

Study Guide

Interactive
Textbook

- Complete student edition
- Section and chapter self-assessments
- Assessment reports for teachers

Help Students Read

Building Vocabulary

Word/Part Analysis Tell students that the word part *son-* means “sound.” Words containing *son-* include *sonar*, *sonic*, *dissonance*, *resonance*, and *sonogram*. All of the words have something to do with sound. Challenge students to find and read the definition for each word and explain how each word is related to sound.

Word Origins Inform students that the term *acoustic* was coined in 1605. Based on the Greek word *akoustikos*, which means “of hearing,” *acoustic* means “of, or relating to, hearing or sound.” In 1683, the plural form of the word, *acoustics*, started being used to mean “the science of sound.” Although the word *acoustics* is plural, it can be used as a singular noun. Ask: **Is it correct to say “Acoustics is a science” or “Acoustics are a science.”?** (*Acoustics is a science.*)

Connecting Concepts

Concept Maps Help students develop one way to show how the information in this chapter is related. Sound travels as longitudinal waves that your ears and brain convert to a form you can hear. Sound waves combine to produce music, and reflected sound waves are used to locate objects and structures. Have students brainstorm to identify the key concepts, key terms, details, and examples, then write each one on a self-sticking note and attach it at random on chart paper or on the board.

Tell students that this concept map will be organized in a hierarchical order and to begin at the top with the key concepts. Ask students these questions to guide them to categorize the information on the self-sticking notes: **What are the properties of sound waves? What is music? How do you hear sound? How can sound waves be used?**

1 The Nature of Sound

Key Concepts

- Sound is a disturbance that travels through a medium as a longitudinal wave.
- Sound waves reflect off objects, diffract through narrow openings and around barriers, and interfere with each other.
- The speed of sound depends on the elasticity, density, and temperature of the medium the sound travels through.

Key Terms

echo
elasticity
density

2 Properties of Sound

Key Concepts

- 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.
- The pitch of a sound that you hear depends on the frequency of the sound wave.
- When a sound source moves, the frequency of the waves changes because the motion of the source adds to the motion of the waves.

Key Terms

loudness
intensity
decibel (dB)
pitch
ultrasound
infrasound
larynx
Doppler effect



Prompt students by using connecting words or phrases, such as “is produced by,” “has properties of,” “includes,” and “can be used for,” to indicate the basis for the organization of the map. The phrases should form a sentence between or among a set of concepts.

3 Music

Key Concepts

- Sound quality results from the blending of a fundamental tone with its overtones. Resonance also plays a role in sound quality.
- There are three basic groups of musical instruments: stringed instruments, wind instruments, and percussion instruments.
- Acoustics is used in the design of concert halls to control reverberation and interference.

Key Terms

music
fundamental tone
overtone
acoustics
reverberation

4 How You Hear Sound

Key Concepts

- The outer ear funnels sound waves, the middle ear transmits the waves inward, and the inner ear converts sound waves into a form that travels to your brain.
- There are many causes of hearing loss, including injury, infection, exposure to loud sounds, and aging.

Key Terms

ear canal
eardrum
cochlea

5 Using Sound

Key Concepts

- Some animals, including bats and dolphins, use echolocation to navigate and to find food.
- Ultrasound technologies such as sonar and ultrasound imaging are used to observe things that cannot be seen directly.

Key Terms

echolocation
sonar
sonogram

Answer

Accept logical presentations by students.

All in One Teaching Resources

- [Key Terms Review: Sound](#)
- [Connecting Concepts: Sound](#)

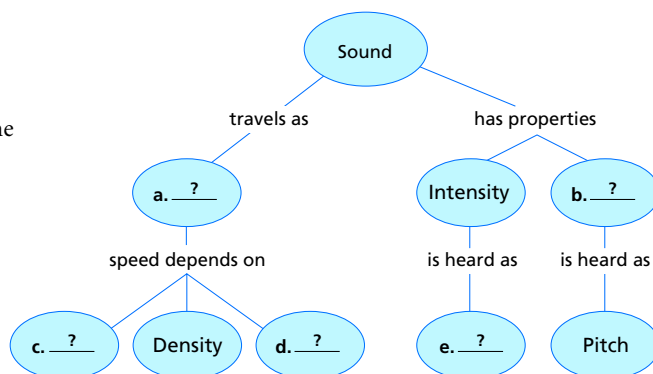
Review and Assessment

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Organizing Information

Concept Mapping Copy the concept map about sound onto a separate sheet of paper. Then complete it and add a title. (For more on Concept Mapping, see the Skills Handbook.)



Reviewing Key Terms

Choose the letter of the best answer.

- The ability of a medium to bounce back after being disturbed is called
 - echolocation.
 - elasticity.
 - density.
 - interference.
- Which property of sound describes your perception of the energy of a sound?
 - loudness
 - intensity
 - pitch
 - wave speed
- The lowest natural frequency of a sound is
 - a standing wave.
 - an overtone.
 - an echo.
 - the fundamental tone.
- In the ear, a fluid-filled cavity that is shaped like a snail shell is the
 - ear canal.
 - eardrum.
 - cochlea.
 - larynx.
- A system of using reflected sound waves to detect and locate objects underwater is called
 - sonar.
 - acoustics.
 - echolocation.
 - reverberation.

If the statement is true, write *true*. If it is false, change the underlined word or words to make the statement true.

- Intensity is mass per unit volume.
- Loudness is how the ear perceives frequency.
- Music is a set of notes that are pleasing.
- The ear canal is a small, drumlike membrane.
- A sonogram is a picture made using reflected ultrasound waves.

Writing in Science

Firsthand Account Imagine that you are a dolphin researcher. Write a letter to a friend describing your latest research. Be sure to include information about how dolphins use their sonar.



Review and Assessment

Concept Map

Sample title: Sound

- Longitudinal waves
- Frequency
- Elasticity
- Temperature
- Loudness

Reviewing Key Terms

- b
- a
- d
- c
- a
- Density
- Pitch
- true
- eardrum
- true

Writing in Science

Writing Mode Description

Scoring Rubric

- Exceeds criteria; includes a vivid firsthand account that accurately describes how a dolphin uses echolocation to navigate and find food
- Meets criteria
- Description is brief and/or includes some errors
- Description is incomplete and/or contains serious errors



Discovery
CHANNEL
SCHOOL
Video
Assessment

Sound

Show the Video Assessment to review chapter content and as a prompt for the writing assignment. Discussion questions: **What are some similarities between the echolocation systems used by dolphins and bats?** (Both use echolocation to navigate and find food, and both are very precise.) **In what ways might humans benefit from research into animal echolocation?** (Scientists might be able to improve how ultrasound is used to help humans navigate the seas, diagnose medical conditions, and even help blind people navigate around objects.)

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- [Performance Assessment Student Worksheet](#)
- [Performance Assessment Scoring Rubric](#)



ExamView® Computer Test
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Review and Assessment

Checking Concepts

11. Sound is a wave. The vibrating air particles next to the gong transmit energy to particles farther away. This process continues to carry the energy of the sound wave to your ear but does not transfer the particles themselves to your ear.

12. Loudness of a sound depends on both intensity and distance. A whisper has low intensity, but if the distance is small enough it may be louder than a more intense sound source that is farther away.

13. Because sound waves diffract, or bend, around corners

14. Because of the Doppler effect, the pitch of the horn will be higher when the car approaches you and lower after the car has passed by.

15. The two instruments have different sound qualities. For the same note, they have the same fundamental tone but different overtones. The difference in overtones causes the difference in sound quality.

16. Reverberation allows you to continue to hear a sound after the sound source stops. Reverberation is caused by sound waves reflecting back and forth.

17. Loud noises can damage hair cells in the cochlea. This causes hearing loss because the damaged hair cells can no longer send messages to the brain.

18. Ultrasound is used in medicine to diagnose and treat many medical conditions and to examine developing babies for problems before they are born.

Thinking Critically

19. Both waves are longitudinal waves, but sound waves can be heard, whereas waves in the spring toy can be seen.

20. You see the lightning first because light travels much faster than sound.

21. Because sound moves more slowly in rubber, rubber would reduce the transmission of sound waves most effectively.

22. A guitar and harp are stringed instruments, a tuba and clarinet are wind instruments, and a bell and drum are percussion instruments.

Checking Concepts

- When a gong vibrates, the air particles next to the gong do not reach your ears, yet you hear the sound of the gong. Explain.
- Explain when a whisper would sound louder than a shout.
- Why do you hear friends talking in the hallway even though you cannot see them around a corner?
- As a car drives past you, the driver keeps a hand pressing on the horn. Describe what you hear as the car approaches and after it has passed by.
- The same note is played on a flute and a cello. Why is there a difference in the sound?
- How can a sound continue to be heard after a sound source stops making the sound?
- How can loud noises damage your hearing?
- How are ultrasound waves used in medicine?

Thinking Critically

- Comparing and Contrasting** How do sound waves behave like waves in a spring toy? How are they different?
- Inferring** Thunder and lightning happen at the same time. Explain why you see the lightning before you hear the thunder.
- Predicting** Look at the data table below. Which substance would you select to reduce the transmission of sound waves? Explain your answer.

Substance	Speed (m/s)
Rubber	60
Plastic	1,800
Gold	3,240
Brick	3,650
Steel	5,200

- Classifying** Classify the following instruments into three groups: a guitar, a tuba, a bell, a clarinet, a drum, and a harp.

Applying Skills

Use the data in the table below to answer Questions 23–25.

The table shows the range of frequencies produced and heard by various animals.

Animal	Highest Frequency Heard (Hz)	Highest Frequency Produced (Hz)
Human	20,000	1,100
Dog	50,000	1,800
Cat	65,000	1,500
Bat	120,000	120,000
Porpoise	150,000	120,000

- Interpreting Data** Can you hear the ultrasound waves that a bat uses for echolocation? Why or why not?
- Graphing** Draw a bar graph to compare the highest frequencies heard and the highest frequencies produced by the animals.
- Calculating** If the speed of sound in air is 343 m/s, what is the shortest wavelength of sound that humans can hear? (*Hint:* Wavelength = Speed ÷ Frequency)

Lab zone Chapter Project

Performance Assessment Present your musical instrument to your class. Explain how it was built and how you solved any design problems. Then demonstrate how you can change the pitch or loudness of your instrument. Brainstorm with the class methods for improving the design of the instrument. How is your instrument similar to or different from instruments your classmates built?

Lab zone Chapter Project

L3

Performance Assessment Give students a chance to demonstrate their instruments and explain the design process, including how their instruments were built and any modifications they made. Have students demonstrate how they can vary loudness and change pitch. Ask them to play a simple tune. Encourage students to reflect on the development process they went

through to produce their instruments. Have them identify problem areas and anything they might have done differently to improve their projects.

Standardized Test Prep

Test-Taking Tip

Interpreting Graphs

If you are asked to interpret a bar graph, look at the labels of the horizontal and vertical axes. The labels tell you what variables are being compared. A bar graph is used to show data in several categories that are not related. The graph on this page compares the loudness of four common sounds. In this graph, the sounds that are being compared are otherwise unrelated to each other. Study the graph and answer the sample question below.

Sample Question

Which sounds are likely to cause hearing damage?

- A noise from a classroom
- B noise from loud thunder or jet engines
- C noise from street traffic or thunder
- D none of the sounds shown on the graph

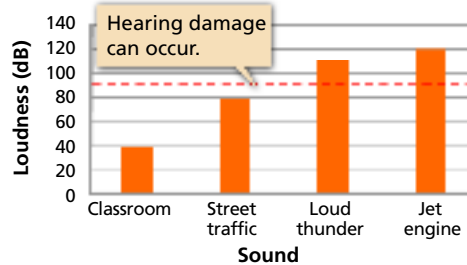
Answer

B is correct because both sounds are louder than 100 dB. You can eliminate A and C because they include a sound softer than 100 dB. D is incorrect because two sounds are louder than 100 dB.

Choose the letter of the best answer.

1. Bats and dolphins use echolocation to determine distances and find prey. What characteristic of sound waves is most important for echolocation?
 - A Sound waves reflect when they hit a surface.
 - B Sound waves spread out from a source.
 - C Sound waves diffract around a corner.
 - D Sound waves interfere when they overlap.
2. A scientist is doing research with 110-dB sound waves. What piece of safety equipment must she wear in the lab?
 - F goggles
 - G gloves
 - H lab apron
 - J hearing protectors

Comparing Loudness



3. Use the graph above to determine how much more intense the sound of a jet engine is than the sound of loud thunder.
 - A ten times more intense
 - B two times more intense
 - C four times more intense
 - D Both sounds are about the same intensity.
4. An experiment was conducted in which two containers held solids A and B at the same temperature. The speed of a sound wave traveling through solid A was greater than its speed through solid B. What can you conclude from this experiment?
 - F Solid A is denser than solid B.
 - G Solid A is less dense than solid B.
 - H Solid A is more elastic than solid B.
 - J Solid A is less dense than solid B or solid A is more elastic than solid B.
5. After a new concert hall is built, it is found that the acoustics are poor because of reverberation. How can the acoustics be improved?
 - A Add metal seats to the hall.
 - B Remove the drapes covering the windows.
 - C Cover the wooden floor with carpeting.
 - D Install a wooden backdrop behind the stage.

Constructed Response

6. You drop a book onto the floor in the bedroom of your apartment. Your neighbor downstairs hears the sound. Describe how the sound travels to your neighbor's ears. What mediums do the sound waves have to travel through?

Applying Skills

23. No, because ultrasound waves have frequencies higher than the human ear can detect
24. Graphs should have the names of the animals on the x -axis and the frequencies on the y -axis. There will be two bars for each animal, one for the highest frequency heard and one for the highest frequency produced. The two bars should be distinguished by shading or color, and there should be a key identifying what the bars represent.
25. The shortest wavelength heard by humans is 0.0172 m (1.72 cm). This is found by dividing the speed of sound (343 m/s) by the highest frequency heard by humans (20,000 Hz).

Standardized Test Prep

1. A
2. J
3. A
4. J
5. C
6. When you drop a book on the floor, the material that makes up the floor vibrates. The vibrations create sound waves that travel through the floor to your neighbor's ceiling in the apartment below. After the sound waves pass through the ceiling, they travel through the air to reach your neighbor's ears.