



This course supports the assessments for Physics: Waves and Optics. The course covers 6 competencies and represents 3 competency units.

Introduction

Overview

Physics: Waves and Optics address foundational topics in the physics of waves and optics as well as thermal physics and the laws of thermodynamics. Students will study basic wave motion and then apply that knowledge to the study of sound and light with even further applications to optical instruments. They will also learn about the law of thermodynamics and theories governing the kinetic theory of gases.

Getting Started

Welcome to Physics: Waves and Optics! In this course, you will continue your study of physics from the point where the previous physics course (Physics: Mechanics) ended. Many of the topics within this course are directly related to the topics you learned previously. For example, the study of waves flows naturally from your previous study of oscillations.

Look around you. Do you see the application of waves and optics? If not, you soon will. As you read this, you are viewing electromagnetic waves through the optical lenses within your eyes. Can you hear anything? Those noises are also waves-sound waves. If you are wearing a watch, there is a small quartz crystal on your wrist that is vibrating 32,768 times per second in order to keep accurate time.

Throughout this course, you will learn about foundational topics in the physics of waves and optics as well as thermal physics and the laws of thermodynamics. You will study basic wave motion and then apply that knowledge to the study of sound and light with even further applications to optical instruments. You will also learn about the law of thermodynamics and theories governing the kinetic theory physics of gases. Like many areas of physics, the ideas and concepts learned in this subdomain will come up again and again in other topics, so learn this material thoroughly.

LabPaq

The cost of the lab kit (LabPaq) is covered by your program lab fee and is used across three courses within your physics program: Mechanics, Waves and Optics, and Electricity and Magnetism. If you have not done so already, you will need to order your Physics LabPaq from Hands-On Labs. If you have previously ordered this kit for another course, there is no need to order another. This kit contains the science equipment and supplies you will need to complete experiments at home and will be shipped to you.

The experiments you will complete in each course support and reinforce the science content and also teach laboratory techniques.

Follow these instructions to order your [Physics LabPaq](#).



Lab manuals and specific instructions for completion of each relevant lab are linked within the course.

The packing list that comes with your kit WILL NOT allow you to do a full inventory because it won't list all the contents of the individual modules in your kit. Please use the packing list linked here: Lab Kit to do a complete inventory of your kit when it arrives. Inventory your kit WITHIN 30 DAYS of receiving it, and contact HOL Customer Service at 866-206-0773, option 3, if you are missing any items. If you don't feel like HOL is providing you with responsive customer service, please let your Program Mentor and/or Course Instructor know immediately.

Competencies

This course provides guidance to help you demonstrate the following 6 competencies:

- **Competency207.2.1:Mechanical Waves**
The graduate applies models of wave motion to solve mechanical wave problems, including sound waves.
- **Competency207.2.3:Thermal Properties**
The graduate applies concepts of temperature and heat to analyze microscopic and macroscopic properties of matter.
- **Competency207.2.5:Thermodynamics**
The graduate applies the concepts of thermodynamics to solve problems.
- **Competency207.2.6:Nature of Light**
The graduate applies models of light to solve problems and describe the behavior of light.
- **Competency207.2.7:Geometric Optics**
The graduate applies the ray model of light to demonstrate how mirrors and lenses are used in optical instruments.
- **Competency207.2.8:Physical Optics**
The graduate applies the wave model of light to demonstrate interference, diffraction, and applications of physical optics.

Teaching Dispositions Statement

Please review the [WGU Statement of Teaching Dispositions](#)

Course Instructor Assistance

While you prepare to demonstrate competency in this subject, remember that course instructors are ready to help you reach your educational goals. As subject matter experts, instructors enjoy and take pride in helping students become reflective learners, problem solvers, and critical thinkers. Course instructors are excited to hear from you and eager to work with you.

Successful students report that working with a course instructor is the key to their success. Course instructors are able to share tips on approaches, tools, and skills that can help you apply the content you are studying. They also provide guidance in assessment preparation strategies, troubleshoot areas of deficiency, and guide you through the revision process if necessary. You



should expect to work with course instructors for the duration of your coursework, so you are welcome to contact them as soon as you begin. Course instructors are fully committed to your success!

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Preparing for Success

The information in this section is provided to detail the resources available for you to use as you complete this course.

Learning Resources

The learning resources listed in this section are required to complete the activities in this course. For many resources, WGU has provided automatic access through the course. However, you may need to manually enroll in or independently acquire other resources. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

Manually Enrolled Learning Resources

Take a moment to enroll in the learning resources listed in this section. To enroll, navigate to the "Learning Resources" tab, click the "Sections" button, and then click the "Enroll Now" button for each resource. Once your mentor approves your enrollment in the resource, you will receive an e-mail with further access instructions. Contact your mentor if you have questions.

Mastering Physics

this web-based resource includes quizzes, tutorials, simulations, and access to the following e-text:

- Young, H.D. & Freedman, R/A. (2012). *Sears and Zemansky's university physics with modern physics (13th ed.)* Boston: Addison-Wesley, ISBN- 13: 978-0-321-69686-1.

LabPaq

The "Physics" LabPaq from Hands-On Labs is a physical shipment. This lab kit (LabPaq) is covered by your program lab fee and is required to complete the performance assessment. You



may have already enrolled for this resource through a different course. This kit includes a lab manual, laser, digital multi-meter, thermometer, stop watch, electrical components, optical equipment, pulleys, scales, and all of the other equipment necessary to complete experiments covering mechanics, electronics, magnetism, optics, waves, and other physics topics. The experiments reinforce science content and teach laboratory techniques.

The packing list that comes with your kit WILL NOT allow you to do a full inventory because it won't list all the contents of the individual modules in your kit. Please use the packing list linked here: [Lab Kit](#) to do a complete inventory of your kit when it arrives. Inventory your kit WITHIN 30 DAYS of receiving it, and contact HOL Customer Service at **866-206-0773, option 3**, if you are missing any items. If you don't feel like HOL is providing you with responsive customer service, please let your Program Mentor and/or Course Instructor know immediately.

Automatically Enrolled Learning Resources

You can access the learning resources listed in this section by clicking on the links provided throughout the course. You may be prompted to log in to the WGU student portal to access the resources.

VitalSourceE-Texts

The following textbooks are available to you as e-texts within this course of study. You will be directly linked to the specific readings required within the activities that follow.

- Hewitt, P.G. (2009). *Conceptual physics* (11th ed.). San Francisco: Addison-Wesley. ISBN-13: 978-0-321-56809-0.
- Young, H. D. & Freedman, R. A. (2012). *Sears and Zemansky's University Physics with Modern Physics* (14th ed.). Boston: Addison-Wesley. ISBN-13: 978-0-321-69686-1.

Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase hard copies at your own expense through a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition.

Thinkwell

You will access Thinkwell materials at the activity level within this course of study. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.

Additional Preparation

There are many different learning tools available to you within your course of study in addition to the learning resources already discussed. Take the time to familiarize yourself with them and determine how best to fit them into your learning process.

Other Preparations



Purchase a Graphing Calculator

Acquire a graphing calculator and familiarize yourself with how to use it. Refer to the [Calculator Guidelines](#) in the WGU Student Handbook for details regarding calculators that are acceptable on WGU exams.

If you are in a secondary mathematics program, refer to the [WGU Calculator Recommendations](#) for calculator suggestions for your degree program. If you are not in a secondary mathematics program, contact your instructor to discuss calculators appropriate to your degree program.

Equation Sheet and Import Contributions Table

During your study of Physics: Mechanics, you created a table of individuals and their contributions to physics, a table of physics applications, and an equation sheet. You will continue to add to the tables and your equation sheet during your studies of Physics: Waves and Optics.

Pacing Guide

Week 1:

- Wave Motion and Sound Waves

Week 2:

- Thermal Properties

Week 3:

- Kinetic Theory of Gases, The Ideal Gas Law, and the Thermal Properties Performance Task
- Task 1: The Thermal Properties Performance Task

Week 4:

- Laws of Thermodynamics
- Task 2: The Laws of Thermodynamics Performance Task

Week 5:

- The Nature and Properties of Light
- Light Investigation Lab

Week 6:

- Reflection and Refraction
- Task 3: The Reflection and Refraction Performance Task

Week 7:



- Lenses and Mirrors, and Interference and Diffraction

Week 8:

- Final Steps
- Complete and submit any remaining work.

Physics: Waves and Optics

Before you begin, be sure you have access to, and have enrolled in, all necessary learning resources as listed in the Learning Resources section. As you are completing the readings, make sure you take notes on any important ideas, concepts, and equations.

Week 1: Wave Motion and Sound Waves

In this topic, you will study wave motion. You will understand what identifies wave motion and behavior, and you will understand natural examples of wave motion.

Introduce yourself to the waves and wave motion

Read:

- [chapter 19 \("Vibrations and Waves"\)](#) from *Conceptual Physics*
- [chapter 15](#) sections 15.1-15.8 from *Sears and Zemansky's University Physics with Modern Physics*

Familiarize yourself with the basics of sound waves and music

Read:

- [chapter 20 \("Sound"\)](#) from *Conceptual Physics*
- [chapter 21 \("Musical Sounds"\)](#) from *Conceptual Physics*
- [chapter 16 \("Sound and Hearing"\)](#) sections 16.1-1 6.8 from *Sears and Zemansky's University Physics with Modern Physics*

Complete:

- Physics LabPaq experiment "Determining the Speed of Sound"

After completing the lab, e-mail your lab notes to the course instructor to verify your answers.

Week 2: Thermal Properties



Temperature is an internal property of matter while heat is a relative measurement of the surrounding medium's energy. You will learn about how temperature is measured, in several different scales; and about thermal expansion, the effect that happens to a body when its internal temperature is increased.

Familiarize yourself to the basics of the thermal properties of matter motion

Read:

- [chapter 15 \("Temperature, Heat, and Expansion"\)](#) from *Conceptual Physics*
- [chapter 16 \("Heat Transfer"\)](#) from *Conceptual Physics*
- [chapter 17 \("Change of Phase"\)](#) from *Conceptual Physics*
- [chapter 17 \("Temperature and Heat"\)](#) from *University Physics with Modern Physics*

Complete:

- Physics LabPac experiment "[Specific Heat Capacity of Metals](#)"
- Physics Lab: "[Caloric Content of Food](#)"

After completing the lab, e-mail your lab notes to the course instructor to verify your answers.

Week 3: Kinetic Theory of Gases, The Ideal Gas Law, and the Thermal Properties performance task

The kinetic theory of gases describes the collective behavior of gases that consist of many individual molecules. The theory explains the changes in the behavior of a gas in terms of its disturbance on things (i.e., the gas pressure and temperature) and in terms of the collisions that happen between molecules. Certain assumptions are considered when studying the theory, and you will learn about what they are and why those assumptions are reasonable based on natural observation.

Familiarize yourself with the basics of the kinetic theory of gases

Read:

- [chapter 14 \("Gases"\)](#) from *Conceptual Physics*
- [Chapter 18 \("Thermal Properties of Matter"\)](#) sections 18.1-18.6 from *Sears and Zemansky's University Physics with Modern Physics*

Review:

- [Theoretical Meteorology](#)

Understand:



Theory and concept of how the ideal gas law and kinetic theory of gases relates to weather conditions within the Earth's atmosphere. Be sure to think about what factors impact weather systems, and answer the question: Is the Earth a closed or open system? In other words, is the atmosphere confined to a set volume? If not, what does that mean for the expected relationship between pressure and temperature?

Complete:

Online lab [Pressure and Volume of a Gas](#)

Task 1: The Thermal Properties Performance Task

Complete through your course:

- Physics: Waves and Optics: Task 1

For details about this performance assessment, see the "Assessment" tab in this course.

Go to the following for an overview of this [task and hints and tips](#).

Before submitting, check that you have covered all the requirements in the rubric. If you need help, contact the course instructor.

Week 4: Laws of Thermodynamics

Thermodynamics is the study of heat and its transformation to useable mechanical energy. Thermodynamics is the study of mechanical work in terms of a change in a medium's pressure, volume, and temperature. The foundation of thermodynamics is the conservation of energy and the natural observation that heat always flows from hot to cold.

Familiarize yourself with an understanding of the laws of thermodynamics

Read:

- [chapter 18 \("Thermodynamics"\)](#) from *Conceptual Physics*
- [chapter 19 \("The First Law of Thermodynamics"\)](#) from *University Physics with Modern Physics*
- [chapter 20 \("The Second Law of Thermodynamics"\)](#) from *University Physics with Modern Physics*

Task 2: The Laws of Thermodynamics Performance Task

Complete through your course:

- Physics: Waves and Optics: Task 2



For details about this performance assessment, see the "Assessment" tab in this course.

Go to the follow for an overview of this [task and hints and tips](#).

Before submitting, check that you have covered all the requirements in the rubric. If you need help, contact the course instructor.

Week 5: The Nature and Properties of Light

In this section you will learn about the properties of light and a few of the most important aspects of light propagation, including reflection and refraction.

Familiarize yourself to the conceptual basics of the properties of light

Read:

- [chapter 26 \("Properties of Light"\)](#) from *Conceptual Physics*

Familiarize yourself with a deeper understanding of the nature of light

Read:

- [section 33.1 \("The Nature of Light"\)](#) from *University Physics with Modern Physics*

Complete:

- Online labs:
 - ["Light Investigation Part I"](#)
 - ["Light Investigation Part II"](#)

After completing the lab, send your lab notes to the course instructor to verify your answers.

Week 6: Reflection and Refraction

Most of the things around you do not actually emit their own light. So how do you see them? Instead of producing some internal light, all visible things reflect light around them. You say that light is reflected when it returns to the medium from which it came. On the contrary, light that is able to enter another medium (e.g., another gas, liquid, or transparent solid) is refracted, and its path is altered by some angle.

Familiarize yourself with the conceptual basics of reflection and refraction of light

Read:

- [chapter 27 \("Color"\)](#) from *Conceptual Physics*



- [chapter 28 \("Reflection and Refraction"\), stop before reading the "Lenses" section](#) from *Conceptual Physics*
- [chapter 33 \("The Nature and Propagation of Light"\)](#) through section 33.6 on buoyancy from *University Physics with Modern Physics*

Complete:

- Physics LabPaq experiment "Reflection and Refraction"

After completing the lab, e-mail your lab notes to the course instructor to verify your answers.

Task 3: The Reflection and Refraction Performance Task

Complete through your course:

- Physics: Waves and Optics: Task 3

For details about this performance assessment, see the "Assessment" tab in this course.

Go to the following for an overview of this [task and hints and tips](#).

Before submitting, check that you have covered all the requirements in the rubric. If you need help, contact the course instructor.

Student Support

WGU values your input! Please submit any feedback you have using the following form:

Access the WGU Library 24 hours a day, 7 days a week:

Visit the Student Success Center to access a variety of topics that will help you succeed at WGU:

Contact the Center for Writing Excellence (CWE) for help with any part of the writing or revision process:

