This course supports the assessments for Modern Physics. The course covers 5 competencies and represents 2 competency units.

**Introduction**

**Overview**
This course provides a broad overview of foundational concepts of modern physics such as relativity and quantum theories and their applications. Topics include atomic physics, nuclear physics, solid-state physics, and particle physics. Students will also cover the application of modern physics to cosmology.

**Getting Started**
Welcome to Modern Physics! This course requires you to pass 3 tasks to earn credits. Tasks should be completed in the order they are listed within the Course of Study. The necessary content is provided in all prior sections leading up to that task. It is however very important that you read all task objectives, directions and evaluation rubrics found in Taskstream before starting any given task.

**Competencies**
This course provides guidance to help you demonstrate the following 5 competencies:

- **Competency 207.4.2: Particle Nature of Light**
  The graduate analyzes experiments and models to demonstrate the particle nature of light.

- **Competency 207.4.3: Wave Nature of Particles**
  The graduate analyzes experiments and atomic models to demonstrate the quantum nature of atoms.

- **Competency 207.4.4: Special Theory of Relativity**
  The graduate uses the special theory of relativity to solve problems in modern physics.

- **Competency 207.4.5: Quantum Mechanics**
  The graduate applies the concepts of quantum mechanics to analyze particles trapped in bound states.

- **Competency 207.4.8: Nuclear Physics**
  The graduate analyzes the structure and behavior of the nucleus and applications of radioactivity and nuclear reactions.

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

**Course Instructor Assistance**
As you prepare to demonstrate competency in this subject, remember that course instructors stand ready to help you reach your educational goals. As subject matter experts, mentors 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’re studying. They also provide guidance in assessment preparation strategies and troubleshoot areas of deficiency. Even if things don’t work out on your first try, course instructors act as a support system to guide you through the revision process. 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.

Automatically Enrolled Learning Resources

You will be automatically enrolled at the activity level for the following learning resources. Simply click on the links provided in the activities to access the learning materials.

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


*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. This web-based resource includes multimedia video lectures, review notes, interactive animations, and sample exercises.
Thinkwell Physics I Online for Physics Majors

Enroll in Learning Resources

You will need to enroll in or subscribe to additional learning resources as a part of this course. You may already have enrolled in these resources for other courses. Please check the "Learning Resources" tab and verify that you have access to the following learning resources. If you do not currently have access, please enroll or renew your enrollment at this time.

Note: For instructions on how to enroll in or subscribe to learning resources through the "Learning Resources" tab, please see the "Acquiring Your Learning Resources" page.

AMNH Seminar (Optional)
This online resource uses multimedia and discussions to connect teachers and future teachers from around the world to cutting-edge research, classroom resources, and each other. Participating in the seminars develops your understanding of the content, models appropriate teaching technique, and exposes you to an array of resources that can be used in your classroom or to help with lesson planning.

While this is an optional learning resource, you are encouraged to take advantage of this opportunity. These seminars are covered as part of your WGU tuition. Each six-week seminar requires about eight hours per week of your time. The seminars have definite start and stop times, so review the AMNH Calendar to determine when the course is offered and consult your mentor to coordinate this seminar into your schedule. Discuss the AMNH-WGU FAQ with your mentor to better understand how to successfully use the AMNH course as a WGU learning resource.

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.

Additional Preparations

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 mentor to discuss calculators appropriate to your degree program.

Pacing Guide
The pacing guide suggests a weekly structure to pace your completion of learning activities.

Week 1:
- The Special Theory of Relativity
- Task 1 The Special Theory of Relativity Performance Task

Week 2:
- Quantum Theory

Week 3:
- Wave Particle Duality and the Heisenberg Uncertainty Principle
- Task 2 The Heisenberg Uncertainty Principle Performance Task

Week 4:
- Quantum Mechanics

Week 5:
- Atomic Theory
- Task 3 The Birth of Modern Physics and Atomic Structure Performance Task

Week 6:
- Nuclear Physics

Modern Physics

Throughout this course you will learn about various topics in modern physics.

Week 1: The Special Theory of Relativity

Start by making sure you have access to and have enrolled in all necessary learning resources as listed above. As you are completing the readings, make sure you take notes on any important ideas, concepts, and equations.

Introduce yourself to the topic of the special theory of relativity

Read:
- chapter 35 ("Special Theory of Relativity") from Conceptual Physics
- chapter 37 ("Newtonian Mechanics and Relativity") sections 37.1–37.5, and 37.9 from Sears and Zemansky’s University Physics with Modern Physics

Watch videos sections from Thinkwell:
- section 9.1 ("Understanding Einstein’s Theory of Relativity")
- section 9.2 ("The Lorentz Transformations")

Task 1: The Special Theory of Relativity Performance Task

Complete in TaskStream:

- Modern Physics: 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 2: Quantum Theory

The quantum theory was born with the discovery that light waves come in bundles (quanta) and have some of the properties that are normally attributed to particles. Familiarize yourself to the conceptual basics of quantum theory

Read:

- chapter 31 ("Light Quanta") from Conceptual Physics
- chapter 32 ("The Atom and the Quantum") from Conceptual Physics

Review:

You should be able to:

- describe the evolution of the atomic theory
- describe the quantum theory (i.e. wave-particle duality of light and the wave nature of particles)
- explain how important experiments led to the quantum theory
- describe the principle of complementarity and correspondence

Week 3: Wave Particle Duality and the Heisenberg Uncertainty Principle

The quantum theory can be divided into two complementary topics. The first topic is the wave-particle duality of light, which states that light exhibits both wave and particle properties. The second topic is the wave nature of particles, which states that particles also exhibit both wave and particle properties. Introduce yourself to the topic of wave particle duality

Read:

- chapter 38 ("Photons, Electrons, and Atoms") from Sears and Zemansky’s University Physics with Modern Physics
Review:

- **Quantum Tunneling and the Heisenberg Uncertainty Principle**

**Task 2: The Heisenberg Uncertainty Principle Performance Task**

**Complete in TaskStream:**

- Modern Physics: Task 2

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: Quantum Mechanics**

Erwin Schrödinger was an Austrian physicist who contributed greatly to the development of quantum mechanics. He developed the mathematical theory of wave mechanics that, for the first time, allowed the wave behavior of physical, and sometimes particle-like, systems to be calculated. The Schrödinger equation serves the same role in quantum mechanics that Newton's second law (F=ma) plays in classical physics.

**Familiarize yourself with Quantum Mechanics**

**Read:**

- **chapter 32 ("The Atom and the Quantum")** sections on "Quantum Mechanics" and "Correspondence Principle" from *Conceptual Physics*
- **chapter 40 ("Quantum Mechanics")** sections 40.1–40.4 from *University Physics with Modern Physics*

**Review:**

You should be able to:

- describe how to calculate the wave functions and energy levels for a particle confined to a box
- describe how to analyze the quantum mechanical behavior of a particle in a potential well

**Week 5: Atomic Theory**

You will learn about the structure of atoms and how the Schrödinger equation can be applied to the hydrogen atom. You will also study the exclusion principle to better understand more complex atoms.
Familiarize yourself to the conceptual basics of the atomic theory of matter

Read:
- chapter 11 ("The Atomic Nature of Matter") from *Conceptual Physics*

Familiarize yourself with a deeper understanding of magnetism and magnetic fields

Read:
- chapter 41 ("Atomic Structure") from *University Physics with Modern Physics*

**Task 3: The Birth of Modern Physics and Atomic Structure Performance Task**

Complete in *TaskStream*:
- Modern Physics: 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.

**Week 6: Nuclear Physics**

You have studied atoms and how those atoms combine to form molecules and solids. You will now change directions and go deeper into the atom and study the nuclei of atoms. You will examine important properties of the nuclei, including the nuclear force holding them together.

Familiarize yourself to the conceptual basics of nuclear physics

Read:
- chapter 33 ("The Atomic Nucleus and Radioactivity") from *Conceptual Physics*
- chapter 34 ("Nuclear Fission and Fusion") from *Conceptual Physics*

Familiarize yourself with a deeper understanding of nuclear physics

Read:
- chapter 43 ("Nuclear Physics") from *University Physics with Modern Physics*

Complete:
- physics LabPaq "Radioactive Decay" experiment

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

**Final Steps**
Congratulations on completing the activities in this course! This course has prepared you to complete the assessments associated with this course. If you have not already been directed to complete the assessments, schedule and complete your assessments now.