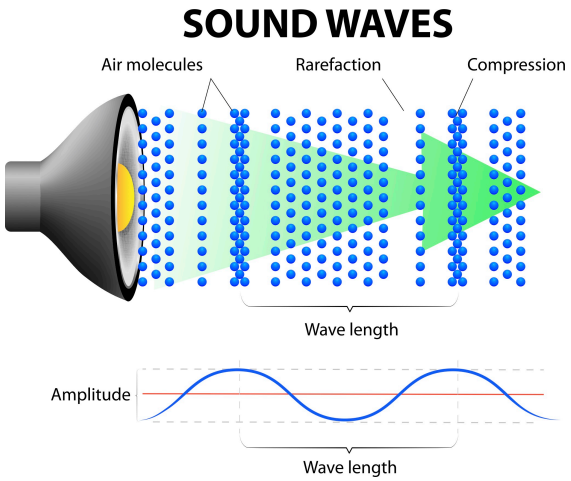
NASA Spotlite
Interactive Lesson

Sound Waves and Medium

Grades 5-8



Teacher Packet

NASA Spotlite Interactive Lesson Guide

This NASA eClips™ Spotlite Interactive Lesson supports existing curriculum and should be used as one of many strategies to build students' understandings of science content. The goal of this 5E lesson is to address a science misconception. Through watching a student-produced video (Engage), completing activities (Explore), explaining relevant concepts while applying new vocabulary collectively using a Frayer Model (Explain), and applying new information (Extend/ Elaborate), students will develop an understanding of the science content and how to correct the science misconception.

This PDF document should be downloaded to use the interactive features. The hyperlinks included in this document open PDFs or webpages and may perform differently based on the device being used. Links may have to be cut and pasted into a web browser to open.

Try using Adobe Acrobat Reader and Flash Player for optimal performance of all interactive features included in this guide.

An accompanying student packet is located on the NASA eClips™ Website.

What are NASA Spotlites?

NASA Spotlites are 90-120 second student-produced video segments that address common science misconceptions as determined by reputable assessment sources such as the National Assessment of Educational Progress (NAEP), National Science Foundation (NSF) Factual Knowledge Questions, and the Misconceptions-Oriented Standards-based Assessment Resources for Teachers (MOSART).

NASA Spotlites are designed to increase scientific literacy in a standards-based classroom. By producing Spotlite videos, students gain production experience, as well as deepen their understanding of science content. Approved NASA Spotlites can be found at the NASA eClips™ website. https://nasaeclips.arc.nasa.gov/

Animated 5E Instructional Model

NASA eClips™ Guides use the 5E constructivist model developed by Biological Sciences Curriculum Study. Constructivism is an educational philosophy that promotes student-centered learning where, students build their own understanding of new ideas. The 5E instructional model consists of five stages for teaching and learning: Engage, Explore, Explain, Extend (or Elaborate), and Evaluate.

Lesson Information

Science Misconception
Sound needs air to travel.

Standards
Next Generation Science Standards
1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.
1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance

Objective
As a result of watching the Spotlite video, learning the vocabulary collaboratively, and exploring how sound waves travel through different materials, students will explain that sound is a form of energy and needs a medium in which to travel.

Time Frame
Between two and three 45-minute class periods:
Day 1 - Engage and Explore
Day 2 - Explain and Elaborate/Extend
Day 3 – Evaluate

Safety
Review digital citizenship before students use online resources.

This icon identifies the suggested directions and information to read to students.

Remind students to save responses. Suggested steps: Under "file" choose "save as." Type your name in front of the document name. Choose "save."

Materials
Assessment
Per student: copy of pretest and posttest
Explore
Per group: tuning fork; paper; half-filled, clear plastic cup of water; ping pong ball
Frayer Model Activity
- Per small group: copy of a digital Frayer Model (alternatively, this can be printed)
- Per classroom: chart paper for posting final vocabulary definitions

Background Information
- Sound is a form of energy that is produced when materials move back and forth or vibrate. Sound must have a medium in which to travel. *** **The plural of medium is medium or media.**
- A medium is a material through which energy, such as a sound wave, travels. Sound cannot travel if there is no medium through which vibrations can move.
- Sound medium can be solids, liquids, or gases. For example, if your ear is placed on a table, the sound produced from tapping can travel directly through the solid table to your ears.
- Sound does not travel in a vacuum, an area such as deep space, where there is little or no matter through which vibrations can move.
- Sound travels fastest in a solid, next fastest in a liquid, and slowest in a gas.
- The molecules in a sound wave move close together (compression) and spread apart (rarefaction) as sound energy moves through a medium.

Target Vocabulary: sound, sound wave, medium, rarefaction, compression, vibration, transmission, vacuum, energy, longitudinal wave

Engage

Pre-Assessment

Probe for students' prior knowledge using the pre-assessments.

1. Pretest items are located on page 12. Student packets contain a pretest.
2. Essential question
3. Discussion questions (this page)

Essential Question

How do forces act on an object at rest?

Today's Lesson

In today's lesson you will learn how sound waves travel through a medium. Using interactive Frayer Models, you will learn key vocabulary that will help you understand that sound is a form of energy that occurs through vibrations in matter.

What do you already know about sound and how it travels through different medium

True or False: Sound needs air to travel.

Select the best choice.
This statement is TRUE.
This statement is FALSE.

Spotlite Video

Next, you will watch a short video about how sound travels through different medium As you watch the video, pay close attention to any new vocabulary.

(Example vocabulary: sound, sound wave, medium, rarefaction, compression, vibration, transmission, vacuum, energy, longitudinal wave)

Video Links - NASA Spotlite: Sound Waves and Media

NASA eClips™ Website: https://nasaeclips.arc.nasa.gov/spotlite/sound-waves-and-mediums/
NASA eClips™ YouTube: https://youtu.be/NuwPSCNiJuY

Use the questions to lead the class in a discussion.

1. What is sound?
2. What medium can sound travel through?
3. How does sound travel though different materials?
4. Why do sound waves travel at different speeds?

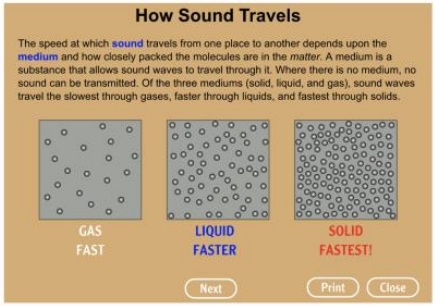
Explore

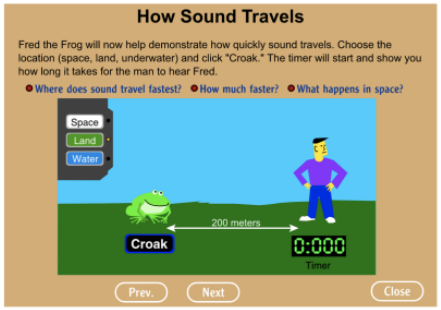
Explore Activity #1

Use this interactive to explore how sound travels through different medium.

Knowitall.org

How Sound Travels | NASA Online

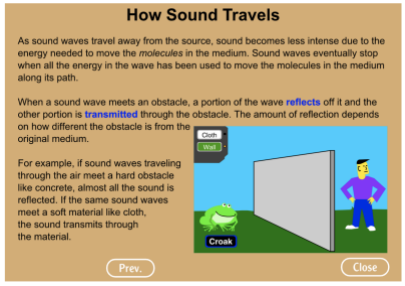




There are three medium (locations) to choose from. Select "croak" and record how long it takes the man to hear the frog's croak.

1. land
2. water
3. the near-vacuum of outer space

Select "next" and explore how sound waves interact with different materials. Record your answers.



1. cloth
2. wall

Website Link
https://www.knowitall.org/interactive/how-sound-travels-nasa-online

Explore Activity #2

Use the materials provided to explore how sound travels through different medium.
Describe what happened when you placed the vibrating tines of the tuning fork:

1. next to your fingers
2. next to a sheet of paper
3. in the water
4. in contact with the ping pong ball

Activity Credit: NASA's Aeronautics Research Mission Directorate- Museum in a Box (https://www.nasa.gov/aeroresearch/resources/mib/noise-good-vibrations)

Think-Pair-Share

In which medium (solid, liquid, or gas) does sound travel fastest?
What happens to sound in the near-vacuum of outer space?
Describe what happens to sound waves when they interact with a hard surface such as a wall or a soft surface such as carpeting.

Explore

Let's Compare Your Answers!

The speed at which sound travels from one place to another depends upon the medium and how closely packed the molecules are in the medium. A medium is matter through which energy, such as a sound wave, moves. Where there is no medium (like a vacuum), no sound can be transmitted.

Sound waves travel slowest through gases, faster through liquids, and fastest through solids. In gases, the molecules are farther apart, and it takes longer for vibrations to move through the molecules. In a solid, the molecules are closer together than in a gas or liquid, and the vibration moves through the molecules more quickly.

As sound waves travel away from their source, sound becomes less intense because energy is expended moving the molecules in the medium. When a sound wave meets an obstacle, portions of the sound waves can be reflected off it, absorbed into it, or transmitted through it. Hard objects tend to reflect sound waves, whereas soft, irregular materials, such as carpeting, absorb sound waves.

Explain

Vocabulary Development

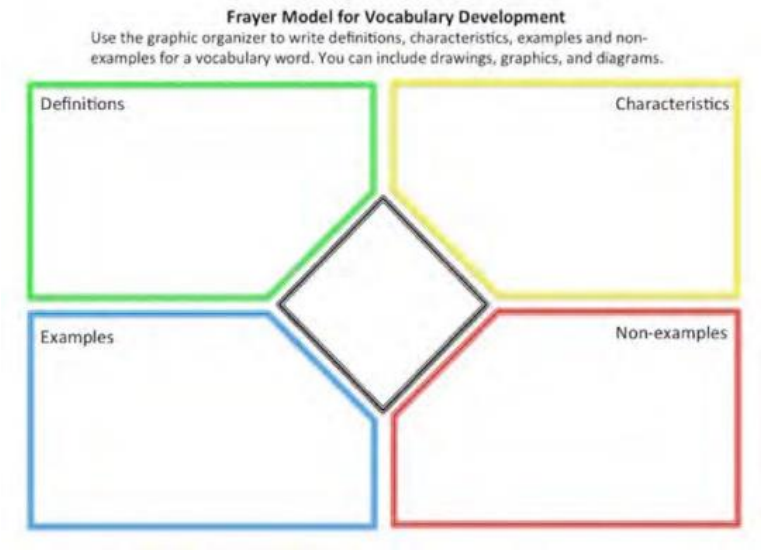
It's almost impossible to learn science concepts without also learning vocabulary words. Those vocabulary words help people discuss science concepts, so they're important. However, knowing vocabulary words is not the same as understanding science concepts. This section is designed to help your students do more than memorize definitions as they connect the vocabulary to the science concepts that they have explored.

1. Place the word "wave" in the center of the graphic organizer. (See page 11 for a fillable Frayer Model.) Facilitate a discussion with students exploring why this word is key vocabulary to this study.
2. Ask students to brainstorm characteristics of the word "wave" and add responses to the area with the corresponding heading on the graphic organizer.
3. Ask students to continue their exploration as they research the topic using a variety of resources including their textbook and notes.
4. Next, ask students to add examples and non-examples in the Frayer Model. Emphasize the higher-level thinking skill of comparing and contrasting.

How are the examples alike/different than the non-examples?

5. Using the information provided, ask students to develop their own definition of the word "wave" that is clear and concise. An example is in the Answer Key section of this document (page 14).
6. After completing the example together, have students select or assign a new vocabulary word to each group of students to work on collaboratively.

Now complete a new Frayer Model with a partner. Select one word from the key vocabulary list and fill in the graphic organizer. We will share some as a class.

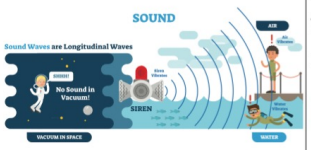


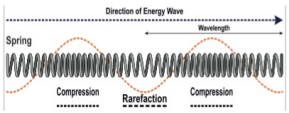
7. Groups will share their Frayer Models and lead discussions to check for understanding of each vocabulary word. Refer to definitions in the Answer Key (page 8).
8. Compile and post final definitions so all students have access for later reference.

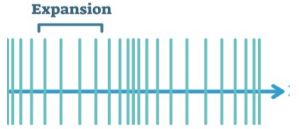
You will review key vocabulary. Pay attention to how your definitions compare to standard definitions.

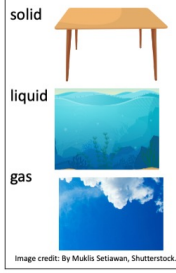
Explain

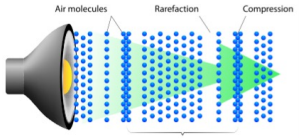
Vocabulary Words

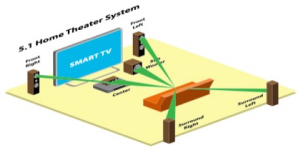
Word	Definition
sound  Image credit: By VectorMine, Shutterstock.com	Sound is a form of energy produced and transmitted by vibrating matter.

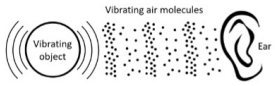
Word	Definition
longitudinal wave  Image credit: By Fouad A. Saad, Shutterstock.com	A longitudinal wave is a wave in which the particles of the medium vibrate parallel to the direction of wave motion.

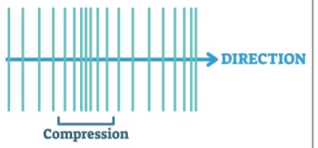
Word	Definition
rarefaction  Image credit: By VectorMine, Shutterstock.com	Rarefaction is where the particles are spread apart in a longitudinal wave.

Word	Definition
medium  Image credit: By Muklis Setiawan, Shutterstock.com	A medium is a physical environment through which energy, such as a light or sound wave, can travel. Example: Glass is a medium through which light can pass.

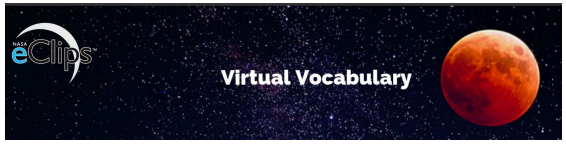
Word	Definition
sound wave  Image credit: By Designua, Shutterstock.com	A sound wave is a series of compressions and rarefactions traveling through a substance.

Word	Definition
acoustics  Image credit: By PRL, Shutterstock.com	Acoustics is the properties or qualities of a room or building that determine how sound is transmitted in it.

Word	Definition
vibration  Image credit: By VectorMine, Shutterstock.com	Vibration is the back and forth movement of matter.

Word	Definition
compression  Image credit: By VectorMine, Shutterstock.com	Compression is where molecules are being pressed closer together in a longitudinal wave.

Visit the NASA eClips™ Virtual Vocabulary for more definitions.

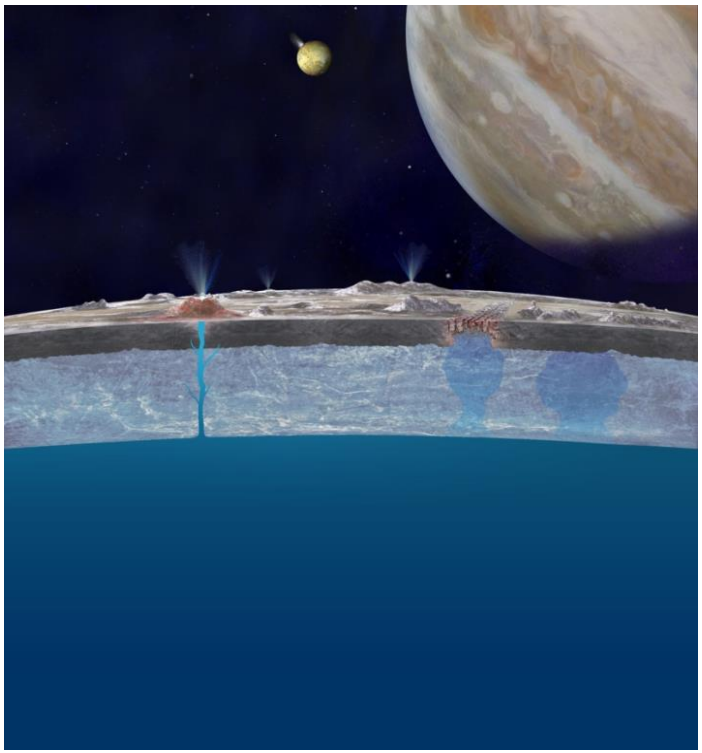


Elaborate/Extend

It is important for the students to explain what's going on by applying what they have learned. It is not unusual for students to have a bit of difficulty with elaborate activities. Student are not used to doing "novel" activities and being asked to apply what they know.

NASA Connection

The mineral-infused liquid water NASA believes is under the icy crust of Europa is shown below.



This illustration of Europa (foreground), Jupiter (right) and Io (middle) is an artist's concept.
Image Credit: NASA/JPL-Caltech

Excerpt from Listening for an Ocean on Europa

https://solarsystem.nasa.gov/news/208/listening-for-an-ocean-on-europa/

Terrestrial ice mechanics studies show that the vibrations created when ice fractures produce sound waves that can penetrate the thick surface ice layer of Europa. These sound waves propagate for what believed to be hundreds of kilometers through the underlying ocean.

Acoustic sensors deployed on the surface of Europa could pick up echoes from the bottom of the ice layer and the bottom of the ocean. By studying these echoes, one could establish the existence and depth of the ocean as well as the ice layer.

If acoustic sensors are placed on the surface of Europa, how could the sensors pick up sounds from the bottom of the ice layer?

Learn more about Jupiter's moon Europa at this link: https://science.nasa.gov/

Evaluate

Post-Assessment

Check students' understanding with these activities.

Identify Misconception

What is a common misconception people have about sound and how can you correct it?

Discussion Questions

1. What is sound?
2. What medium can sound travel through?
3. How does sound travel though different materials?
4. Why do sound waves travel at different speeds?

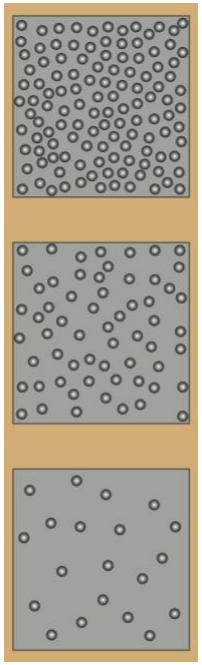
Carefully rewatch the NASA Spotlite video about sound to assess your understanding of how it travels through different medium

Video Links - NASA Spotlite: Sound Waves and Medium

NASA eClips™ Website: https://nasaeclips.arc.nasa.gov/spotlite/sound-waves-and-mediums/
NASA eClips™ YouTube: https://youtu.be/NuwPSCNiJuY

Vocabulary Review

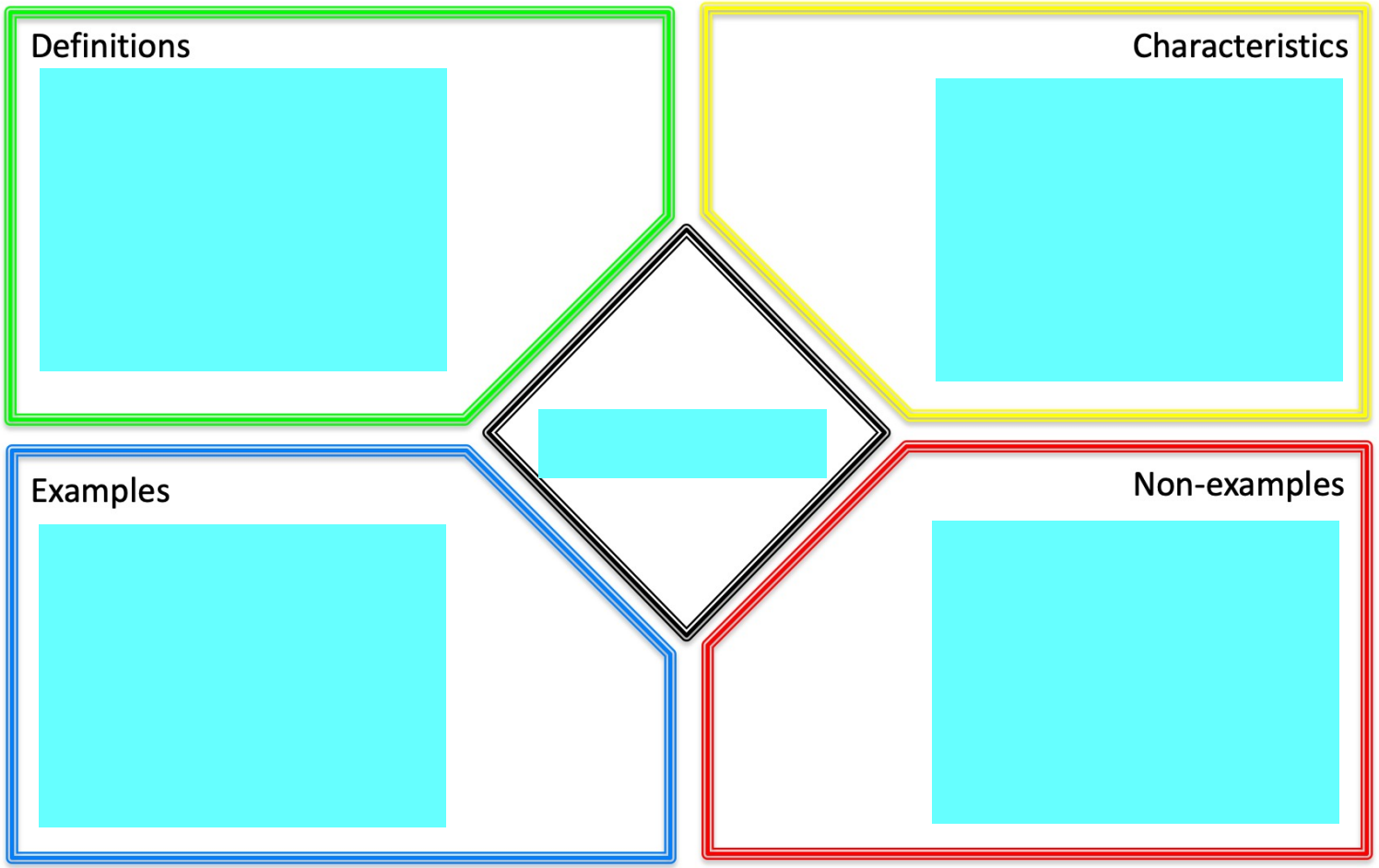
Using your new vocabulary words, identify and explain how sound waves move through each medium.



Resources

Frayer Model for Vocabulary Development

Use the graphic organizer to write definitions, characteristics, examples and non-examples for a vocabulary word. You can include drawings, graphics, and diagrams.



Visit the NASA eClips™ Virtual Vocabulary for more definitions.

Resources

Sound Grades 5-8 Pretest / Posttest
NASA Spotlite Interactive Lesson

Read each question and select the best choice.

1. This is the material through which a sound wave travels.

Select the best answer.
A. compression
B. rarefaction
C. medium
D. vibration

2. This is a form of energy that is produced by vibrations in matter.

Select the best answer.
A. light
B. potential energy
C. sound
D. medium

3. Which of the following statements about sound is true?

Select the best answer.
A. Sound can only travel through air.
B. Sound does not need a medium to travel.
C. Sound travels fastest in gases.
D. Sound travels through solids, liquids, and gases.

4. Tonya and Derek were discussing the transmission of sound. In which of the scenarios that they discussed would sound NOT travel.

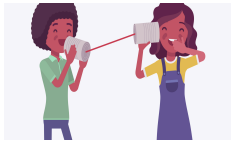
A. 
B. 
C. 
D. 

Image credit: NASA and Shutterstock

Select the best answer.
A. in the near-vacuum of deep space
B. between two swimmers underwater
C. between two students using a string telephone
D. between a cow and farmer in a field

5. The back and forth movement of molecules in a medium that serves as the basis for sound is called

Select the best answer.
A. vibration
B. medium
C. rarefaction
D compression

Answer Key

Sound Grades 5-8 Pretest / Posttest
NASA Spotlite Interactive Lesson

Read each question and select the best choice.

1. This is the material through which a sound wave travels.

A. compression
B. rarefaction
C. **medium** **
D. vibration

2. This is a form of energy that is produced by vibrations in matter.

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B. potential energy
C. **sound** **
D. medium

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D. **Sound travels through solids, liquids, and gases.** **

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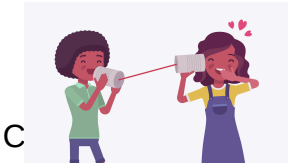
C 
D. 

Image credit: NASA and Shutterstock

A. in the near-vacuum of deep space **
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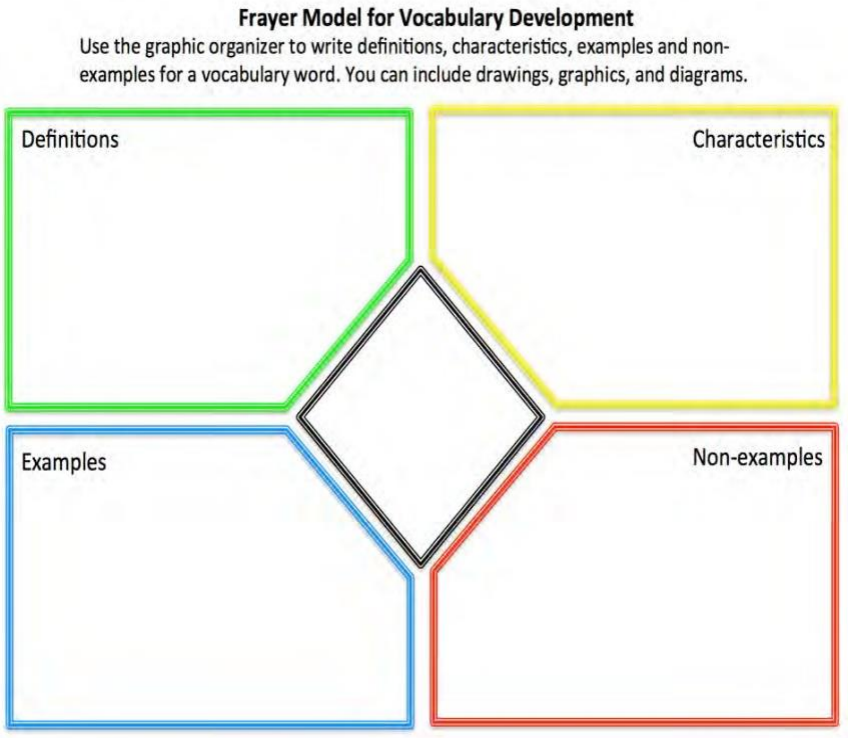
C. between two students using a string telephone
D. between a cow and farmer in a field

5. The back and forth movement of molecules in a medium that serves as the basis for sound is called

A. vibration **
B. medium
C. rarefaction
D compression

Answer Key



Vocabulary Word
wave

Characteristics
form of energy, needs a medium to travel, behaves differently depending on the material

Examples

light wave, sound wave

Non-examples
color, solid, liquid

Definition
A wave is a disturbance that travels through a medium, transporting energy from one location (its source) to another location without changing the material.

Product Information

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