

 Lesson Plan: Sound

Grade Level: 8

Subject: Physical Science

Duration: 45–60 min

NGSS MS-PS4-1: Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

 Learning Objectives

By the end of this lesson, students will be able to:

- **Describe** sound as a longitudinal wave produced by a vibrating object and carried through a medium as compressions and rarefactions.
- **Relate** the amplitude of a sound wave to the energy it carries and to the loudness a listener



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through a medium as this kind of wave.

- **Wavelength:** The distance from a point on one wave to the matching point on the next wave, for example from the center of one compression to the center of the next.
- **Amplitude:** The height of a wave measured from its resting line to the top of a peak. A larger amplitude means the vibration carried more energy, so the sound is louder.
- **Frequency:** The number of complete back-and-forth vibrations a source makes each second, measured in units called hertz (Hz). Humans normally hear frequencies from about 20 Hz to 20,000 Hz.



- **Pitch:** How high or low a sound seems to a listener. Pitch is set by frequency: faster vibrations are heard as a higher pitch and slower vibrations as a lower pitch.
- **Loudness:** How strongly a listener perceives the energy a sound wave carries. Loudness increases with the wave's amplitude and decreases with distance from the source, and it is measured in units called decibels (dB).
- **Elasticity:** How well the particles of a material spring back to their resting positions after a wave passes through them. Solids such as steel are far more elastic than water or air, which is why sound travels fastest through them.

 Materials Needed: (all links are included in this PDF)

- Sound Study Guide, printed for each student
(<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-sound-2.pdf>)
- Sound Activity Lesson pages with the labeled wave diagram, Speed of Sound chart, Decibels



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Lesson Procedure

Step 1: Introduction (5 minutes)

- Pluck a guitar string and ask students: the string is over here and your ear is over there, so what is actually moving through the space in between?
- Collect answers on the board, then confirm that a vibrating object pushes on the air around it and that push travels outward as a wave.
- Project the wave diagram on page 1 of the Activity Lesson and tell students that by the end of the period they will be able to read every label on it.



(<https://newpathworksheets.com/api/activity-lesson/activity-lesson-science-grade-8-sound-2-4.pdf>)

Step 2: Direct Instruction (15 minutes)

- Read the Study Guide overview and define sound as a longitudinal wave, pointing out the compressions and rarefactions the particles of the medium form.
(<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-sound-2.pdf>)
- Strike a tuning fork and dip its tines into a clear cup of water so students see the vibration splash, then press the fork's base against a desktop so the solid carries the sound louder into the room.
- Walk through the labeled wave diagram in the Activity Lesson, naming crest, trough, wavelength, amplitude, and frequency on the drawing.
(<https://newpathworksheets.com/api/activity-lesson/activity-lesson-science-grade-8-sound-2-4.pdf>)
- Use the Decibels of Sound chart to tie amplitude to energy and loudness, from a whisper at 10 dB to a rock concert at 140 dB, and contrast that with frequency in hertz setting pitch.



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- Have students label the parts of the ear on the Activity Lesson diagram and write a short paragraph tracing a sound wave from the eardrum to the brain.
(<https://newpathworksheets.com/api/activity-lesson/activity-lesson-science-grade-8-sound-2-4.pdf>)
- Have students answer the Activity Lesson chart questions on their own: quietest sound, loudest sound, and the fastest and slowest medium.
(<https://newpathworksheets.com/api/activity-lesson/activity-lesson-science-grade-8-sound-2-4.pdf>)



- Assign the Practice Worksheet 1 items that ask students to draw a conclusion from the speed-of-sound graph and to order media by how fast they carry sound.
(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-sound-2-1.pdf>)

Step 5: Assessment (10 minutes)

- Administer Practice Worksheet 0 as a ten-item check on wave interactions, loudness in decibels, frequency ranges, and reading the speed-of-sound graph.
(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-sound-2-0.pdf>)
- Have students decide whether a whisper, a jackhammer, and a jet plane at takeoff differ mainly in amplitude or in frequency, and whether a bat's squeak and a bass drum differ mainly in pitch or in loudness.
- Collect an exit response: explain why an astronaut on the Moon hears nothing when a hammer strikes a rock, using the word medium.



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in their fingertips before they are asked to name it.



Extension Activities

- Build a straw panpipe by cutting drinking straws to different lengths and taping them side by side, then order the straws by pitch and explain the pattern in terms of frequency.
- Stretch rubber bands of different thicknesses across an open box and test which change alters pitch and which alters loudness: the thickness of the band or how hard it is plucked.



- Time an echo by clapping once toward a large flat wall from a measured distance, then use 343 m/s to estimate the total distance the sound traveled and compare it to the measurement.

Complete List of Available Resources:

- NewPathWorksheets: Sound (<https://newpathworksheets.com/science/grade-8/sound-2>)
- Study Guide PDF (<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-sound-2.pdf>)
- Activity Lesson PDF (<https://newpathworksheets.com/api/activity-lesson/activity-lesson-science-grade-8-sound-2-4.pdf>)
- Worksheet PDF 0 (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-sound-2-0.pdf>)
- Worksheet PDF 1 (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-sound-2-1.pdf>)



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SOUND

Overview

Sound is a type of **longitudinal wave**. As it travels through its medium, the medium's particles show areas of **compression** and **rarefaction**. While the most common medium for sound is air, we know it can travel through many other substances. The diagram below shows a typical sound wave.

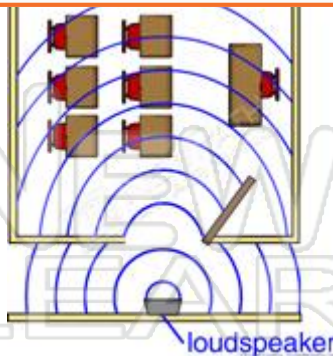
LESSON CHECKPOINT:
What is a sound wave?

Sound Wave Interactions

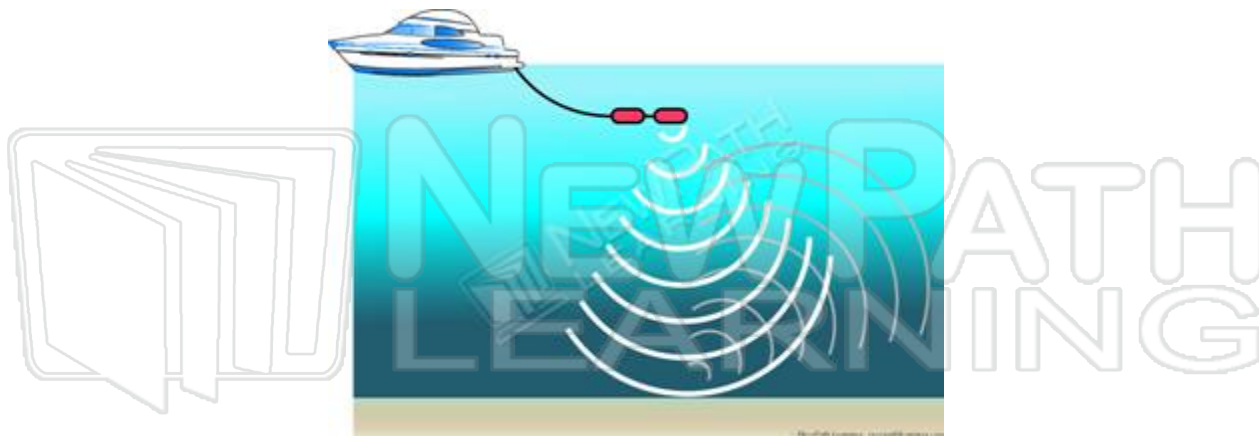


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The meeting of sound waves is called **interference** and this is the third type of interaction. Depending on what happens, this interference can be either constructive or destructive.



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liquids (30° C)	fresh water	1,509
	salt water	1,546
solids (25° C)	lead	1,210
	iron	4,480
	aluminum	5,000
	glass	5,170

The speed of sound is also influenced by the **density** and **elasticity** of the medium. Notice in the chart above how different media conduct sound at different speeds.

Elasticity has to do with how well the particles of a medium bounce back after energy passes through them. The reason sound travels faster through a solid than it does through water or air is because solids are far more elastic than liquids or vapors.

LESSON CHECKPOINT: *What factors affect the speed of sound?*

Loudness of Sound

The **loudness** of sound depends upon its intensity and the distance from the sound's source. The intensity of sound is determined by how much energy the sound carries. The harder you blow into a trumpet, the louder the sound



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Sound's **pitch** depends upon its frequency. At certain frequencies certain sounds seem quite high, while at other frequencies sounds can seem quite low. The frequency of sound is measured in units called **hertz**. Humans normally can hear frequencies between 20 and 20,000 hertz. Sounds above this frequency are referred to as **ultrasound**.

LESSON CHECKPOINT: *What is the difference between the loudness of a sound and its pitch?*

Doppler Effect When the frequency of sound changes as its source moves in relationship to someone listening, this is called the **Doppler Effect**. In the diagram below, the sound of the fire truck seems to change as it passes the people on the street. This is the result of the Doppler Effect.



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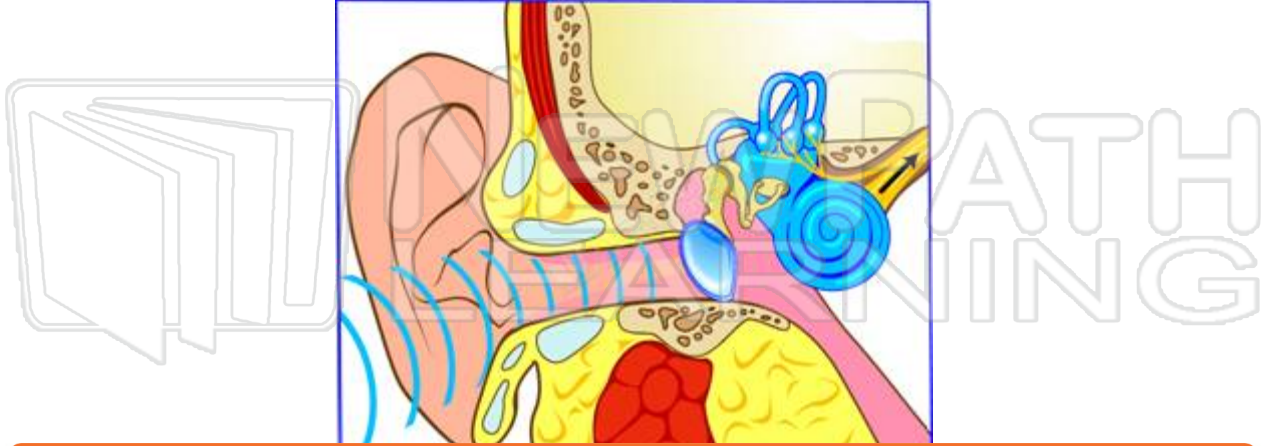
Hearing Sound

The hearing of sound requires both our ears and our brain.

1. The outer ear shown below captures the sound wave and uses its energy to move small bones in the middle ear.
2. The movement of these bones causes nerve endings in the inner ear to be stimulated.

3. The nerves send impulses to the hearing center in the brain.
4. The brain interprets the nerve impulses as particular sounds.

Overall, the ear converts the mechanical energy of air to the mechanical energy of bones in the middle ear to electrical energy sent to the brain.



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bounce back they create of picture of what they reflected.

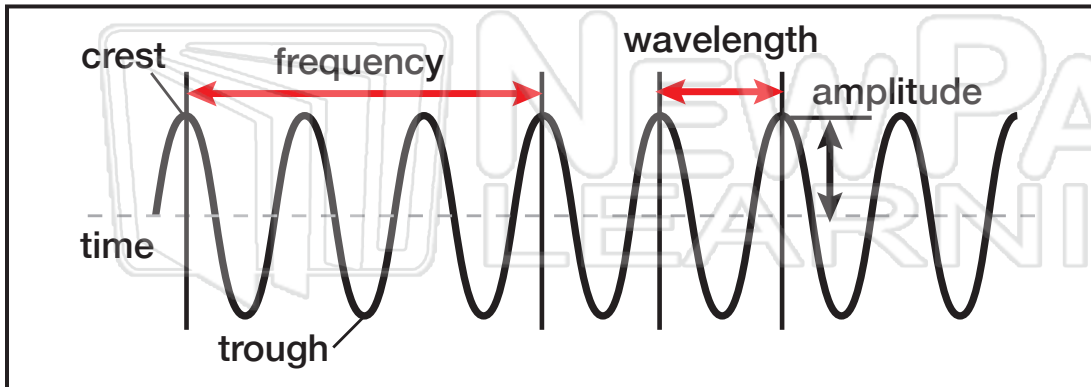




Sound

Name _____ Class _____ Date _____

Sound is created by the **vibrations** of an object. A **vibration** is a complete back-and-forth motion by an object. The object could be a guitar string, a drum, the diaphragm of a loudspeaker, or even your vocal cords.



Sound
A wave
sound

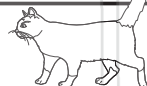
Sound
Long
raref
throu
glass



length
→

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Frequency Range by Animal	
Animal	Frequency range (Hz)
bat 	2,000 to 110,000
cat 	45 to 64,000
human 	20 to 20,000
dog 	67 to 45,000

The **pitch** of the sound determines how low or high a sound seems to be. The pitch of a sound depends upon the frequency of the vibrations that cause it.

The **frequency** of a sound is the **number of vibrations** per second. **Frequency** is measured in units called **hertz (Hz)**.



Sound

Name _____ Class _____ Date _____

The **loudness** of a sound depends upon the **amplitude** (height of a sound wave) of the vibrations that cause it. The **bigger** the vibration, the greater the **amplitude** of the waves, and thus the **louder** the sound will be. The **loudness** of sound is measured in units called **decibels (dB)**.

Decibels of Sound

a whisper		10
normal voice		60
train horn		100
jet plane		120
rock concert		140



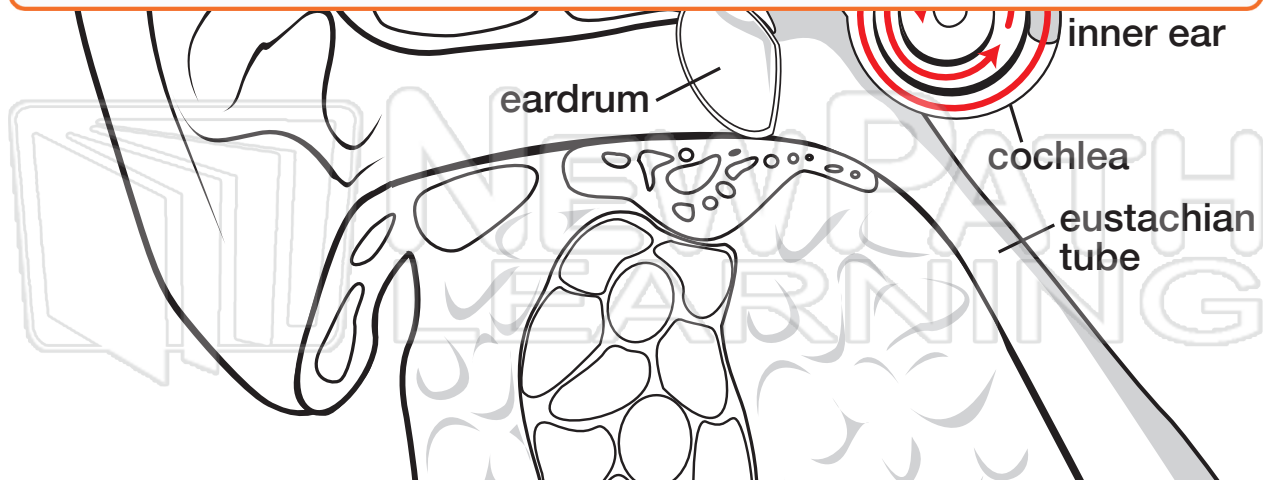
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Sound

Name _____ Class _____ Date _____

Use the charts to answer the questions. Fill in the blanks below.

Sound travels at different **speeds** through different matter. In general, the denser the matter, the faster sound travels through it.

The **loudness** of a sound depends upon the **amplitude** (height of a sound wave) of the vibrations that cause it. The **loudness** of sound is measured in units called **decibels** (dB).

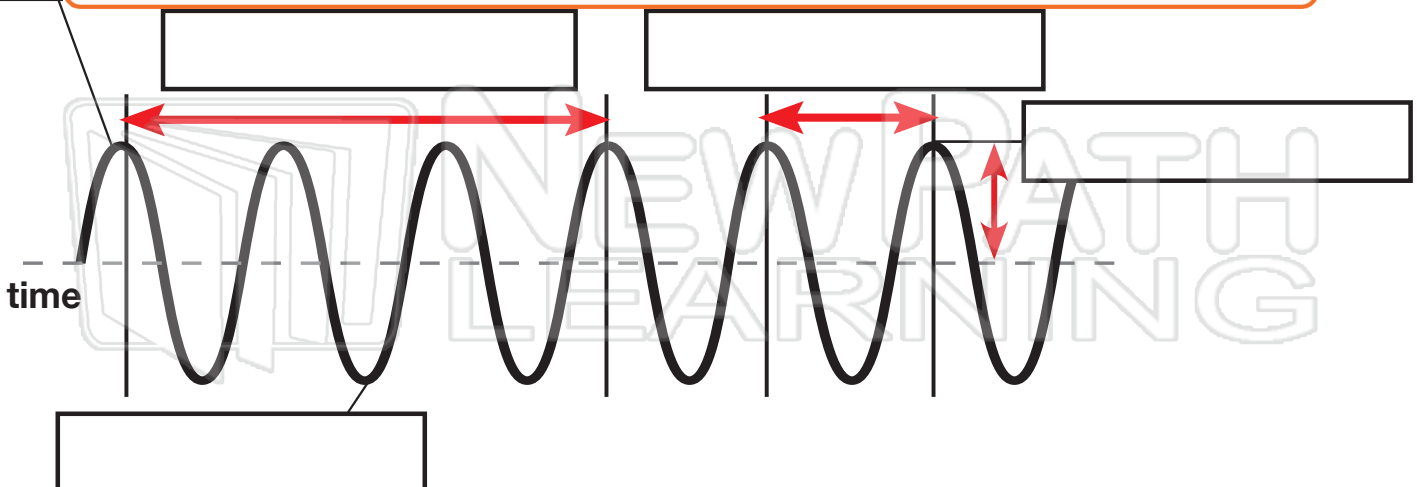
Speed of Sound	
Medium	Speed (m/s)
air (0°C)	331
air (20°C)	343

Decibels of Sound		
a whisper		10
normal voice		60
train horn		100



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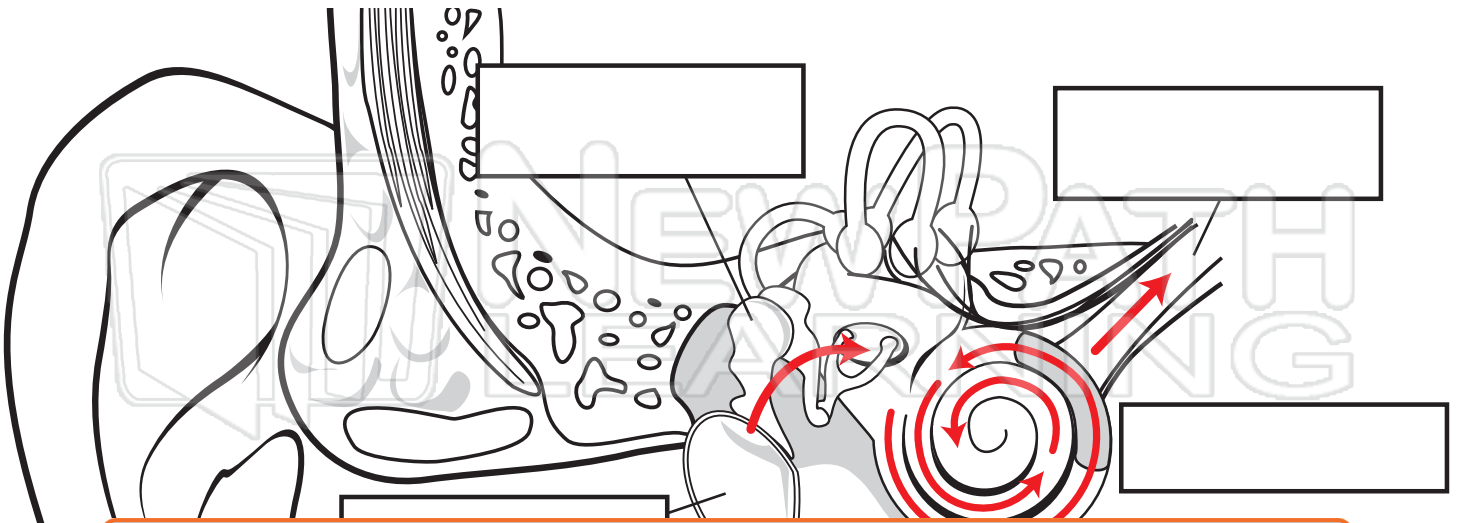




Sound

Name _____ Class _____ Date _____

Label parts of the ear.



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Brief





Sound

Answer Key

Use the charts to answer the questions. Fill in the blanks below.

Sound travels at different **speeds** through different matter. In general, the denser the matter, the faster sound travels through it.

The **loudness** of a sound depends upon the **amplitude** (height of a sound wave) of the vibrations that cause it. The **loudness** of sound is measured in units called **decibels** (dB).

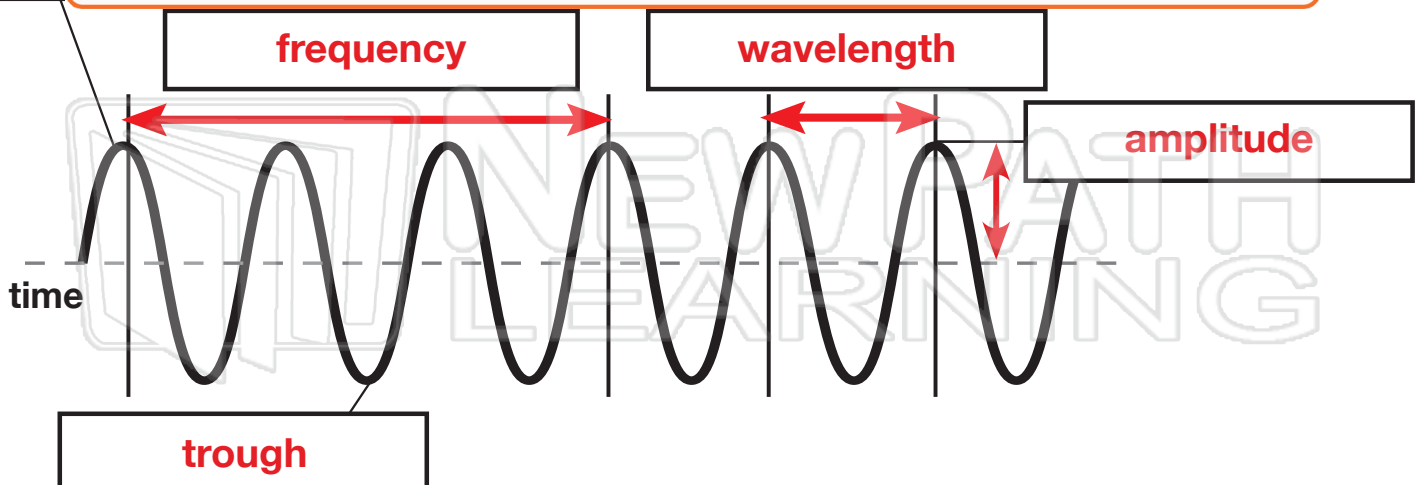
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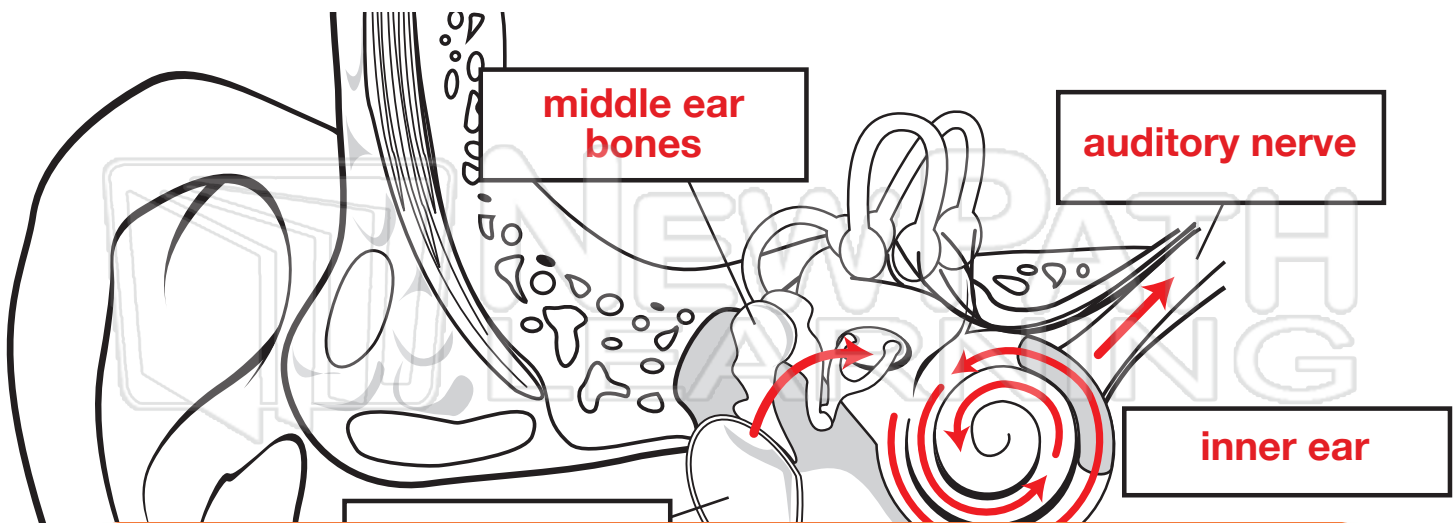




Sound

Answer Key

Label parts of the ear.



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small bones in the middle ear carry these vibrations to the cochlea.

The cochlea contains tiny hairs, which vibrate and send messages to the brain that are interpreted as sound. The auditory nerve carries messages from the cochlea to the brain.

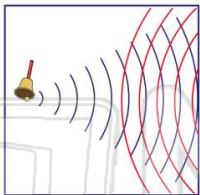


Name _____ Class _____ Date _____

1

When sound waves that are traveling from **opposite directions** meet, this is called _____.

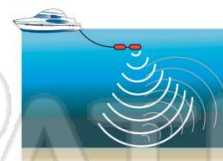
- A amplitude
- B loudness
- C interference
- D combination



2

In the diagram below, a ship is directing **ultrasound waves** off the **ocean floor**. This ship is using _____.

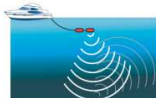
- A radar
- B GPS
- C loud sound
- D sonar



3

In the diagram below, a ship is using **sonar** to examine the ocean floor underneath it. The sonar waves **hit the ocean floor**, then are _____.

- A diffracted equally in all directions



4

The **loudness** of a **sound** depends upon which of the following?

- A the pitch of the sound and the distance from the sound
- B the temperature of the air and the distance from the sound
- C the humidity in the air and the distance



5



PREVIEW

7

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9

This picture shows a medical **machine** that uses sound waves to make **images** of what is **inside a patient's body**. This procedure is called a(n) _____ examination.

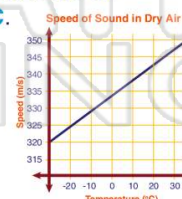
- A ultrasound
- B infrared
- C microscopic
- D telescopic



10

Using the graph below, determine **how fast** sound travels when the air temperature is **20°C**.

- A 340 m/s
- B 343 m/s
- C 350 m/s
- D 355 m/s



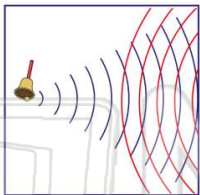


Name _____ Class _____ Date _____

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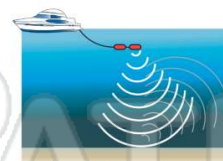


C

2

In the diagram below, a ship is directing **ultrasound waves** off the **ocean floor**. This ship is using _____.

- A radar
- B GPS
- C loud sound
- D sonar



D

3

In the diagram below, a ship is using **sonar** to examine the ocean floor underneath it. The sonar waves **hit the ocean floor**, then are _____.

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B

4

The **loudness** of a **sound** depends upon which of the following?

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D

5



C

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7

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C

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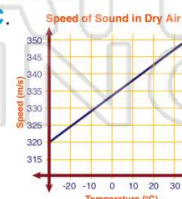


A

10

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- B 343 m/s
- C 350 m/s
- D 355 m/s



B

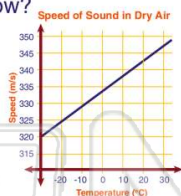


Name _____ Class _____ Date _____

1

What correct **conclusion** can be made based on the **graph** below?

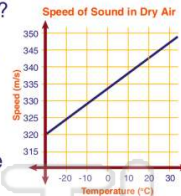
- A sound travels faster in dry air
- B sound travels faster in cold air
- C sound travels faster in moist air
- D sound travels faster in warm air



2

What is **one possible reason** for the data shown in the graph below?

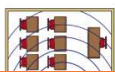
- A warm air is less dense than cold air
- B cold air is less dense than warm air
- C warm and cold air have the same densities
- D it is always windier when the air is warm



3

The diagram below shows sound waves **entering** a **classroom**. In order for the sound waves to **spread out** in this manner, sound waves have to _____.

- A diffract
- B reflect



4

Using the chart below, determine through which of these **substances** sound travels the **fastest**.

- A lead
- B fresh water
- C salt water

Speed of Sound		
medium		speed
gases	air (0° C)	331
	air (20° C)	343
liquids (30° C)	fresh water	1,509
	salt water	1,546

5



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- C sound waves move faster
- D frequencies have gone up



- C sound is not loud enough
- D sound requires moisture

9

In the picture below, a fire truck with its **siren** on is **moving** to a fire. Why does the siren **sound different** at **point A** than at **point B**?

- A the effect of gravity
- B the Doppler effect
- C temperatures are different
- D humidity levels are different



10

The **Doppler effect** causes a siren sound from a fire truck to sound different at points A and B. The siren always **sounds the same** for the firefighters **on the truck** because they are **moving faster** than the source of the sound.

True or false?

- A true
- B false



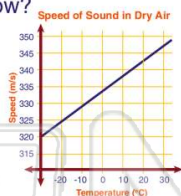


Name _____ Class _____ Date _____

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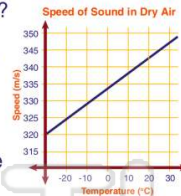


D

2

What is **one possible reason** for the data shown in the graph below?

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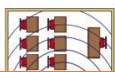


A

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A

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liquids (30° C)	fresh water	1,509
	salt water	1,546

C

5



C

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A

- C sound waves move faster
- D frequencies have gone up



- C sound is not loud enough
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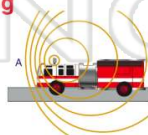
B

10

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True or false?

- A true
- B false



B



Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Resonance

Doppler effect

Sonar

Pitch

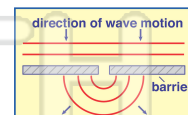
Loudness

Interference

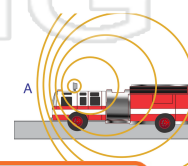
Diffraction

Elasticity

1. _____ - the ability for sound to spread out and go around obstacles in its path



2. _____ - the change in the frequency of sound as its source moves in relationship to a listener



3. _____
bounc



4. _____
either
waves

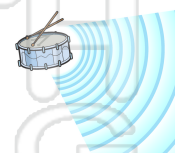
5. _____
waves

6. _____

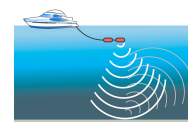
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7. _____ - the vibration that occurs in objects near or attached to the source of sound



8. _____ - a device used by ships in which sound is sent below the surface to create a picture of what is below the ship





Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Resonance

Doppler effect

Sonar

Pitch

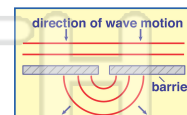
Loudness

Interference

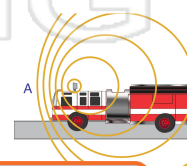
Diffraction

Elasticity

1. diffraction - the ability for sound to spread out and go around obstacles in its path



2. Doppler effect - the change in the frequency of sound as its source moves in relationship to a listener



3. elasticity - the ability of a material to return to its original shape after being deformed

4. interference - the combination of two or more waves to form a new wave

5. loudness - the amount of energy in a sound wave

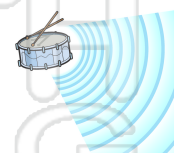
6. pitch - the frequency of a sound wave



PREVIEW

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7. resonance - the vibration that occurs in objects near or attached to the source of sound



8. sonar - a device used by ships in which sound is sent below the surface to create a picture of what is below the ship

