Making Waves

4.PS4.1 Use a model of a simple wave to explain regular patterns of amplitude, wavelength, and direction.

4.MD.A.1 Measure and estimate to determine relative sizes of measurement units within a single system of measurement involving length, liquid volume, and mass/weight of objects using customary and metric units.

By: Allison Frazier

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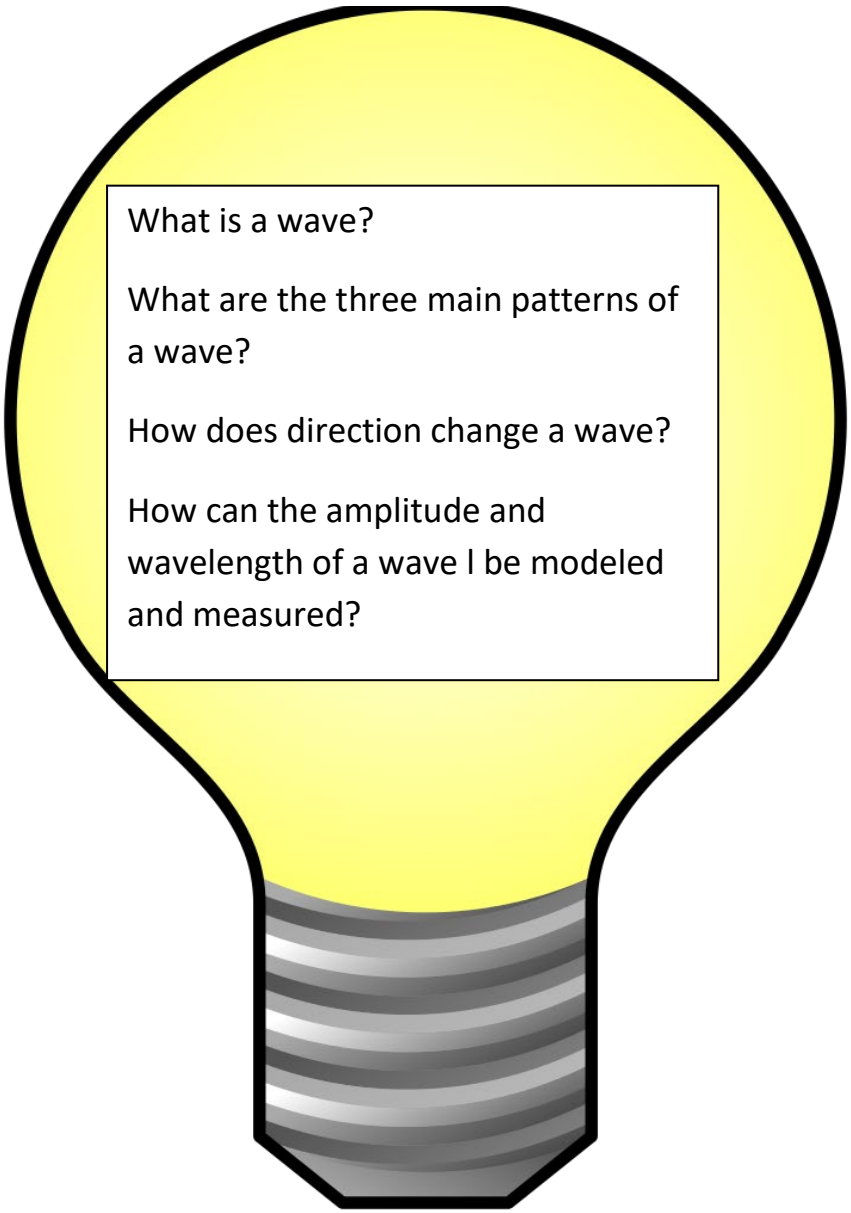
Overarching Question: What are waves and how can we create wave models to observe their direction, wavelength, and amplitude?



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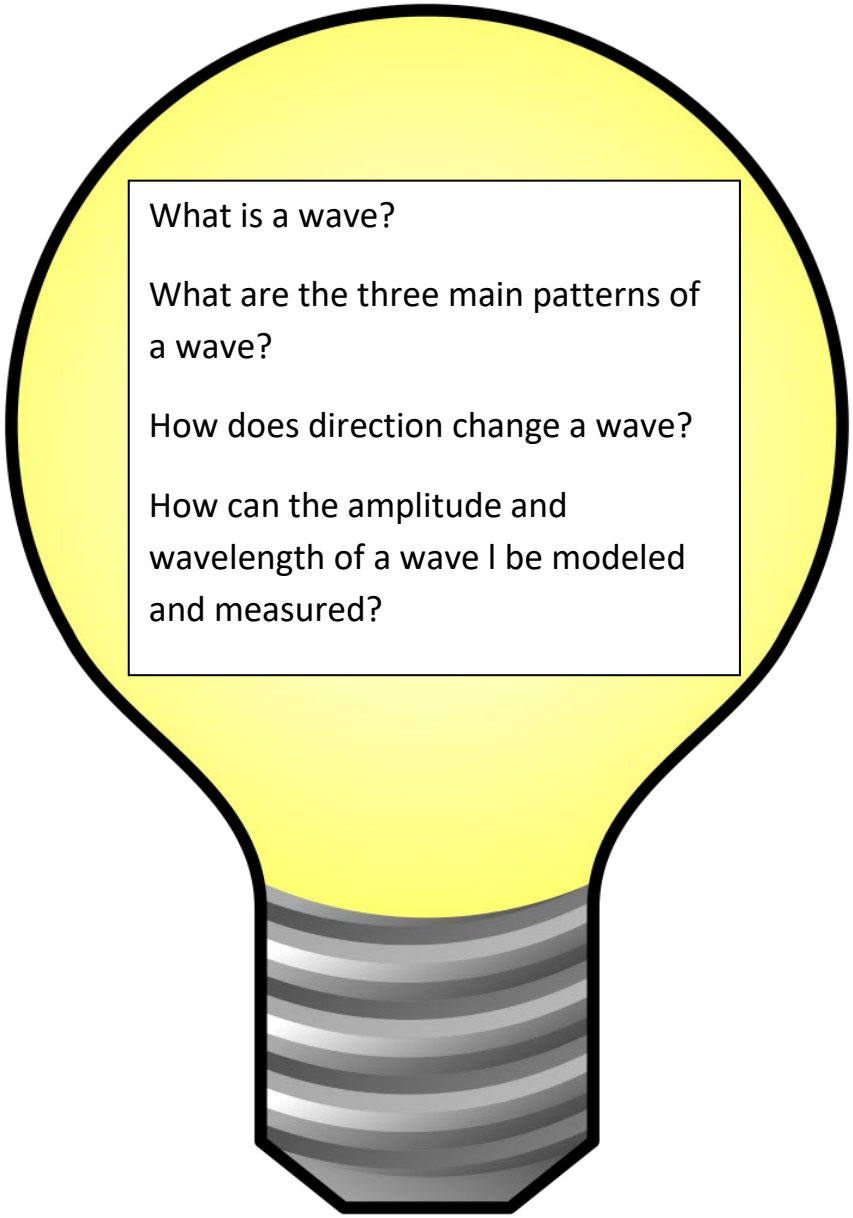

Line of Evidence – What is a Wave?
A wave is a disturbance that moves through matter or through empty space. Waves do not carry matter, but instead energy from one place to another.

Line of Evidence – Wave Stations
Direction is the way in which a wave's energy travels. If a wave moves particles in matter perpendicular to the direction that the wave is traveling, then it is a transverse wave. If the wave makes the particles in matter move back and forth in the same direction the wave is traveling, then it is a longitudinal wave.

Line of Evidence – What is a Wave?
The three main patterns of a wave are amplitude, wavelength and direction. Amplitude is a measure of the vertical distance between a peak or valley and the equilibrium point. Wavelength is a measure of the horizontal distance between two crests or two troughs. Direction is the way in which a wave's energy travels.

Line of Evidence – Making Waves with Jump Ropes
A transverse wave model can be created using a jump rope. After laying the jump rope out on a surface and creating the crests and troughs, a tape measure can be used to determine the distance in centimeters between two crests or two troughs (wavelength) and the distance from the equilibrium to a crest or trough (amplitude).

Big Aha Thesis Statement
A wave is disturbance that moves through space and matter, transferring energy. Waves can be created and modeled by using jump ropes, a slinky, water, etc. These models can be physically manipulated to portray the direction of a wave. Using the jump rope model is a helpful tool help create and measure the wavelength and amplitude.

Engage - Biggest Wave Ever

Where have you seen different types of waves before?

Have you ever seen a crowd do the “wave” at a sporting event? Can you describe what it looked like?

World Record for Biggest Wave Ever – Bristol, TN

https://www.youtube.com/watch?v=H0K2dvB-7WY

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Explore – Wave Stations

We are going to explore different types of waves by visiting various stations around the classroom. You will rotate through stations after hand-on practice with each wave type. While visiting each of the stations, you will record what the waves look like and predict what type of wave you are creating such as transverse or longitudinal.

Station 1 – Jump Ropes Grab a partner and move around with a jump rope. What kind of waves can you create? Record these observations in your notebook.

Station 2 – Rock in Dishpan You are your partner will drop a small rock into a dishpan of water, watching the waves created. You can conduct multiple trials and record your observations.

Station 3 – Slinky Help your partner load a slinky onto a yardstick. Hold the yardstick horizontally at waist level and as steady as possible. Holding one end of the slinky still, have your partner jerk the other end of the slinky forward and back along the yardstick as quickly as possible. Notice the movement of the slinky and record what you see.

Adams, B. (2007). Making waves. *Science and Children, 44*(5), 50-52. Retrieved from https://login.iris.etsu.edu:3443/login?url=https://search.proquest.com/docview/236907554?accountid=10771

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Explore – Wave Stations

Station 1 – Jump Rope
Some things I observed . . .
Which type of waves did I create?

Station 2 – Rock in Dishpan
Some things I observed . . .
Which type of waves did I create?

Station 3 – Slinky
Some things I observed . . .
Which type of waves did I create?

Explore – ANSWER KEY Wave Stations

Station 1 – Jump Rope
Some things I observed . . .
Which type of waves did I create? Transverse

Station 2 – Rock in Dishpan
Some things I observed . . .
Which type of waves did I create? Transverse

Station 3 – Slinky
Some things I observed . . .
Which type of waves did I create? Longitudinal

Explain – What is a Wave?

A _____ can be described as a disturbance that travels through a medium from one location to another location.

There are different types of waves such as mechanical waves, sound waves, and electromagnetic waves.

Patterns of a wave include: _____, _____, and _____.

The direction of a wave is the direction in which a wave's energy travels.

The direction of a wave determines whether the wave is _____ or _____.

Longitudinal and transverse waves are mechanical waves.

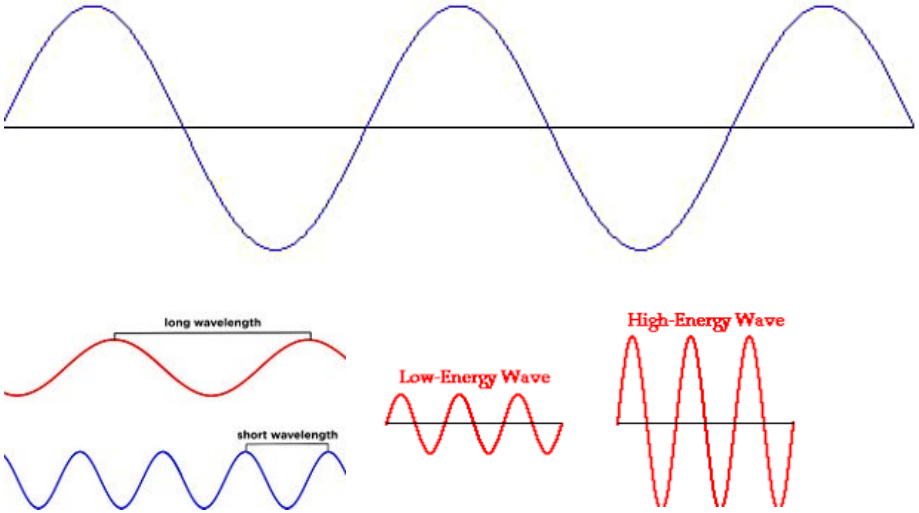
A transverse wave moves perpendicular to the direction of the wave. The points where the waves are the **highest** are called _____. The points where the wave is **lowest** are called _____.

A longitudinal wave moves back and forth in the same direction the wave is traveling.

The amplitude of a wave is the vertical distance between a peak or valley and the equilibrium point.

The _____ is the horizontal distance between two crests or two troughs of a wave.

Explain – What is a Wave?



Explain – What is a Wave? ANSWER KEY

A wave can be described as a disturbance that travels through a medium from one location to another location.

There are different types of waves such as mechanical waves, sound waves, and electromagnetic waves.

Patterns of a wave include: direction, amplitude, and wavelength.

The direction of a wave is the direction in which a wave's energy travels.

The direction of a wave determines whether the wave is longitudinal or transverse.

Longitudinal and transverse waves are mechanical waves.

A transverse wave moves perpendicular to the direction of the wave. The points where the waves are the **highest** are called crests. The points where the wave is **lowest** are called troughs.

A longitudinal wave moves back and forth in the same direction the wave is traveling.

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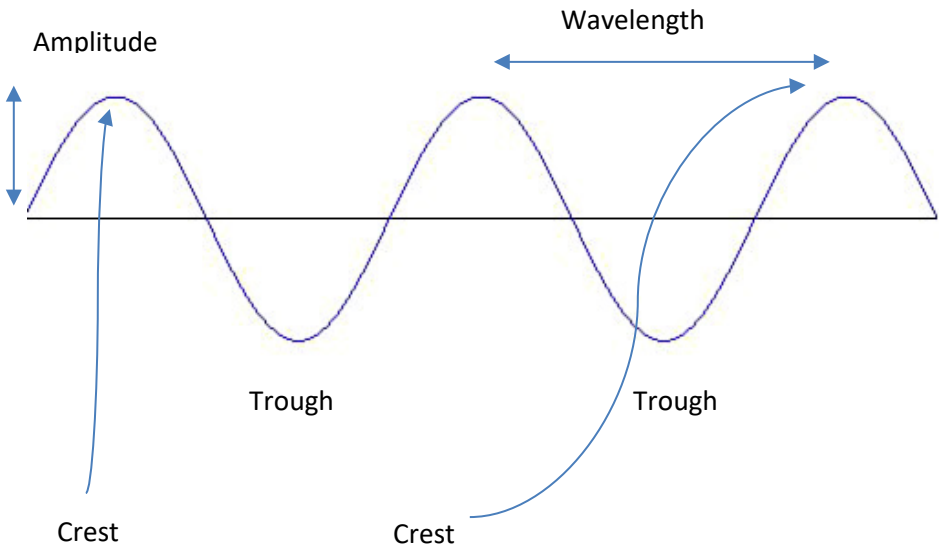

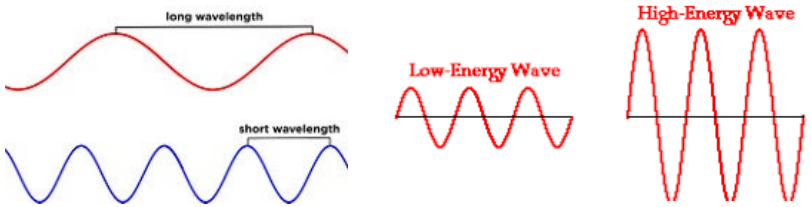

Physics for Kids. (n.d.). Retrieved from https://www.ducksters.com/science/physics/properties_of_waves.php

What is a Wave? (n.d.). Retrieved from https://www.physicsclassroom.com/class/waves/Lesson-1/What-is-a-Wave

Elaborate – Making Waves with Jump Ropes

We will be extending on your knowledge gained from the explorations of wave types when you visited the different stations. I want you to think about and refer back to the terms “wavelength” and “amplitude.” Think about how we could show a wave’s wavelength and amplitude.

What you will need:

- A partner ☺
- Jump Rope
- Measuring tape

Directions: You will work with a partner to create waves with certain wavelengths and amplitudes using a jump rope. You will use the measuring tape to measure these distances and check your model wave’s accuracy.

Simon Says Big Amplitude, Small Wavelength! - Activity. (n.d.). Retrieved from https://www.teachengineering.org/activities/view/cub_soundandlight_lesson2_activity1

Elaborate – Making Waves with Jump Ropes

Challenge 1: Design a wave of your own and measure the wavelength and amplitude.

Wavelength ____cm.

Amplitude ____cm.

Challenge 2: Make a model of a wave with a wavelength of 40 cm and an amplitude of 20cm.

Challenge 3: Create a wave model for your partner and let them measure the wavelength and amplitude. Take your own measurements to check the accuracy.

My wave had an amplitude of _____cm.

My wave had a wavelength of _____cm.

My partner’s wave had an amplitude of ____cm.

My partner's wave had a wavelength of ____cm.

Making Waves with Jump Ropes CER

Claim (Write a statement telling how wavelength and amplitude are related.)

Evidence (Provide scientific data to support your claim. This should include how these properties relate to the wave model.)

Reasoning (Explain why your evidence supports your claim. Describe the wave properties and how they are connected to waves.)

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ANSWER KEY Making Waves with Jump Ropes CER

Claim (Write a statement telling how wavelength and amplitude are related.)

Both wavelength and amplitude are properties of a wave that can be measured.

Evidence (Provide scientific data to support your claim. This should include how these properties relate to the wave model.)

We created wave models using a jump rope. When manipulating the rope, we were able to create different sizes of wavelengths and amplitudes during multiple trials that we could measure with a tape measure.

Reasoning (Explain why your evidence supports your claim. Describe the wave properties and how they are connected to waves.)

Waves have properties such as amplitude and wavelength. Amplitude is the vertical distance between a peak or a valley and the equilibrium point of the wave. Wavelength is the distance between crests of a wave. Using the rope model, we could portray these properties and take measurements of these distances.

ANSWER KEY Making Waves with Jump Ropes CER

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Evaluate – Math Questions

1. Describe how we could measure the amplitude of a wave.

2. Which measurement unit could we use to describe the wavelength?
    a. Inches
    b. Grams
    c. Quarts
    d. Milliliters

3. If we are calculating the amplitude of a wave in customary units, we would write it as (centimeters/inches). Circle the correct answer.

4. Describe in your own words what it means to estimate.

5. Compare and contrast the characteristics of metric units and customary units.

Evaluate – ANSWER KEY Math Questions

1. Describe how we could measure the amplitude of a wave.

We could measure the amplitude of a wave model by using a tape measure or ruler to measure the vertical distance from the resting point to either a peak or a valley.

2. Which measurement unit could we use to describe the wavelength?
    a. Inches
    b. Grams
    c. Quarts
    d. Milliliters

3. If we are calculating the amplitude of a wave in customary units, we would write it as (centimeters/inches). Circle the correct answer.

4. Describe in your own words what it means to estimate.

When you estimate, you roughly calculate or judge the value, quantity, or extent of something.

5. Compare and contrast the characteristics of metric units and customary units.

Metric – centimeter, liters, grams

Customary – inches, feet, gallons, miles

Evaluate – Science Questions

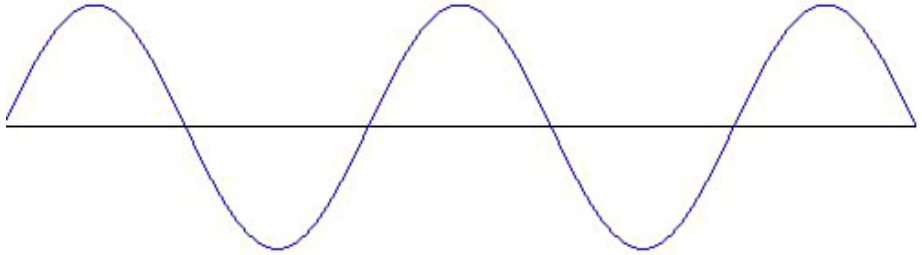
1. A traveling disturbance in a medium is known as a _____.

2. _____ is the vertical distance between a peak or a valley and the equilibrium point.

3. In your own words, describe the meaning of the term wavelength.

4. Sketch a picture of a wave with a small amplitude.

5. Label the parts of the wave below.



Evaluate – ANSWER KEY Science Questions

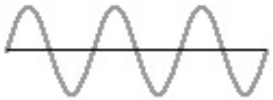
1. A traveling disturbance in a medium is known as a *wave*.

2. *Amplitude* is the vertical distance between a peak or valley and the equilibrium point.

3. In your own words, describe the meaning of the term wavelength.

Wavelength is the distance between two crests or troughs of the wave.

4. Sketch a picture of wave with a small amplitude.



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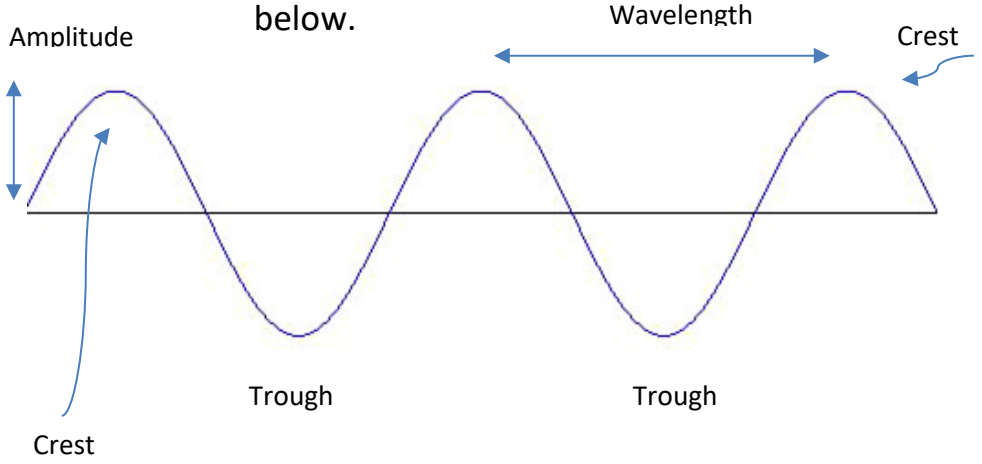

Big Ah-Ha Thesis

The purpose of this unite was to explore the three main patterns of a wave using wave models. We watched a video opening our eyes to the possibility of waves beyond the ocean scene. We rotated throughout various wave stations, labeled a wave model, and created our own unique waves using a jump ropes.

We watched a video of the largest crows wave in history. We could see how waves could look differently and began thinking about where else we might have seen waves beside in the swimming pool or at the beach.

There are different types of waves which we got to see and create at different stations around the room. At the first station we created transverse waves by moving a jump rope in a wave motion. At the second station we dropped a rock into a dishpan of water, observing the ripple pattern and concluding we created a transverse wave. We loaded a slinky onto a yardstick at the third station and stretched one end of the slinky out with a quick release while holding the other end still. We could see have the slinky moved back and forth on the yardstick to create a longitudinal wave.

After seeing the different directions that a wave could travel and the types of waves that were created from these directions, we went on to identifying the measurable patterns of waves such as amplitude and wavelength. We used what we learned about transverse waves at the stations to create additional waves out of the jump rope with a partner. We laid the jump rope out and moved it to make peaks and valleys. The, we used a measuring tape to determine the distances between certain points on the wave to record the amplitude and wavelength.

We learned about the patterns of a wave and how using wave models could help us understand those patterns. Each of the learning activities built upon one another to deepen our knowledge about waves.

Self-Reflection Paragraph

Before this unit, I had not thought about the different types of waves. When I thought of waves, I just thought about waves you see at the beach. After seeing the video of the crowd wave, it got me thinking about all the other places that I have seen waves before like skipping rocks or even in the dishwater at home. Now I know that there are different types of waves such as transverse and longitudinal and they have measureable characteristics such as wavelength and amplitude.