CHAPTER 12 Sound

Chapter Opener

__ Tapping Prior Knowledge, TE Review previously learned concepts and check for preconceptions about the chapter content.

__ Discovery Lab, Resonance and the Nature of Sound, ANC Students explore the phenomenon of resonance in pendulums and tuning forks and investigate the variables that affect the sound produced by an instrument. (BASIC)

__ Visual Concepts CD-ROM This CD-ROM consists of multimedia presentations of core physics concepts. (BASIC)

SECTION 1 Sound Waves

PACING

Regular Schedule: with lab(s): 2 days without lab(s): 1 days
Block Schedule: with lab(s): 1 days without lab(s): 0.5 days

OBJECTIVES

1. Explain how sound waves are produced.
2. Relate frequency to pitch.
3. Compare the speed of sound in various media.
4. Relate plane waves to spherical waves.
5. Recognize the Doppler effect, and determine the direction of a frequency shift when there is relative motion between a source and an observer.

NATIONAL SCIENCE EDUCATION STANDARDS

UCP 1: Systems, order, and organization
UCP 2: Evidence, models, and explanation
UCP 3: Change, consistency, and measurements
UCP 5: Form and function
SAI 1: Abilities to do scientific inquiry
SAI 2: Understanding about scientific inquiry
ST 1: Abilities of technological design
ST 2: Understanding about science and technology
HNS 1: Science as a human endeavor
HNS 3: History of science
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SPSP 2: Populations, resources, and environments

SPSP 5: Science and technology in society

PS6a: Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.

FOCUS (5 MINUTES)

Overview Review the objectives listed in the Student Edition. (GENERAL)

MOTIVATE (5 MINUTES)

Visual Strategy, Figure 1, TE Ask students how the position of the air molecules is related to the motion of the prongs over time. (GENERAL)

Demonstration, Sound Waves in a Solid, TE This demonstration uses a coat hanger and two strings to show students sound waves traveling through a solid. (BASIC)

TEACH (70 MINUTES)

PowerNotes® Resources Use the customizable presentation to help students master the concepts in this section. (GENERAL)

Transparency 54, Production of a Sound Wave This transparency illustrates how sound is produced by a tuning fork.

Transparency 55, Graph of a Sound Wave This transparency shows how a longitudinal wave produced by a vibrating object can be represented by a sine curve.

Transparency 56, Spherical Waves This transparency shows how spherical waves can be represented graphically in two dimensions with a series of circles surrounding the source.

Transparency 57, The Doppler Effect This transparency illustrates that relative motion exists between a moving car and a stationary listener.

Transparency Master 40A, Speed of Sound in Various Media This transparency master lists the speed of sound waves in various media.

Conceptual Challenge, p. 411, SE These conceptual questions challenge students to apply the section content to real-world applications. (GENERAL)

Demonstration, The Doppler Effect, TE This demonstration uses a battery-operated high-volume oscillator to show that the observed frequency of sound waves depends on the relative motion between the source and the observer. (GENERAL)

Appendix J: Advanced Topics, The Doppler Effect and the Big Bang, SE This feature allows students to explore higher-level concepts related to the chapter. (ADVANCED)

Skills Practice Lab, Speed of Sound, SE Students measure the speed of sound. (GENERAL)

Datasheet, Speed of Sound, ANC Students use the datasheet to complete the in-text lab. (GENERAL)
CLOSE (10 MINUTES)

__ Section Review, SE Students answer review questions, critical-thinking questions, and interpreting-graphics questions that assess their understanding of the section objectives. (GENERAL)

__ Study Guide, Sound Waves, ANC Use this worksheet to review the main concepts presented in the section. (GENERAL)

__ Section Quiz, ANC Use this quiz to assess students' understanding of the section. (BASIC)

OTHER RESOURCE OPTIONS

__ Holt Online Learning Students can access interactive problem-solving help and active visual concept development with the Holt Physics Online Edition available at my.hrw.com.

__ CBLTM Lab, Speed of Sound, SE This is a CBL version of the end-of-chapter Skills Practice Lab. (GENERAL)

__ CBLTM Experiment, Speed of Sound, ANC In this Skills Practice CBL lab, students measure the speed of sound. (GENERAL)

__ SciLinks, Online Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Sound SciLinks Code: HF61426

__ SciLinks, Online Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Doppler Effect SciLinks Code: HF60424
SECTION 2 Sound Intensity and Resonance

PACING
Regular Schedule: with lab(s): N/A days without lab(s): 1 days
Block Schedule: with lab(s): N/A days without lab(s): 0.5 days

OBJECTIVES
1. Calculate the intensity of sound waves.
2. Relate intensity, decibel level, and perceived loudness.
3. Explain why resonance occurs.

NATIONAL SCIENCE EDUCATION STANDARDS
UCP 1: Systems, order, and organization
UCP 2: Evidence, models, and explanation
UCP 3: Change, consistency, and measurements
UCP 5: Form and function
SAI 1: Abilities to do scientific inquiry
SAI 2: Understanding about scientific inquiry
ST 1: Abilities of technological design
ST 2: Understanding about science and technology
HNS 3: History of science
SPSP 1: Personal health
SPSP 2: Populations, resources, and environments
SPSP 3: Natural hazards
SPSP 4: Risks and benefits
PS6a: Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.

FOCUS (5 MINUTES)
__ Overview Review the objectives listed in the Student Edition. (GENERAL)

MOTIVATE (5 MINUTES)
__ Key Models and Analogies, p. 414, TE Explain to students how the surface of an expanding balloon can be compared to a spherical sound wave. (GENERAL)

TEACH (25 MINUTES)
__ PowerNotes® Resources Use the customizable presentation to help students master the concepts in this section. (GENERAL)

__ Transparency 58, Diagram of the Human Ear This transparency illustrates the three regions of the ear.

__ Transparency Master 41A, Range of Audibility of the Average Human Ear This transparency master shows the frequency and intensity of the sound waves that can be heard by the human ear.

__ Transparency Master 42A, Conversion of Intensity to Decibel Level This transparency master shows the decibel level for several different intensities and gives a real-world example of a sound at each level.

__ Sample Set A, Intensity of Sound Waves, SE This sample and practice problem set covers intensity of sound waves. (BASIC)

__ Classroom Practice, Intensity of Sound Waves, SE Use this problem as a teamwork exercise or for demonstration at the board or on an overhead projector. (BASIC)

__ Visual Strategy, Figure 9, TE Students decide whether there are musical sounds of the same frequency and intensity as those of speech, and if the graph describes an individual’s hearing exactly. (GENERAL)

__ Misconception Alert, p. 417, TE Work with the examples in the table to point out that the ratio of one decibel level to another does not give the ratio between the intensities of these sounds. (GENERAL)

__ Visual Strategy, Table 2, TE Students discuss how the sound intensity of a subway compares with that of a conversation. (GENERAL)

__ Quick Lab, Resonance, SE Students swing on a swing and make observations about amplitude and resonance. (GENERAL)

__ Datasheet, Resonance Students use the datasheet to complete the in-text QuickLab (GENERAL)

__ Demonstration, Resonance, TE This demonstration uses several tuning forks to show students resonance. (GENERAL)

__ Conceptual Challenge, p. 419, SE These conceptual questions challenge students to apply the section content to real-world applications. (GENERAL)

CLOSE (10 MINUTES)

__ Section Review, SE Students answer review questions, critical-thinking questions, and interpreting-graphics questions that assess their understanding of the section objectives. (GENERAL)

__ Study Guide, Sound Intensity and Resonance, ANC Use this worksheet to review the main concepts presented in the section. (GENERAL)

__ Section Quiz, ANC Use this quiz to assess students’ understanding of the section. (BASIC)

OTHER RESOURCE OPTIONS
Holt Online Learning Students can access interactive problem-solving help and active visual concept development with the Holt Physics Online Edition available at my.hrw.com.

Problem Workbook, Sample Set A: Intensity of Sound Waves, ANC This worksheet provides an additional example problem and several practice problems that cover intensity of sound waves. (BASIC)

Problem Bank, Sample Set A: Intensity of Sound Waves, OSP This worksheet provides a third example problem and several practice problems that cover intensity of sound waves. (BASIC)

Integrating Health, Why Your Ears Pop, Online Students can visit my.hrw.com and enter the keyword HF6SNDX to find this activity. Teacher resources can be found by entering the keyword HF6SNDXT. (BASIC)

SciLinks, Online Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Resonance SciLinks Code: HF61303
SECTION 3 Harmonics

PACING
Regular Schedule: with lab(s): N/A days without lab(s): 1 days
Block Schedule: with lab(s): N/A days without lab(s): 0.5 days

OBJECTIVES
1. Differentiate between the harmonic series of open and closed pipes.
2. Calculate the harmonics of a vibrating string and of open and closed pipes.
3. Relate harmonics and timbre.
4. Relate the frequency difference between two waves to the number of beats heard per second.

NATIONAL SCIENCE EDUCATION STANDARDS
UCP 1: Systems, order, and organization
UCP 2: Evidence, models, and explanation
UCP 3: Change, consistency, and measurements
UCP 4: Evolution and equilibrium
UCP 5: Form and function
SAI 1: Abilities to do scientific inquiry
SAI 2: Understanding about scientific inquiry
ST 1: Abilities of technological design
ST 2: Understanding about science and technology
HNS 1: Science as a human endeavor
HNS 2: Nature of science
SPSP 2: Populations, resources, and environments
SPSP 5: Science and technology in society

FOCUS (5 MINUTES)
__ Overview Review the objectives listed in the Student Edition. (GENERAL)

MOTIVATE (5 MINUTES)
__ Demonstration, Seeing Sounds, TE This demonstration uses an oscilloscope, a microphone, and a small amplifier to allow students to observe sound waves from a variety of sources. (GENERAL)
__ Teaching Tip, p. 423, TE Have students visualize the harmonics to help them recall the
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appropriate equations. (BASIC)

TEACH (25 MINUTES)

__ **PowerNotes® Resources** Use the customizable presentation to help students master the concepts in this section. (GENERAL)

__ **Transparency 59, Harmonics of Open and Closed Pipes** This transparency illustrates the first three harmonics of both open-ended and closed pipes.

__ **Transparency 60, Harmonics of Musical Instruments** This transparency shows the harmonics present in a tuning fork, a clarinet, and a viola when each sounds the musical note A-natural.

__ **Transparency 61, Beats** This transparency shows how beats occur by constructive and destructive interference.

__ **Transparency Master 43A, The Harmonic Series** This transparency master summarizes the first four harmonics for a vibrating violin string.

__ **Visual Strategy, Table 3, TE** Students find the wavelength and frequency for the next possible case in the harmonic series. (GENERAL)

__ **Quick Lab, A Pipe Closed at One End, SE** Students use a straw to create a steady tone, then snip off the end to see how the pitch changes as the straw becomes shorter. (GENERAL)

__ **Datasheet, A Pipe Closed at One End** Students use the datasheet to complete the in-text QuickLab (GENERAL)

__ **Sample Set B, Harmonics, SE** This sample and practice problem set covers harmonics. (GENERAL)

__ **Classroom Practice, Harmonics, TE** Use these problems as a teamwork exercise or for demonstration at the board or on an overhead projector. (GENERAL)

__ **Visual Strategy, Table 4, TE** Students list the frequencies produced by the clarinet in order of intensity. (ADVANCED)

__ **Conceptual Challenge, p. 430, SE** These conceptual questions challenge students to apply the section content to real-world applications. (ADVANCED)

__ **Visual Strategy, Figure 18, TE** Students determine at what time the two waves are exactly out of phase and in phase. (GENERAL)

CLOSE (10 MINUTES)

__ **Section Review, SE** Students answer review questions, critical-thinking questions, and interpreting-graphics questions that assess their understanding of the section objectives. (ADVANCED)

__ **Study Guide, Harmonics, ANC** Use this worksheet to review the main concepts presented in the section. (GENERAL)

__ **Section Quiz, ANC** Use this quiz to assess students' understanding of the section. (GENERAL)
OTHER RESOURCE OPTIONS

- **Holt Online Learning** Students can access interactive problem-solving help and active visual concept development with the Holt Physics Online Edition available at my.hrw.com.

- **Problem Workbook, Sample Set B: Harmonics, ANC** This worksheet provides an additional example problem and several practice problems that cover harmonics. (GENERAL)

- **Problem Bank, Sample Set B: Harmonics, OSP** This worksheet provides a third example problem and several practice problems that cover harmonics. (GENERAL)

- **Invention Lab, Building a Musical Instrument, ANC** Students design their own instrument and describe the instrument using the concepts of frequency, pitch, and resonance. (ADVANCED)

- **CBLTM Experiment, Sound Waves and Beats, ANC** In this scenario-based CBL lab, students use CBLs and sensors to determine if they have tuned one string of a stringed instrument by using their ears to the same pitch as that generated by a tuning fork. (ADVANCED)

- **SciLinks, Online** Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Harmonics SciLinks Code: HF60715

- **SciLinks, Online** Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Acoustics SciLinks Code: HF60015
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END OF CHAPTER REVIEW AND ASSESSMENT

PACING
Regular Schedule: with lab(s): N/A days without lab(s): 2 days
Block Schedule: with lab(s): N/A days without lab(s): 1 days

__ Chapter Highlights, p. 433, SE This page summarizes the vocabulary terms and key concepts of the chapter.

__ Chapter Review, pp. 434–437, SE Students review the chapter material with review questions, conceptual questions, practice problems, and a mixed review section.

__ Alternative Assessment, p. 437, SE These projects challenge students to apply and extend concepts that they have learned in the chapter. (ADVANCED)

__ Graphing Calculator Practice, p. 436, SE Students program their graphing calculators to determine a sound’s apparent frequency to a stationary observer given the sound’s frequency and velocity relative to the observer. (GENERAL)

__ Standardized Test Prep, pp. 438–439, SE This feature helps students sharpen their testtaking abilities while reviewing the chapter content. (GENERAL)

__ Appendix D: Equations, p. 860, SE This appendix summarizes the equations introduced in the chapter.

__ Appendix I: Additional Problems, pp. 889, SE This appendix provides additional mixed practice problems that cover the equations introduced in the chapter.

__ Study Guide, Mixed Review, ANC Students can use this worksheet to review the main concepts of the chapter in preparation for the chapter test. (GENERAL)

__ Holt PuzzlePro® Use this software to create crossword puzzles and word searches that make learning vocabulary fun.

__ Chapter Test A, ANC Assign this test for general-level chapter assessment. (GENERAL)

__ Chapter Test B, ANC Assign this test for advanced-level chapter assessment. (ADVANCED)

__ Test Generator Create a customized homework assignment, quiz, or test using the