CHAPTER 15 Interference and Diffraction

Chapter Opener

- **Tapping Prior Knowledge, TE** Review previously learned concepts and check for preconceptions about the chapter content.
- **Visual Concepts CD-ROM** This CD-ROM consists of multimedia presentations of core physics concepts. (BASIC)

SECTION 1 Interference

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. **Describe how light waves interfere with each other to produce bright and dark fringes.**
2. **Identify the conditions required for interference to occur.**
3. **Predict the location of interference fringes using the equation for double-slit interference.**

NATIONAL SCIENCE EDUCATION STANDARDS

UCP 1: Systems, order, and organization
UCP 2: Evidence, models, and explanation
UCP 3: Change, consistency, and measurements

FOCUS (5 MINUTES)

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

MOTIVATE (5 MINUTES)

- **Demonstration, Interference in Sound Waves, TE** This demonstration introduces students to interference patterns using sound waves from two coherent sources. (GENERAL)
- **Teaching Tip, p. 527, TE** Ask students to draw waves of the same wavelength that are out of phase by 45°, 90°, 135°.
- **Demonstration, Interference in a Ripple Tank, TE** This demonstration uses a ripple tank to demonstrate interference patterns using two types of point sources. (BASIC)
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TEACH (25 MINUTES)

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

__ **Transparency 78, Interference Between Transverse Waves** This transparency illustrates constructive and destructive interference of waves.

__ **Transparency 79, Conditions for Interference of Light Waves** This transparency illustrates why interference patterns consist of light and dark fringes.

__ **Transparency Master 50A, Comparison of Waves in Phase and 180° out of Phase** This transparency master illustrates waves that are in phase and waves that are 180° out of phase.

__ **Transparency Master 51A, Path Difference for Light Waves from Two Slits** This transparency master illustrates the geometry involved with determining the path difference for light waves from two slits.

__ **Transparency Master 52A, Position of Higher-Order Interference Fringes** This transparency master illustrates a representation of the interference pattern formed by double-slit interference.

__ **Demonstration, How Distance Traveled Affect Interference, TE** This demonstration uses a sine-wave generator, amplifier, two speakers, and a tape measure to illustrate facts about constructive interference. (ADVANCED)

__ **Visual Strategy, Figure 7, TE** Students determine the size of the path difference if parts of the figure are assigned certain values. (GENERAL)

__ **Demonstration, Thin-Film Interference, TE** This demonstration shows that wavelength affects the position of interference fringes. (BASIC)

__ **Visual Strategy, Figure 8, TE** Students answer questions about the lines shown in the figure. (BASIC)

__ **Sample Set A, Interference, SE** This sample and practice problem set covers interference. (GENERAL)

__ **Classroom Practice, Interference, TE** Use this problem as a teamwork exercise or for demonstration at the board or on an overhead projector. (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, Interference, 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
Lesson Plan Chapter 15 Interference and Diffraction

_**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: Interference, ANC**_ This worksheet provides an additional example problem and several practice problems that cover interference. (GENERAL)

_**Problem Bank, Sample Set A: Interference, OSP**_ This worksheet provides a third example problem and several practice problems that cover interference. (GENERAL)

_**SciLinks, Online**_ Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Interference SciLinks Code: HF60806
SECTION 2 Diffraction

PACING
Regular Schedule: with lab(s): 3 days without lab(s): 2 days
Block Schedule: with lab(s): 1.5 days without lab(s): 1 days

OBJECTIVES
1. Describe how light waves bend around obstacles and produce bright and dark fringes.
2. Calculate the positions of fringes for a diffraction grating.
3. Describe how diffraction determines an optical instrument’s ability to resolve images.

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
SPSP 5: Science and technology in society

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

MOTIVATE (5 MINUTES)
__ Demonstration, Waves Bending Around Corners, TE This demonstration shows students wave diffraction in a ripple tank. (GENERAL)
__ Demonstration, Diffraction and Interference by a Single Slit, TE This demonstration shows students diffraction and single-slit interference in a ripple tank. (GENERAL)

TEACH (115 MINUTES)
__ PowerNotes® Resources Use the customizable presentation to help students master the
Lesson Plan Chapter 15 Interference and Diffraction

concepts in this section. (GENERAL)

__ Transparency 80, Diffraction of Light with Decreasing Slit Width This transparency shows that diffraction becomes more evident as the width of the slit is narrowed.

__ Transparency 81, Constructive Interference by a Diffraction Grating This transparency shows a schematic diagram of a section of a diffraction grating and how diffracted beams interfere with one another to produce a pattern.

__ Transparency 82, Function and Use of a Diffraction Grating in a Spectrometer This transparency illustrates that the position of the maximums in a pattern created by a diffraction grating are wavelength dependent and provides a diagram of the basic components of a spectrometer.

__ Transparency 83, Resolution of Two Light Sources This transparency shows that each of two distant point sources produces a diffraction pattern and that two point sources are barely resolved if the central maxima of their diffraction patterns do not overlap.

__ Transparency Master 53A, Destructive Interference in Single-Slit Diffraction This transparency illustrates why destructive interference occurs in single-slit diffraction.

__ Demonstration, Light Diffraction by an Obstacle: Poisson Spot, TE This demonstration uses a laser to show the bright spot of light produced by interference of diffracted light around the edge of an obstacle. (ADVANCED)

__ Conceptual Challenge, p. 535, SE These conceptual questions challenge students to apply the section content to real-world applications. (ADVANCED)

__ Demonstration, Effect of Slit Size on Diffraction Patterns, TE This demonstration uses two razor blades and a clear glass or plastic plate to show that light diffraction is more evident in narrow slits. (GENERAL)

__ Demonstration, Multiple-Slit Diffraction, TE This demonstration uses a laser and two optical gratings to show patterns formed by a diffraction grating and the effect of different grating line separations. (GENERAL)

__ Sample Set B, Diffraction Gratings, SE This sample and practice problem set covers diffraction gratings. (GENERAL)

__ Classroom Practice, Diffraction Gratings, SE Use this problem as a teamwork exercise or for demonstration at the board or on an overhead projector. (GENERAL)

__ Skills Practice Lab, Diffraction, SE Students find wavelengths of diffracted light. (GENERAL)

__ Datasheet, Diffraction, 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, Diffraction, ANC Use this worksheet to review the main concepts presented in the section. (GENERAL)
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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 B: Diffraction Gratings, ANC This worksheet provides an additional example problem and several practice problems that cover diffraction gratings. (GENERAL)

Problem Bank, Sample Set B: Diffraction Gratings, OSP This worksheet provides a third example problem and several practice problems that cover diffraction gratings. (GENERAL)

SciLinks, Online Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Diffraction SciLinks Code: HF60405
SECTION 3 Lasers

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. Describe the properties of laser light.
2. Explain how laser light has particular advantages in certain applications.

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
ST 1: Abilities of technological design
ST 2: Understanding about science and technology
HNS 1: Science as a human endeavor
SPSP 5: Science and technology in society

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

MOTIVATE (5 MINUTES)
__ Demonstration, Dancing Light, TE This demonstration shows students some characteristics of a laser beam. (ADVANCED)
__ Demonstration, Interference in Laser Light, TE This demonstration shows students interference of light waves with the same wavelength. (GENERAL)

TEACH (25 MINUTES)
__ PowerNotes® Resources Use the customizable presentation to help students master the concepts in this section. (GENERAL)
__ Transparency 84, Operation of a Laser This transparency illustrates how a laser works.
__ Transparency 85, Components of a Compact Disc Player This transparency depicts the internal mechanisms of a compact disc player.
__ Transparency Master 54A, Wave Fronts from Noncoherent and Coherent Light
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**Sources** This transparency master compares incoherent light produced by an incandescent bulb with coherent light produced by a laser.

**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, Lasers, ANC** Use this worksheet to review the main concepts presented in the section. (ADVANCED)

- **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.

- **SciLinks, Online** Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Lasers SciLinks Code: HF60853

- **SciLinks, Online** Students can visit www.scilinks.org to find internet resources related to the chapter content. Topic: Bar Codes SciLinks Code: HF60135
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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. 547, SE This page summarizes the vocabulary terms and key concepts of the chapter.

__ Chapter Review, pp. 548–550, SE Students review the chapter material with review questions, conceptual questions, practice problems, and a mixed review section.

__ Alternative Assessment, p. 550, SE These projects challenge students to apply and extend concepts that they have learned in the chapter. (ADVANCED)

__ Graphing Calculator Practice, p. 551, SE Students program their graphing calculators to build a table for identifying the separations on a screen due to double-slit interference between the first three bright fringes. (GENERAL)

__ Standardized Test Prep, pp. 552–553, SE This feature helps students sharpen their test-taking abilities while reviewing the chapter content. (GENERAL)

__ Appendix D: Equations, p. 861, SE This appendix summarizes the equations introduced in the chapter.

__ Appendix I: Additional Problems, p. 891, 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