LESSON ACTIVITY:

Prisoner of Echo

Prisoner of Echo is a physical science learning game aligned to Common Core and Next Generation Science standards. Partner with Jenkins, a helpful but slightly snarky robot, to navigate a mining facility and find missing scientist, Andar. Using knowledge of sound waves, players use the Sonic Manipulator to adjust wave frequency and amplitude to advance through different levels and unlock the ultimate secret! Educators will need to purchase one account per students in order to access *Prisoner of Echo.* You can do so here.

INTRO MATERIALS:

Slinky

Whiteboard and marker

LAB MATERIALS:

Tuning fork

Rubber stopper

Glass container of water

Nail

2 rulers, one metal and one wooden

Wooden rods - at least 2cm in diameter

Metal rod - at least 2cm in diameter

Plastic rod - at least 2cm in diameter

Paper or cardboard tube - at least 2cm in diameter

Meterstick

TIME REQUIRED: 45 minutes

LEARNING OBJECTIVES:

Investigate different properties of sound, sound transmission through different materials, and echos.

NGSS STANDARDS:

MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Disciplinary Core Idea: PS4.A: Wave Properties

- A sound wave needs a medium through which it is transmitted.

KEY TERMINOLOGY:

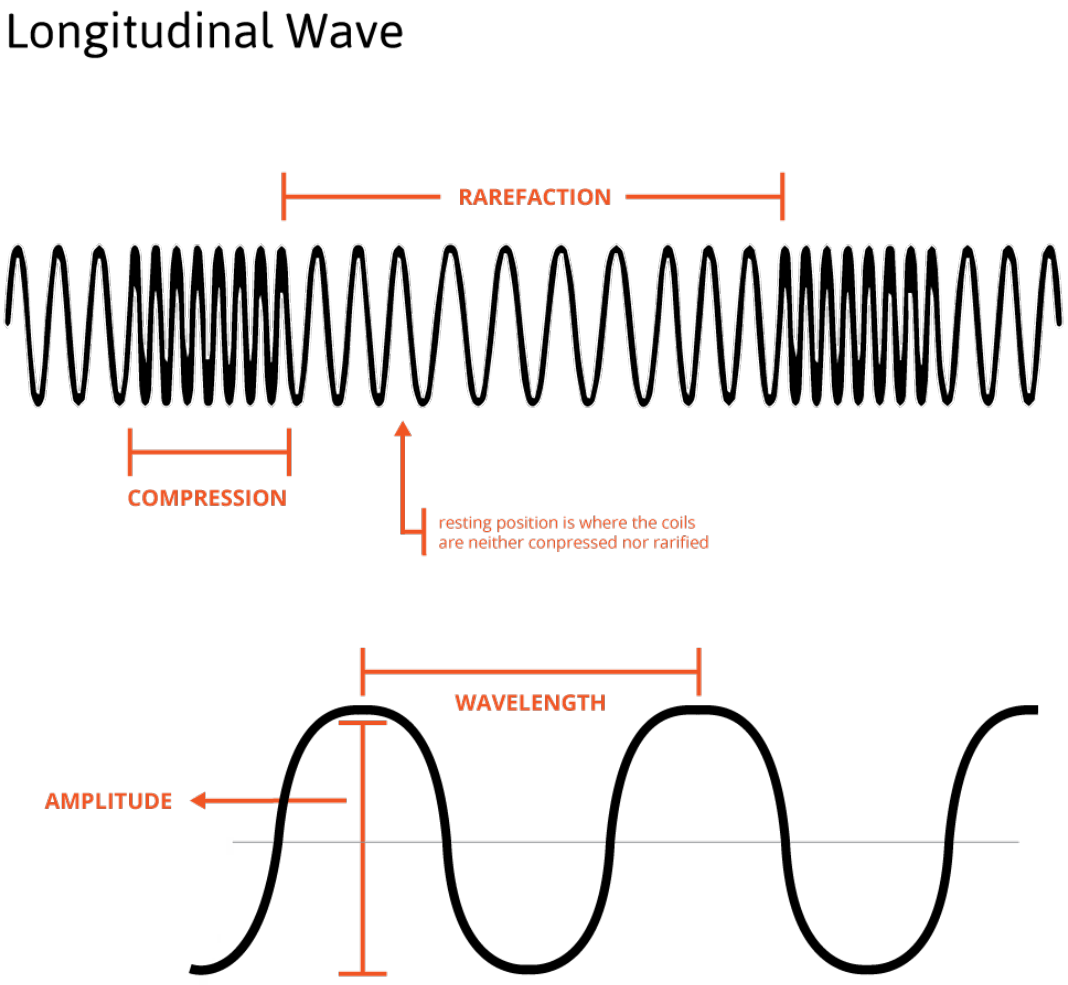
- ***Amplitude*** is the fluctuation or displacement of a wave from its position of equilibrium. With sound waves, Amplitude is the extent to which air particles are displaced: the bigger the amplitude, the louder the sound.
- ***Pitch*** is generally referred to as the highness or lowness of a sound.
- ***Frequency*** is the number of compressions that pass a fixed point per second; the higher the frequency, the higher the pitch.

Lab Introduction

To get started, explain to students that they will be working with a partner to complete lab activities about sound. Briefly demonstrate the basic movement of sound waves using the pre-compressed Slinky.

Hold up the Slinky and vibrate the first coil back and forth horizontally. Explain that this illustrates the movement of sound waves. The wave bouncing back toward your hand illustrates an echo. Point out that the parts of the spring represent air molecules that vibrate back and forth. Sound waves are longitudinal waves because the air particles that vibrate move back and forth in the direction of the wave movement.

Draw a diagram on the board of a longitudinal wave similar to the one below. Point out each part of the wave as you review the diagram. Explain that a wavelength is measured as the distance between the centers of two compressions. The loudness, or intensity, of a sound depends on the amplitude of the sound wave.



Lab Activity

Distribute the Lab Sheets included below and have students review the introduction and materials lists. As they are reading, distribute the lab materials to each student pair. Review the procedural steps as a class, including any safety and cleanup protocols students should follow when working with the materials.

PRINTABLE STUDENT SHEET - LAB SHEET:

Sound Transmission

In this lab, you will investigate different properties of sound by completing a series of mini-experiments. In the first experiment, you will produce sounds using different materials. In the second experiment, you will investigate sound transmission through different materials. And in the third experiment, you will investigate echoes.
Be sure to follow your teacher's safety and cleanup instructions.

Experiment 1

MATERIALS:

- Tuning fork
- Rubber stopper
- Glass container of water
- 2 rulers, one metal and one wooden

PROCEDURE:

1. Carefully strike the tuning fork on the edge of the rubber stopper.

2. Hold the tuning fork close to your ear. Gently touch the end of the fork to your hand.

3. Record your observations below

4. Strike the tuning fork on the rubber stopper again.

5. Place the prongs of the fork on the surface of the water in the glass.

6. Record your observations below.

7. Hold one end of the wooden ruler on the edge of a table.

8. Push down on the other end of the ruler and release.

9. Repeat steps 7 and 8 several times, using different lengths of the ruler hanging over the edge of the table.

10. Record your observations below.

Experiment 2

MATERIALS:

- Wooden rod, at least 2 cm in diameter
- Nail
- Metal rod, at least 2 cm in diameter
- Plastic rod, at least 2 cm in diameter
- Paper or cardboard tube, at least 2 cm in diameter

PROCEDURE:

1. Hold one end of the wooden rod near your ear and scratch the other end with the nail.

2. Can you hear the sound through the wood? What about through the air? Record your observations below.

3. Repeat steps 1 and 2 using metal, plastic, and cardboard rods or tubes. Record your observations below.

Experiment 3

MATERIALS:

- Meterstick

PROCEDURE:

1. Stand about 50 meters from the wall and clap your hands. Listen for the echo.

2. Clap your hands twice and listen for two echoes.

3. Clap fast enough that you begin a new clap just as you hear the echo from a previous clap. Do you still hear echoes? What does the time between claps tell you? Record your observations below.

Lab Summary

Review your observations and write a summary of the results for each experiment.

EXPERIMENT 1:

EXPERIMENT 2:

EXPERIMENT 3:

Lab Summary - Answer Sheet

Review your observations and write a summary of the results for each experiment.

EXPERIMENT 1:

[Sample answer: As the tuning fork vibrates, it produces sound. The vibrations can be felt by the hands and seen moving through the water. The sounds produced by the wooden and metal rulers were different. But with both rulers, the longer the length of the ruler hanging over the table, the lower the pitch.]

EXPERIMENT 2:

[Sample answer: Sound traveled best through the metal rod.]

EXPERIMENT 3:

[Sample answer: The speed at which you clap gives you a general idea of how fast sound travels.]