INTERACTIONS OF WAVES *(MODIFIED FOR ADEED)*

Overview:

Waves are reflected differently depending on the shape of the source wave.

Objectives:

The student will:

- describe what happens when a "circular" or "straight" water wave is reflected off a solid barrier perpendicular to the wave direction;
- make generalizations about reflected waves; and
- create a poster with two labeled diagrams that shows what happens when a "circular" and a "straight" incoming wave hit a solid barrier perpendicular to the wave direction.

Targeted Alaska Grade Level Expectations:

Science

[9] SB4.3 The student demonstrates an understanding of motions, forces, their characteristics, relationships, and effects by describing the interactions of waves (i.e., reflection, refraction, wave addition).

[9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

Writing

[9] W4.2.2 The student writes for a variety of purposes and audiences by writing in a variety of nonfiction forms (e.g., letter, report, biography, autobiography, and/or essay) to inform, describe or persuade.

Vocabulary:

barrier – a limit or boundary of any kind; any natural bar or obstacle that prevents movement or access

"circular wave" (longitudinal wave) - a wave is a progressive disturbance propagated from point to point in a medium or space without progress or advance by the points themselves, as in the transmission of sound or light; there are two types of waves, longitudinal, where the medium is compressed (as illustrated by a coil, where the coil remains straight); and transverse, where the medium is disturbed at right angles to the direction of waves (as illustrated by a coil, where the coil moves up and down)

medium - an intervening substance, as air, through which a force acts or an effect is produced

reflection - the return of light, heat, or sound after striking a surface without it being absorbed

"straight wave"(transverse wave) - a wave is a progressive disturbance propagated from point to point in a medium or space without progress or advance by the points themselves, as in the transmission of sound or light; there are two types of waves, longitudinal, where the medium is compressed (as illustrated by a coil, where the coil remains straight); and transverse, where the medium is disturbed at right angles to the direction of waves (as illustrated by a coil, where the coil moves up and down)

wave - a progressive disturbance propagated from point to point in a medium or space without progress or advance by the points themselves, as in the transmission of sound or light; a regular movement on a surface or within a material when energy travels through it. On the surface of an ocean or body of water, it is usually in the form of a curving swell or ridge

wave frequency - the number of cycles or completed alternations per unit time of a wave or oscillation

Materials:

- Rectangular container, approximately 30 centimeters wide, 40 centimeters long, and 10 centimeters high (one per group)
- Water
- Meter stick (one per group)

- String, 40 centimeters (one length per group)
- Eye droppers (one per group)
- 50-milliliter beaker
- Unsharpened wooden pencil (one per group)
- Science notebook
- Objects (non-floating) to serve as barrier (one 8 centimeter object and one 15 centimeter object per group)

Activity Preparation:

1. Fill each beaker with about 40 milliliters of water.
2. Tie the ends of the string to each end of the pencil. This will be used as a small "straight" wave making when place horizontally to the surface of the water and pulled out again.

Activity Procedure:

Gear Up

Process Skills: measuring, observing, describing, and communicating

3. Ask students to write in their science notebook what they know about wave reflection. After they are finished, ask them to share what they wrote with the class. Record responses on the board.
4. Place a rectangular container in the center of the classroom. Fill it to a depth of 2 centimeters from the bottom with water. Ask students what they think the wave pattern will be if a drop of water is dropped from a height of 40 centimeters into the center of the pan. Write student predictions on the board. Use an eyedropper to drop one drop of water into the pan and ask students for their observations. List responses on the board.
5. Discuss the following questions as a class:
   a. What was the wave pattern of the water droplet?
   b. What happened to the wave after it hit the edge of the pan?
   c. How did the waves behave when they came back on each other after striking all sides of the dish?
   d. How would these patterns change if the placement of the water droplet were different within the pan?
6. Define circular wave and straight wave if those terms have not come up in discussion.

Explore

Process Skills: measuring, observing, recording, describing, and communicating

7. Tell students they will explore how drops (circular) and straight waves reflect off a solid surface.
8. Divide students into pairs and distribute materials to each pair: pan, meter stick, eyedropper, beaker, pencil and string (see Activity Procedure).
9. Ask pairs to investigate what happens if they drop water from the same height, but in different places, into the pan. Instruct students to record where they dropped their water droplets into the pan of water and their observations of what happened in their science notebook. Discuss student results.
10. Explain students will explore how "straight" waves behave when they encounter solid barriers perpendicular to the wave direction. Have students record their set-up(s) and the results of their explorations in their science notebook. Instruct students perform multiple trials: with one barrier, with one barrier on either side of the wave generation point, with two barriers on one side of the wave generation point. Student should use the pencil on the string to make straight waves by lowering it into the water, horizontally to the surface, and pulling it out again.

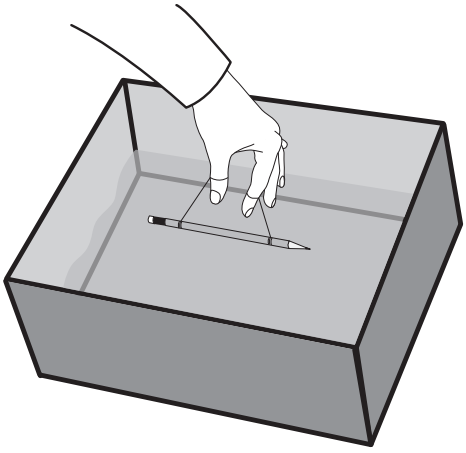

Fig. 1: Pencil being lowered into a pan of water repeatedly to create a straight wave

Generalize

Process Skills: describing, making generalizations, and inferring

11. Discuss the following questions as a class:
    a. What happened when the water droplets were dropped from the corners? The sides? Why?
    b. What happened when the straight wave encountered a "hard" barrier perpendicular to the wave direction? Why?
    c. What happened when the wave encountered two "hard" barriers spaced apart, perpendicular to the wave direction? Why?
12. Review vocabulary words used in lesson.

Apply

Process Skills: inferring, describing, and communicating

13. Ask students to use what they learned about wave reflection to make a diagram with labels, showing where they would anchor a 10-meter boat to take shelter from a 40-kilometer southeast wind with 1-meter high waves on a large lake or ocean.

Assessment Task:

Create a poster with at least two diagrams that illustrate and describe what happens when a circular and straight incoming wave reflect off a solid barrier perpendicular to the wave. The diagram should include at least three labels. Make at least three generalizations describing what happens when a wave is reflected off a barrier.

Rubric:

Objective	GLE	Below Proficient	Proficient	Above Proficient
The student describes what happens when a "circular" or a "straight" water wave is reflected off a solid barrier perpendicular to the wave direction.	[9]SB4.3	The student does not describe "straight" wave reflection or "circular" wave reflection.	The student describes "straight" wave reflection or "circular" wave reflection, but not both.	The student describes both "straight" and "circular" wave reflection.
The student makes generalizations about reflected waves.	[9]SA1.1	The student makes two or less generalizations.	The student makes three generalizations.	The student makes four or more generalizations.
The student creates a poster with two labeled diagrams that show what happens when a "circular" and a "straight" incoming wave hit a solid barrier perpendicular to the wave direction.	[9]W4.2.2	The student's poster has less than two diagrams and less than three labels.	The student's poster has two diagrams and three labels.	The student's poster has more than two diagrams and more than three labels.