

Name: _____

Properties of Sound



- What Affects Pitch?
- What Affects Loudness?
- What Causes the Doppler Effect?

my planet DiARY

To get a dog's attention, a dog trainer blows into a small whistle. But you don't hear a thing. Dogs can hear frequencies well above the human range of hearing. Frequency is measured in hertz (Hz), or the number of sound waves a vibrating object gives off per second. A higher frequency means that the sound has a higher pitch. The table compares the range of frequencies that humans and various animals can hear.

SCIENCE STATS

Animal	Range of Hearing (in Hertz)
Human	20–20,000
Dog	67–45,000
Mouse	1,000–91,000
Cat	45–64,000
Bullfrog	100–2,500
Elephant	16–12,000

Use the data in the table to answer the following question.
Which animal can hear the widest range of frequencies?

PLANET DIARY Go to Planet Diary to learn more about the properties of sound.

Lab zone

Do the Inquiry Warm-Up
How Does Amplitude Affect Loudness?

What Affects Pitch?

Pitch is an important property of sound that you may already know about. Have you ever described someone's voice as "high-pitched" or "low-pitched"? The **pitch** of a sound is a description of how high or low the sound seems to a person. **The pitch of a sound you hear depends on the frequency of the sound wave.** Sound waves with a high frequency have a high pitch. Sound waves with a low frequency have a low pitch.

Vocabulary

- pitch • loudness • intensity • decibel
- Doppler effect

Skills

- 🔄 Reading: Compare and Contrast
- 🔺 Inquiry: Make Models

The frequency of a sound wave depends on how fast the source of the sound is vibrating. For example, when you speak or sing, air from your lungs rushes past your vocal cords, making them vibrate. This produces sound waves. To sing specific pitches, or notes, you use muscles in your throat to stretch or relax your vocal cords. When your vocal cords stretch, they vibrate more quickly as the air rushes by them. This creates higher-frequency sound waves that have higher pitches. When your vocal cords relax, lower-frequency sound waves with lower pitches are produced.

Frequency is measured in hertz (Hz). For example, a frequency of 50 Hz means 50 vibrations per second. A trained soprano voice can produce frequencies higher than 1,000 Hz. A bass singer can produce frequencies lower than 80 Hz. Young people can normally hear sounds with frequencies between 20 Hz and 20,000 Hz.

FIGURE 1

Pitch

The female soprano singer sings high notes and the male bass singer sings low notes.

🔺 **Make Models** In the bubble above the bass singer, draw lines to represent the frequency of the sound wave for a low note. Then explain your drawing.



Lab zone Do the Lab Investigation Changing Pitch.


Assess Your Understanding

got it?

- I get it! Now I know the pitch of a sound that you hear depends on _____
- I need extra help with _____

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What Affects Loudness?

Loudness is another important property of sound. You probably already know about loudness. For example, the closer you are to a sound, the louder it is. Also, a whisper in your ear can be just as loud as a shout from a block away. Loudness describes your awareness of the energy of a sound.  **The loudness of a sound depends on the energy and intensity of the sound wave.**


Energy If you hit a drum lightly, you hear a sound. If you hit the drum harder, you hear a louder sound. Why? When you hit a drum harder, you transfer more energy to it. This causes the amplitude, or the distance the drumhead moves from its rest position, to increase. A sound source vibrating with a large amplitude produces a sound wave with a large amplitude. Recall that the greater the amplitude of a wave, the more energy it has. So the more energy a sound wave has, the louder it sounds.

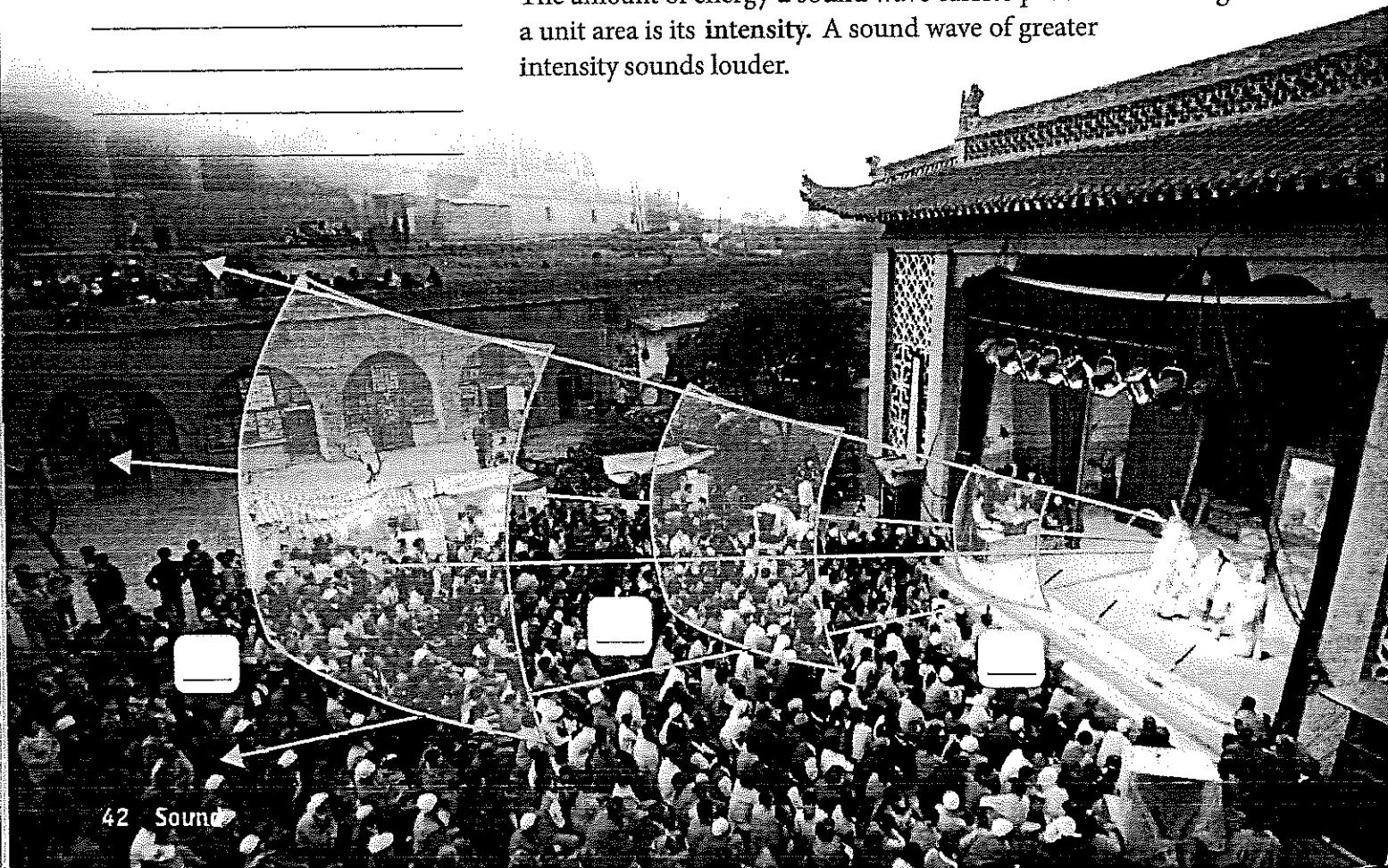
Intensity If you were to move closer to the stage shown in Figure 2, the voices of the performers would sound louder. Why? Close to the sound source, a sound wave covers a small area. As a wave travels away from the source, it covers more area. The total energy of the wave, however, stays the same. Therefore, the closer a sound wave is to its source, the more energy it has in a given area. The amount of energy a sound wave carries per second through a unit area is its **intensity**. A sound wave of greater intensity sounds louder.

FIGURE 2

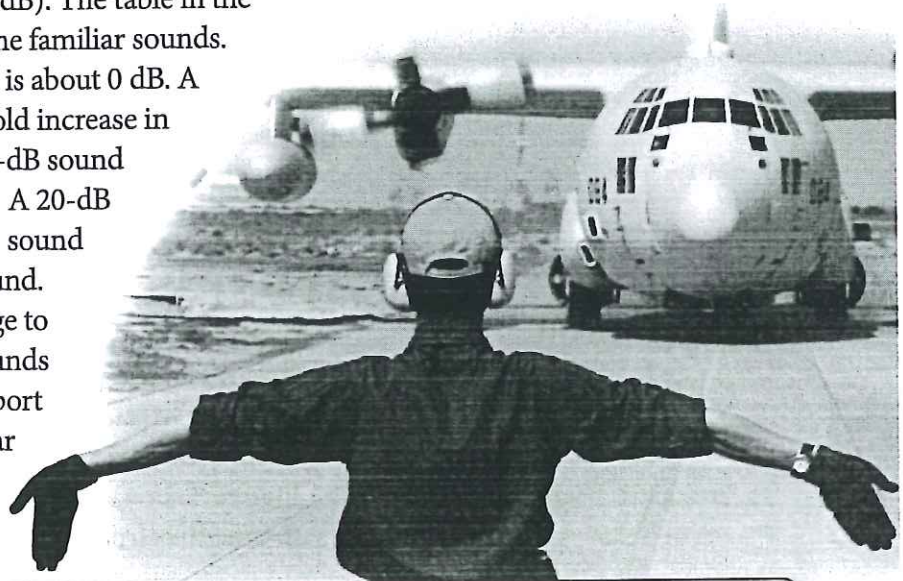
Intensity

Sound waves spread out as they travel away from the source.

 **Interpret Diagrams** Rank the intensity of a sound wave at the three locations. A ranking of 1 is the greatest. Write your answers in the boxes. Explain your answers.



Measuring Loudness The loudness of different sounds is compared using a unit called the **decibel (dB)**. The table in the Apply It below compares the loudness of some familiar sounds. The loudness of a sound you can barely hear is about 0 dB. A 10-dB increase in loudness represents a tenfold increase in the intensity of the sound. For example, a 10-dB sound is ten times more intense than a 0-dB sound. A 20-dB sound is 100 times more intense than a 0-dB sound and ten times more intense than a 10-dB sound. Sounds louder than 100 dB can cause damage to your ears, especially if you listen to those sounds for long periods of time. For this reason, airport workers, like the one shown to the right, wear hearing protection.



apply it!

Use the table to answer the questions.

- 1 Which sounds louder, a rock concert or a jet plane at takeoff?

- 2 Which sounds could be dangerous to your ears?

- 3 Calculate How much more intense is a 20-dB whisper than the threshold of human hearing?

- 4 **CHALLENGE** How much more intense is a 90-dB hair dryer than 60-dB street traffic?

Measuring Loudness

Sound	Loudness (dB)
Threshold of human hearing	0
Whisper	15–20
Normal conversation	40–50
Busy street traffic	60–70
Hairdryer	80–90
Rock concert	110–120
Headphones at peak volume	120
Jet plane at takeoff	120–160

Assess Your Understanding

- a. **Review** The amount of energy a sound wave carries per second through a unit area is its _____
- b. **Describe** The intensity of a sound wave (increases/decreases) with distance.
- c. **Calculate** An 80-dB sound is _____ times more intense than a 60-dB sound.



Do the Quick Lab Listen to This.

got it?

- I get it! Now I know that the loudness of a sound depends on _____
- _____
- I need extra help with _____

Go to **MY SCIENCE COACH** online for help with this subject.