

Grade 4 - Science

Unit: 2.2 How We See

1.4-22 Grade 4 CPI CC-1, Similarities and differences in patterns can be used to sort and classify designed products. [4-PS4-3]

1.4-22 Grade 4 CPI CC-2, Knowledge of relevant scientific concepts and research findings is important in engineering. [4-PS4-3]

1.4-22 Grade 4 CPI DCI-1, Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information-convert it from digitized form to voice and vice versa. [4-PS4-3]

1.4-22 Grade 4 CPI DCI-2, Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. [4-PS4-3]

1.4-22 Grade 4 CPI SEP-1, Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. [4-PS4-3]

Goals and Objectives

- By the end of the lesson, students will be able to:
 - Explain that light travels in a straight line
 - Explain that light bends
 - Explain that light reflects off objects

Learning Activities or Instructional Strategies

‘How Light Travels’ Experiment

1. Gather the students around you in a semicircle. Ask students to recall the previous lesson in which they wiggled a Slinky. “What were those wiggles in the Slinky called?” [Waves.] Explain to the students that many kinds of energy travel in waves. Light is one of them. Tell them that they will begin a study of how light travels and behaves and then build a model of an eye to help them understand how we see.

2. Conduct a demonstration that illustrates the necessity of light to identify objects in our environment. Ask a student to switch off the lights. Then uncover the picture or poster you taped to the wall earlier. From a position a few inches away from the poster, shine a flashlight at a spot on the poster. Ask students to describe what they see. (They will only be able to see/describe the small portion of the poster illuminated by the flashlight.) Then ask the class, “How can you tell what else is in the picture?” [Students are likely to suggest that they need more light to identify what else is in the picture.] Move the flashlight farther away from the picture in stages until they can see and describe the entire image.

3. Now that students have had an experience that demonstrates the importance of light in knowing our environment, invite them to observe how light travels. Setup the mist maker in front of the class so that everyone can see it. Darken the room again and shine the laser toward a wall opposite you so the light beam travels through the mist. Students will be able to see the straight ray of light.

4. Ask, "Can you describe how light travels?" [Light travels in straight lines.] Invite another volunteer to hold the laser straight. Ask, "How can we make light change direction?" Let students discuss possible ideas. For light to change direction it is necessary to make it interact with matter. Take the mirror from the How Light Travels Kit and go toward the end of the laser beam. You can ask a student to use the spray bottle to help you to find the beam. Once you have found it, hold the mirror at about a 45° angle to send the light toward the ceiling. To show that the direction has changed, ask the volunteer to spray some water along the path and above the mirror.

5. Remove the mirror. Ask another volunteer to hold a sheet of white copy paper along the laser path. The laser will form a bright dot. Now place a sheet of wax paper between the laser and the sheet of white paper, at about 2 feet from the white paper. Remove and then replace the sheet of wax paper a few times and ask students to notice the difference. When the sheet of wax paper is present, the light scatters all around instead of forming a bright dot.

6. Turn on the lights again and explain to students how we can use a simple model to describe how light travels and interacts. Take the tennis ball from the How Light Travels Kit and roll it across the floor where there are no obstacles. If the floor is straight the ball should travel in a straight line. Explain that light, when it does not interact with anything, travels in a straight line, just like the tennis ball.

7. Now select a wall of the classroom that has been cleared of objects. At the center of this surface where the floor meets the wall, place a piece of masking tape in a straight line on the floor perpendicular to the wall. Ask a volunteer to stand at an angle from the wall and roll the tennis ball at the wall, aiming at the spot where the tape meets the wall. Use a sticker from the kit to mark where student is standing and where the ball ended up after bouncing off the wall. Place yard/meter sticks on the floor from the first sticker to the end of the tape, and from the second sticker to the end of the tape (see figure to the right). Tell students that the yard/meter sticks represent the path of the ball. Ask the class to notice the angle between the tape and the ball's path before it hit the wall, and compare it to the angle between the tape and ball's path after it hit the wall. They should be the same. You may want to choose a volunteer or two to measure the exact angles. Repeat the process with as many students as time allows.

8. Ask, "What is the wall like in our model? What did I use before to change the direction of the light?" [A mirror.] Tell students that when light strikes a mirror-like surface, it behaves in the same way as the ball bouncing off the wall. This phenomenon is called reflection. In general, waves have a similar behavior; they bounce (reflect) under certain conditions. For this reason, we see light uniformly distributed in a room.

9. Now roll the ball over an uneven surface, such as a thick carpet or a wrinkled piece of paper/fabric. The ball should not simply follow a straight line. Instead it may slow down and exhibit variations in the direction of its movement. Explain that this also happens to light when it travels through materials. Remind them of how the light moved when it traveled through wax paper.

10. Conclude the lesson by summarizing the three above observations and explaining how these properties allow us to see objects:

- a. Light travels in a straight line, allowing us to receive light from sources far away, like the Sun;
- b. We can see objects that do not emit visible light because light bounces off them;
- c. Light travels through matter in different ways.

Assessments teacher observation, science notebook