# Lesson 3: Waves: Transverse vs. Longitudinal Waves

## Objective:

Students will understand the difference between transverse and longitudinal waves

## NGSS:

MS-PS4.A. A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.

## Overview:

Students will learn that waves are energy disturbances that travel through a medium from location to location. Basically, waves are energy moving from place to place. Common places where waves are experienced include sound, light, water, and earthquakes. Longitudinal waves cause particles to move parallel to the direction the wave is traveling. Transverse waves move at right angles.

A longitudinal wave has a spring-like structure. The longitudinal wave undergoes a series of compressions and rarefactions. The distance between two crests makes the wavelength.


The transverse wave makes a series of crests and troughs. The distance between two crests makes the wavelength. The distance between the crest or trough from the equilibrium position of the wave makes the amplitude of the curve.


A wave frequency is measured in waves per second called a hertz (Hz) and describes the number of waves produced in a given time period.

The length of the wave is measured from top peak to top peak (crest to crest) or bottom peak to bottom peak (trough to trough).

Amplitude is the height or depth of a wave. It reflects the amount of energy a wave caries. High amplitude describes high peak-to-peak distance, while low amplitude describes a series of low peak-to-peak distances.

## Essential Questions:

1. What are the differences between a longitudinal and transverse wave?
2. What does frequency describe and how is it measured?
3. What is a wavelength?
4. What is an amplitude of a wave?

## Supplies:

* Slinkys (enough for two students to share)
* Meter stick (be sure to have an accessible meter stick with both braille and large print)
* Tactile diagrams of transverse and longitudinal waves prepared with large-print and braille labels (similar to pictures above)

## Procedure:

1. Place students in groups of three.
2. Give each group three the tactile diagrams of the waves. Ask each lab group to make observations of the diagrams. Ask students to share observations with the entire class.
3. Next, hand each lab grouping a Slinky. Tell students that they are now going to make the waves that they observed in the diagrams.
4. Have each pair of students stretch a Slinky to a length of about 4 meters between them.
5. Have one student lift up one side of the Slinky to send a wave to another student. Allow a third student to stand in the middle of the partners to feel the movement in the Slinky. Have that student describe what they are feeling. Rotate the roles of each student so that each student has a chance to feel the wave. What do the students observe? [Answers will vary but it should include an upward and downward movement of the Slinky.]
6. Have one student move one end of the Slinky back and forth on the floor repeatedly. Have the student in the middle again describe what they are feeling. Rotate the roles of each student so that each student has a chance to feel the wave. What do the students observe? [Multiple waves moving across the Slinky.] What type of wave is being created? [Transverse.]
7. Next, create another series of waves by having one partner move their hand toward and away from their partner. The partner on the other end does not move. Have the student in the middle describe what they are feeling. Again, rotate so that all students have a chance to feel and create waves. What type of wave is being created? [Longitudinal.]
8. Next, tell students that they are going to learn more about waves and how to create different amplitudes and frequencies of waves. Have students stand and use their hands to show the following:
9. High amplitude for a longitudinal wave: Students should push hard.
10. Low amplitude for a longitudinal wave: Students should push soft.
11. High amplitude for a transverse wave: Students should move their hands back and forth a large distance.
12. Low amplitude for a transverse wave: Students should move their hands back and forth a small distance.
13. Low frequency for a longitudinal wave: Students should move their hands back and forth slowly.
14. High frequency for a transverse wave: Students should move their hands back and forth fast.
15. Long wavelength for a longitudinal wave: Students should push their hands slowly.
16. Short wavelength for a transverse wave: Students should move their hands back and forth fast.
17. Be sure to rotate through this experiment in a similar manner as described above so that all students are participating and feeling each wave.
18. Ask students to describe the differences between longitudinal and transverse waves as a summative assessment. Be sure to ask about the meanings of the vocabulary terms: amplitude, frequency, and wavelength.

Adapted from:

National Park Service, U. S. Department of the Interior (n.d.). Outdoor classroom lesson plan: Introduction to waves lesson. [https://www.nps.gov/common/uploads/teachers/lessonplans/Introduction to Waves.pdf](https://www.nps.gov/common/uploads/teachers/lessonplans/Introduction%20to%20Waves.pdf)

Westerville City Schools. (n.d.). Slinky wave lab. <http://www.westerville.k12.oh.us/userfiles/4161/Classes/9094/Slinky%20Wave%20Lab.pdf>