

What Is a Wave? Lesson 2

Not the Bermuda Triangle

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Published by *K20 Center*

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Grade Level	9th – 10th Grade	**Time Frame**	90 minutes
Subject	Science	**Duration**	2 class periods
Course	Physical Science		

Essential Question

What are waves? How do waves behave differently from particles?

Summary

In this second lesson of the What Is a Wave? unit, students will review key concepts from the first lesson using the Strike Out! strategy. Students will connect prior learning to new content by watching videos that demonstrate the speed of sound waves, and then will be introduced to the Triangle of Power strategy to calculate velocity.

Snapshot

Engage

Students present memes they made about the previous lesson in the unit, then work in groups to generate key concepts about the previous lesson content.

Explore

Students calculate the velocity of a wavelength.

Explain

Students are introduced to vocabulary and the Triangle of Power strategy.

Extend

Students determine if the speed of sound changes based on musical notes.

Evaluate

Students complete Exit Tickets to demonstrate their understanding of the lesson.

Standards

Oklahoma Academic Standards (Physical Science)

PS.PS4.1 : Use mathematical representations to explain both qualitative and quantitative relationships among frequency, wavelength, and speed of waves traveling in various media.
PS.PS4.1.1: The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.

Attachments

- Lesson Slides—Not The Bermuda Triangle.pptx
- Vocabulary Packet Teacher Guide—Not The Bermuda Triangle.docx
- Vocabulary Packet Teacher Guide—Not The Bermuda Triangle.pdf
- Vocabulary Packet—Not The Bermuda Triangle - Spanish.docx
- Vocabulary Packet—Not The Bermuda Triangle - Spanish.pdf
- Vocabulary Packet—Not The Bermuda Triangle.docx
- Vocabulary Packet—Not The Bermuda Triangle.pdf

Materials

- Lesson Slides (attached)
- Vocabulary Packet (attached, one per student)
- Vocabulary Teacher Guide (attached)
- Notebook paper
- Writing utensils
- White board, SMART board, or large poster paper

15 minutes

Engage

Use the attached **Lesson Slides** to guide the lesson. Show **slides 3 and 4** and review the essential questions and objectives with students. Move to **slide 5** and ask students to get their Lesson 1 meme about waves ready to present.

Show **slide 6** and ask students to take out a piece of notebook paper. Explain the Strike Out strategy to students. As each student presents their meme one at a time, the rest of the class should write down key ideas and important information from the previous lesson on their notebook paper.

After the presentations, show **slide 7** and have students work in groups of three to develop one list of key concepts from their individual lists. Students should compare their individual lists and work together to create one group list. Then, have each group pass their list to another group for review. Each group should strike out what they believe is the least important key concept as they review the lists. When the group receives their original list again, have students look it over and choose one concept to reclaim and add back to the list. Then, create a class list of key concepts from each group's list on a large piece of paper or on the whiteboard. Keep this list posted to refer back to throughout the unit.

Show **slide 8** and refer to the Driving Question Board that was created in Lesson 1. Ask students to think about if there are any questions that can be answered right now; if so, write the answers as a class and post them on the board. You can also ask if any questions should be added.

35 minutes

Explore

Ask students to use a piece of notebook paper for the next activity. Show **slide 9** and read the definition of "velocity" to students:

- Velocity is the speed at which something travels. If we know the speed at which something was traveling and the total time the object was moving, we can determine the distance it traveled.
- Velocity = Distance / Time
- Distance = Velocity * Time

Go to **slide 10** and ask students to think about a time it was storming, how did they use the lightning and thunder to determine how far away the storm was? Have a class discussion about the timing between lightning and thunder to calculate the distance of a storm.

Then, show **slide 11**. Play the video, titled "How Can You Figure Out How Far Away Lightning Struck?" and pause at 1:46. Ask students to talk with a partner about how the person in the video determined how far away the storm was. Have students share their thoughts as a class.

Embedded video
https://youtube.com/watch?v=2P7nODA4rrc

Show **slide 12** and play the video, titled "Speed of Sound - Lightning." Ask students to determine how many seconds passed between the sound of thunder and the flash of lightning as they watch the video. Pause at 19 seconds and ask for responses. Then, show the rest of the video, which uses a timer and concludes that it took 7.1 seconds.

Embedded video
https://youtube.com/watch?v=3TXJ2sk02JA

Show **slide 13** and ask students to determine how far away the lightning was from the camera. Have students use the equation (Distance = Velocity * Time) to estimate the velocity of sound. Inform students that the speed of sound is 338 m/s and the time they heard the thunder after seeing lightning was 7.1 seconds. After giving time for students to work out the problem, show **slide 14** and confirm that students arrived at 2,400 m as the answer.

Move to **slide 15** and play the "Pipelinefunk" video. Ask students to watch and listen to the video as a saxophone player uses a long pipe to create an echo.

Embedded video
https://youtube.com/watch?v=p8GcHoSIPDg

As they watch, ask students to think about how long it takes for the sound to travel down the pipe and back. Students can use a stopwatch on their device if they have one. Students should conclude that it takes 1.15 seconds for the sound to travel down the pipe and back. Ask students to think about what information is needed to confirm that the speed of sound is 338 m/s.

Show **slide 16** and have students use the velocity calculated previously to determine the total distance traveled by the sound, down the pipe and back. Have students use the information given to confirm the speed of sound. Show **slide 17** and confirm with students the answer to the problem on slide 16. Show **slide 18** and ask students to think about how they could calculate the velocity of a sound wave using frequency and wavelength.

Teacher's Note: Lesson Pacing

Consider stopping here until the next class period.

35 minutes

Explain

Inform students that the size of waves, number of waves, and speed of waves are interconnected. Show **slide 19** and pass out the attached **Vocabulary Packet** to each student.

As students view the "Physics - Waves - Introduction" video, ask them to find each vocabulary word that is discussed in the video in their Vocabulary Packet and take notes.

Embedded video

https://youtube.com/watch?v=RVyHkV3wlyk

After showing the video, if needed, transition through slides **20-22** to provide definitions of the vocabulary from the video. Show **slide 23** to reinforce the wave equation that was explained in the video. Show **slide 24** to talk through the relationship between wave velocity and frequency.

Student Responses

See the attached **Vocabulary Packet Teacher Guide** document for a key with student responses.

Go to **slide 25** to introduce students to the Triangle of Power strategy. Explain that the Triangle of Power can be used to complete any *a = b (c)* equation that they encounter.

Show **slide 26** and explain to students how to calculate the velocity of a wave, then go to **slide 27** and provide time for students to complete the problem using the velocity formula. The correct answer is on **slide 28**.

Show **slide 29** and explain that the Triangle of Power can also be used to find the frequency of a wave, then show **slide 30** and provide time for students to complete the problem using the frequency formula. **Slide 31** has the correct answer.

Show **slide 32** and inform students that the wavelength of a wave can also be calculated with the Triangle of Power. Show **slide 33** and provide time for students to complete the problem using the wavelength formula. **Slide 34** has the correct answer.

Show **slide 35** and ask students to decide which formula to use for the problem shown and provide time for students to complete the problem. **Slide 36** has the correct answer.

Pause here. Remind students there are two important concepts to remember:

- Waves always travel at a constant speed. (Remind students of the Slinky® activity from the first lesson to reinforce this idea.)
- As the wavelength of a wave gets longer, its frequency decreases; as the frequency of a wave increases, its wavelength gets shorter. (This is an inverse relationship: as one quantity increases, its partner decreases and vice versa.)

Show **slide 37** and introduce students to the Muddiest Point strategy. Ask students to think about what they have learned so far and write down what is unclear or "muddy" to them still. Collect student responses to assess their understanding of the lesson content.

Extend

Show **slide 38** and ask students to consider the question on the slide: "Will the speed of sound vary for different musical notes (frequencies)?"

Then, show **slide 39** and play the video, titled "Cymatics: Ruben's Tube vs. Tesla Coil."

Embedded video
https://youtube.com/watch?v=slopZnMLeQo

Move to **slide 40** and have students talk to an Elbow Partner about the questions on the slide. Ask students to share what they thought about the speed of sound of different musical notes before and after viewing the video.

Display **slide 41** and ask students to think about what they have learned in this lesson. Have them work to consider if any questions from the Driving Question Board can be answered at this time, and also if any questions should be added.

10 minutes

Evaluate

Show **slide 42** to display the Exit Ticket questions. Tell students to respond to the two questions on the last slide. Collect student responses and assess their understanding of the lesson content.

Sample Student Responses

1. Students should explain the inverse relationship of wavelengths.
2. Students should calculate the velocity; the answer is v=1,496 m/s.

Resources

- BrainStuff – HowStuffWorks. (2013, July 5). *How Can You Figure Out How Far Away Lightning Struck?* [Video]. YouTube. https://www.youtube.com/watch?v=2P7nODA4rrc
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- Küpper, A. (2020, June 9). *PIPELINEFUNK – concert/ Saxophone Jame with a Crazy Natural Echo from the Pipeline / Armin Küpper* [Video]. YouTube. https://www.youtube.com/watch?v=p8GcHoSIPDg
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