

\* READ & ANNOTATE

# Properties of Sound

## Guide for Reading

- What factors affect the loudness of a sound?
- What does the pitch of a sound depend on?
- What causes the Doppler effect?

ANSWER Q'S ON LEFT  
 SIDE OF IAN  
 - COMPLETE SENTENCES

**Loudness** describes your perception of the energy of a sound. In other words, loudness describes what you hear. **The loudness of a sound depends on two factors: the amount of energy it takes to make the sound and the distance from the source of the sound.** In general, the greater the energy used to make a sound, the louder the sound. Recall that the greater the amplitude of a wave, the more energy the wave has. Therefore, the larger the amplitude of a sound wave, the louder the sound. As a sound wave travels away from its source, it spreads out and covers more area. However, the total energy of the sound wave stays the same. As a result, the farther a sound wave is from its source, the less energy it has over a given area. The amount of energy a sound wave carries per second through a unit area is its **intensity**. The loudness of different sounds is compared using a unit called the **decibel (dB)**. The higher the decibel rating, the louder the sound.

The **pitch** of a sound is a description of how high or low the sound seems to a person. **The pitch of a sound that you hear depends on the frequency of the sound wave.** The frequency of a sound wave is the number of vibrations that occur per second. Sound waves of high frequency have a high pitch. Sound waves of low frequency have a low pitch. Most people can hear sounds with frequencies between 20 Hz and 20,000 Hz. Sound waves with frequencies above the normal human range of hearing are called **ultrasound**. Sounds with frequencies below the normal human range of hearing are called **infrasound**.

Pitch is an important property of music. Music usually uses specific pitches called notes. When you sing, you change pitch using your vocal cords. Your vocal cords are located in your voice box, or **larynx**. In speaking or singing, air from your lungs rushes past your vocal cords, making them vibrate. This produces sound waves. By stretching or relaxing your vocal cords, you can produce sounds of different pitches.

Even though a sound source may produce waves that have a constant frequency, the pitch of the sound may vary for a listener. As a police car with its siren on moves toward you, the pitch of the siren becomes higher. As the car goes by and moves away, the pitch becomes lower. But the frequency of the siren is not really changing. The change in frequency of a wave as its source moves in relation to the observer is called the **Doppler effect**. **When a sound source moves, the frequency of the waves changes because the motion of the source adds to the motion of the waves.** As a sound approaches and passes the speed of sound, the sound waves pile up until they overlap. This produces a shock wave that releases a huge amount of energy. People nearby hear a loud noise called a sonic boom when the shock wave passes by them.



Guided Reading and Study

The Nature of Sound (continued)

Interactions of Sound Waves

4. Fill in the blanks in the table below.

Sound Wave Interactions

Type of Interaction	Description
a.	Sound waves bounce back from surfaces.
Diffraction	b.
c.	Sound waves meet and interact with each other.

5. A reflected sound wave is called a(n) \_\_\_\_\_.

The Speed of Sound

6. The speed of a sound wave depends on these three properties of the medium.

\_\_\_\_\_

7. Use the table in Figure 1 to answer the following question. Through which medium does sound travel faster, air or water?

\_\_\_\_\_

8. The ability of a material to bounce back after being disturbed is called \_\_\_\_\_.

**EXPLAIN**

9. Is the following sentence true or false? The more elastic a medium, the slower sound travels in it. \_\_\_\_\_

10. The amount of matter there is in a given amount of space is called \_\_\_\_\_.

**EXPLAIN**

11. Is the following sentence true or false? In materials in the same state of matter, sound travels more slowly in denser mediums. \_\_\_\_\_

12. Does sound travel more slowly through a given medium with a low temperature or high temperature?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

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5. In what units is loudness measured?

\_\_\_\_\_

6. Why are loud sounds dangerous?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Pitch**

7. What is the pitch of a sound?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

8. What does the pitch of a sound depend on?

\_\_\_\_\_  
\_\_\_\_\_

9. Sound waves with frequencies above the normal human range of hearing are called \_\_\_\_\_.

10. Sound waves with frequencies below the normal human range of hearing are called \_\_\_\_\_.

11. Circle the letter of each sentence that is true about how a person changes the pitch of sounds when singing.

- a. A person relaxes the vocal cords to produce lower-frequency sound waves.
- b. A person stretches the vocal cords to produce lower-frequency sound waves.
- c. A person stretches the vocal cords to produce higher-frequency sound waves.
- d. A person relaxes the vocal cords to produce higher-frequency sound waves.



**The Doppler Effect**

12. What is the Doppler effect?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

13. The change in frequency of sound waves in the Doppler effect is heard as a change in \_\_\_\_\_.