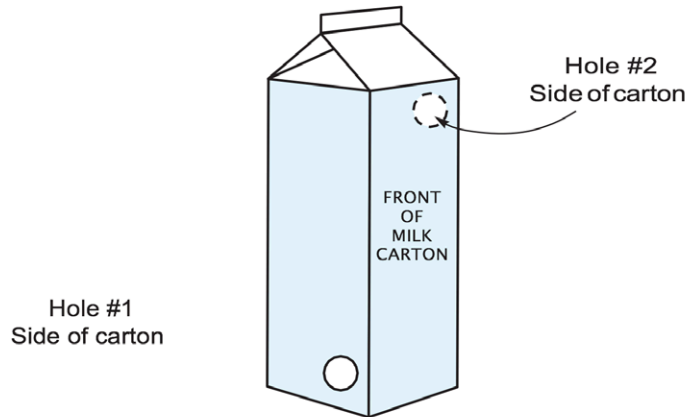
BACKGROUND INFORMATION

What are periscopes?

A periscope is an optical device used for viewing activities or the environment while hidden. You may have heard of their use on submarines, but they have other uses as well. Troops have used them to view their surroundings when they have been hidden in trenches, and others have used them to view wildlife.

UP PERISCOPE

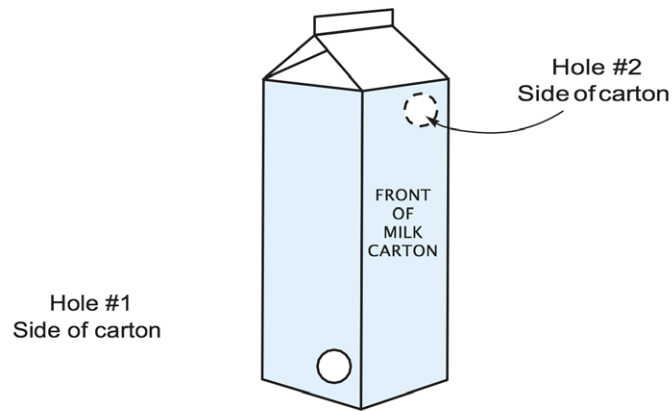
Study the diagram. Where would you place the two mirrors in your milk carton? Draw two line segments showing where you would place the mirrors.



Why do you think this is the best placement?

UP PERISCOPE

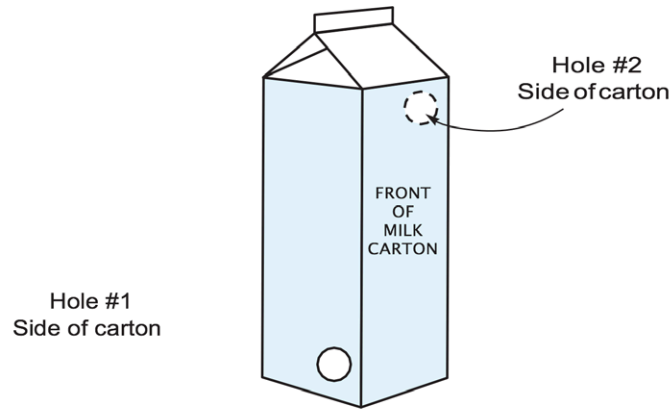
After discussing the placement of the mirrors with your group, draw two line segments showing where your group will place the mirrors.



Do you think this is the best placement? Explain your answer.

UP PERISCOPE

After examining the periscope designs in your class, determine the best placement for the mirrors. Draw two line segments that represent the best placement.



Did this match your original placement?

Why do you think this design is the best?