What Is A Wave? Lesson 3

Galloping Gertie

Grade Level	9th – 10th Grade	**Time Frame**	135 Minutes
Subject	Science	**Duration**	3 Periods
Course	Physical Science		

Essential Question

What are waves? How does the behavior of waves differ from that of other objects?

Summary

In this third lesson of the What Is A Wave? unit, students experiment with long springs, participate in a guided inquiry activity on constructive and destructive interference, and experiment with whirly tubes. Students are assessed by providing reasoning to true or false statements.

Snapshot

Engage

Students view a video that demonstrates wave oscillation.

Explore

Students conduct experiments with long springs to study how wave oscillations reflect and combine.

Explain

Students complete a guided inquiry activity on constructive and destructive interference.

Extend

Students experiment with whirly tubes to understand resonance.

Evaluate

Students choose if statements are true or false and provide reasoning of their choice.

Standards

Oklahoma Academic Standards (Physical Science)

PS.PS3.3 : Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
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-Waves-Galloping-Gertie.pptx
- Student-Wave-Interference-Activity-Galloping-Gertie.docx
- Teacher-Wave-Interference-Activity-Guide.docx
- Wave-Vocabulary-Packet.docx
- Wave-Vocabulary-Teacher-s-Guide.docx

Materials

- Lesson Slides (attached)
- Long Spring Activity Sheet (attached)
- Guided Inquiry Sheet (attached)
- Wave Unit Vocabulary Packet (attached)
- Long springs
- Masking tape
- Meter sticks
- Whirly Tubes

5 minutes

Engage

Use the attached **Lesson Slides** to guide the lesson. Review the essential questions of the unit on **slide 3** and the lesson objectives on **slide 4**. Show **slide 5** and introduce students to the I Notice, I Wonder strategy. Show **slide 6** and play the video for students.

Embedded video

https://youtube.com/watch?v=13J76PXE6OA

Show **slide 7** and ask for students to share what they observed and what questions they have. Ask students how the bridge could have trapped and amplified vibrations on the bridge. Explain to students that wind caused small vibrations that developed into larger vibrations until the bridge collapsed.

40 minutes

Explore

Lesson Preparation

The activity will require space for students to spread out, an area outside of the classroom may be needed to complete the activity.

Tell students they will observe how multiple waves can occupy the same space in the next activity. Arrange students in groups of three. Provide students with the necessary materials to complete the activity, which are one long spring, a meter stick, masking tape, and a marker. Show **slide 8** and tell students to follow the directions on slide 8 to begin the activity. **Slides 9-19** detail each step of the long spring activity. Explain each step of the activity to students before allowing the groups to begin the activity.

Lesson Pacing

Consider stopping at this point until the next class time.

50 minutes

Explain

Continue the lesson on **slide 20**. Arrange students into groups of three and show **slide 21**, tell students each group member will have a designated role. Pass out the attached **Student Wave Interference Activity** handout to each group of three students. As students progress through the Student Wave Interference Activity, move around the classroom and observe the groups. Provide feedback and assistance as needed to clarify any misconceptions, a **Teacher Wave Interference Activity Guide** is attached. The activity is included step by step on **slides 22-29**.

After the groups are done working through the activity, tell each group they will be responsible for sharing their answer to one of the questions on the activity. Questions # 3, 4, 6, 7, 10 should be covered in the discussion. Ask for volunteers to share, encourage multiple groups to share responses. Group reporter answers the question for the group. Teacher corrects answers that are incomplete or inaccurate. Teacher may prompt for questions to ensure that essential understandings are covered. Correct any misconceptions at this time.

After activity questions have been shared and discussed, show **slides 30-32** and review key vocabulary introduced during this activity: *interference*, *reflection*, *phase*.

Lesson Pacing

Consider stopping at this point until the next class time.

45 minutes

Extend

Begin class by showing the video embedded in **slide 33**, then ask the reflection questions on **slide 34**. Tell students to share their thoughts with a partner and then ask for volunteers to share and have a class discussion about the reflection questions.

Divide students into groups of three and provide each group with a Whirly Tube. Show **slide 35** and tell students to experiment with the tubes. Tell students to talk in their groups about the sound the Whirly Tube makes as they spin the tube at different speeds. Tell students that the whirly tube is vibrating as a single frequency, which is called resonance.

Tell students to return from their groups and have their Wave Unit Vocabulary Packet out to take notes. Show **slide 36** to introduce the concept of resonance and play the video clip. Tell students the flame in the video is a visual representation of resonance. Refer back to the Galloping Gertie video watched in the beginning of the lesson and tell students that was also an example of resonance.

Show **slide 37** and introduce the concept of interference patterns. Tell we are transitioning from reflection/mixing of *trapped* waves to the mixing of *freely traveling* waves. Show **slide 38** to define an interference pattern, then show the video on **slide 39** as an example of an interference pattern in water waves.

Light Sensitivity Warning

The video on slide 39 is not suitable for students with photo/light sensitive epilepsy, please skip this video if it would affect one of your students.

Introduce Thomas Young on **slide 40** and provide background information for students. Show **slide 41** and explain that Thomas Young first discovered interference patterns by shining light through a card with two narrow openings. The light passing through the two openings blended to produce an interference pattern of light and dark bands.

Show **slide 42** and play the video for students. This video provides a wealth of supplemental content about interference patterns as well as great interactive demonstrations and graphics. Show **slide 43** and ask students to refer back to the Driving Question Board, are there any questions that can be answered right now? Have a class discussion about any questions that remain.

5 minutes

Evaluate

Show **slide 44** and introduce students to the Justified True or False strategy. Tell students to read the statements and think if each one is true or false. Show **slides 45-49** and tell students to use notebook paper to respond to each statement with true or false and their reasoning for that choice.

Collect the student responses and assess understanding of the lesson.

Resources

- Kamenícek, J. (2014, March 31). File:London Millennium Bridge from Saint Paul's.jpg. Retrieved July 07, 2021, from https://commons.wikimedia.org/wiki/File:London_Millennium_Bridge_from_Saint_Paul%27s.jpg
- K20 Center. (n.d.). I Notice, I Wonder. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/d9908066f654727934df7bf4f507d1a7
- K20 Center. (n.d.). Justified true or false. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/174
- K20 Center. (n.d.). Driving question board. Strategies. Retrieved from https://learn.k20center.ou.edu/strategy/1511