Edgenuity

Warm-Up | Sound Waves

Lesson Question

How are sound waves different from other waves?

Lesson Goals

Differentiate sound waves from other types of waves.

Analyze the production and transmission of sound waves.

Describe the properties of sound waves.

Examine how the Doppler effect applies to sound waves.

Words to Know

Write the letter of the definition next to the matching word as you work through the lesson. You may use the glossary to help you.

C pitch

A dissipate

D wave speed

B Doppler effect

A. to cause something to spread out and disappear

B. the change in frequency of a wave due to the motion of the source and/or receiver

C. a measure of how high or how low a sound is perceived, determined by the frequency of the sound wave

D. the distance traveled by a sound wave per unit of time

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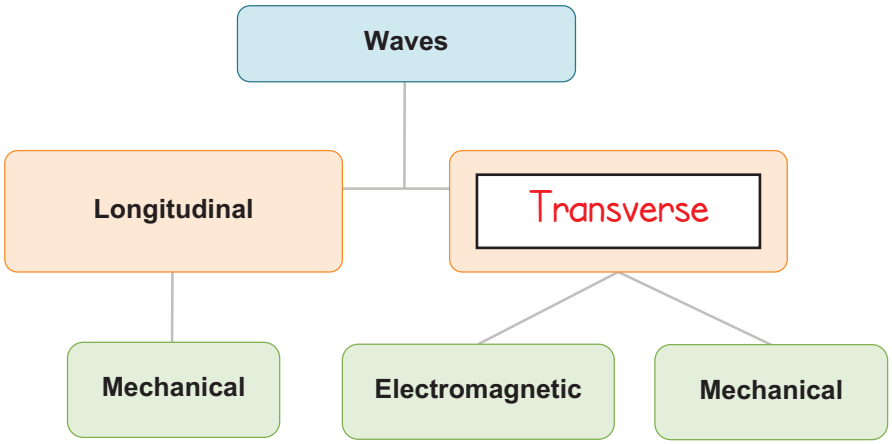
Types of Waves

A wave is a disturbance that carries energy from one place to another through matter and space.



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Sound Waves

Sound waves are longitudinal waves.

- Produced by the compression and expansion of an elastic medium like air or water
- Require a medium to transfer energy

Production of Sound Waves

- A sound wave starts when something is caused to vibrate.
  - A bell vibrates when struck.
  - A guitar string vibrates when strummed.
- Energy from a vibrating object is transferred through the movement of particles within the medium, creating a mechanical wave.
- When the vibration in the medium strikes your ear, you hear the sound.

Transmission of Sound Waves

- After a sound is produced, it travels to the ear through a medium.
  - Can travel through solids, liquids, and gases
- Sound waves eventually dissipate.
  - Each time the particles of the medium interact, part of the energy of the wave is lost.
  - The energy carried by the wave cannot be distinguished from other background movements of the medium.

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Wavelength of Sound Waves

- The wavelength is the distance between any two [equivalent] points.
- In a sound wave, wavelength can be measured between compressions or rarefactions.

Frequency of Sound Waves

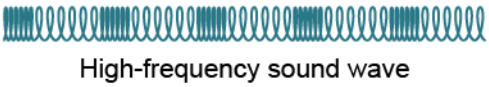
- The frequency of a wave is the number of [oscillations] per second.

$$\text{frequency} = \frac{\text{[cycles]}}{\text{time}}$$

Hz

Low-frequency sound wave

3 Hz

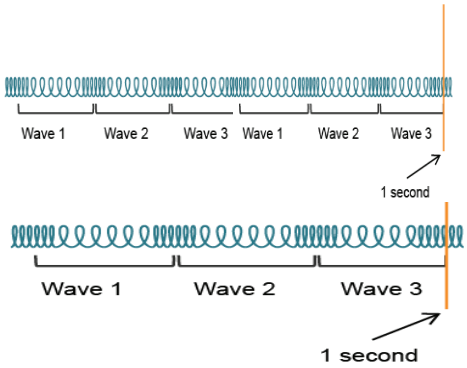


High-frequency sound wave

5 Hz

Wavelength, Frequency, and Pitch

- Frequency and wavelength determine the [pitch] of a sound.
- Frequency is [directly] proportional to pitch.
  - Higher frequency = higher pitch
  - Lower frequency = lower pitch
- Frequency is inversely related to [wavelength]
  - Longer wavelength = lower pitch
  - Shorter wavelength = higher pitch



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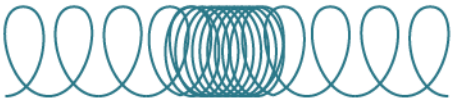
Amplitude and Loudness

- Amplitude is the density of the medium's particles at the compressions of the wave.
- Amplitude determines loudness.
  - High-amplitude waves create louder sounds.
  - Low-amplitude waves create softer sounds.



High-amplitude wave

Low-amplitude wave

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Wave Speed

- Wave speed measures how fast the sound wave is traveling through a medium.

$$v = \frac{d}{t}$$

$$v = f\lambda$$

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Type of Medium

- The speed of a sound wave is [affected] by the type of medium through which it travels.
  - Fastest in [solids]; slowest in gases
    - The particles of solids are close together, so the chance of energy transfer is [higher].
    - The particles in gases are far apart, so the chance of energy transfer is lower than in liquids or solids.

Medium at 21°C	Speed of Sound (m/s)
Solid steel	5180
Ocean water	1524
Air	344

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Temperature of Medium

- As the temperature of the medium [increases], the speed of the sound wave increases.
  - As temperature increases, the particles of the medium move faster.
  - The faster the particles move, the [greater] the chance that the particles will bump into each other.
  - The more the [particles] bump into each other, the more energy is transferred.

Temperature of Air (°C)	Speed of Sound (m/s)
20	343.6
5	334.5
–10	325.3

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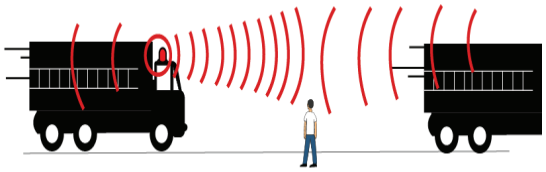
The Doppler Effect

- The Doppler effect is the change in [frequency] of a wave due to the motion of the [source] and/or receiver.
  - As the fire truck moves [toward] the observer, the sound waves arrive at a higher frequency (higher pitch).
  - As the fire truck moves away from the observer, the sound waves arrive at a [lower] frequency (lower pitch).



Summary | Sound Waves

Lesson Question

How are sound waves different from other waves?

Answer

(Sample answer) Sound waves are longitudinal, mechanical waves that require a medium through which to pass. As a result, their speed is dependent on the composition and temperature of the medium. While sound waves do experience the Doppler effect, it changes the pitch of the sound as opposed to the color of light waves.

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Review: Key concepts

- Sound waves are [longitudinal] waves that are produced by the compression and expansion of an elastic medium.
  - A sound wave starts when something is caused to vibrate.
  - Energy from the vibrating object is transferred through the [movement] of particles within the medium, creating a mechanical wave.
  - When the vibration in the medium strikes your ear, you hear the sound.
- Important properties of sound waves:
  - Wavelength
  - Frequency
  - [Amplitude]
- Factors affecting the speed of sound waves:
  - Type of medium
  - [Temperature] of medium

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- The Doppler effect is the change in frequency of a wave due to the motion of the source and/or receiver.
  - As an object producing sound waves moves toward the observer, the sound waves arrive at a higher frequency (higher pitch).
  - As an object producing sound waves moves away from the observer, the sound waves arrive at a lower frequency (lower pitch).

Use this space to write any questions or thoughts about this lesson.