



NEW JERSEY CENTER
FOR TEACHING & LEARNING

Progressive Science Initiative® (PSI®)
PHYS6658: Learning & Teaching AP Physics 2: Advanced Topics

Primary Student Contact: Yuriy Zavorotniy yuriy@njctl.org

Faculty Team: Dr. Bob Goodman bob@njctl.org
 Dr. John Ennis john@njctl.org
 Yuriy Zavorotniy yuriy@njctl.org
 Katy Goodman katy@njctl.org

Course Credit: 3.0 NJCTL credits

Dates & Times:

This is a 3-credit, self-paced course, covering 6 modules of content. The exact number of hours that you can expect to spend on each module will vary based upon the module coursework, as well as your study style and preferences. You should plan to spend approximately 15 hours per credit working online, and up to 30 hours per credit working offline.

Graduate Student Handbook: www.njctl.org/graduate-handbook/

COURSE DESCRIPTION:

This course is designed for those who are learning to teach Algebra-Based Physics and Trigonometry-Based Physics for middle school or high school students, focusing on conveying physics and mathematical concepts. Underlying themes are physics connections to everyday life, applications of algebra and trigonometry in physics, problem solving, and hands-on laboratory experience. The course presents physics as the foundation for studying chemistry, biology and advanced mathematics. Technology serves as a tool to establish these connections through exploration, problem solving, formative assessment, presentation, and communication.

This course covers two-dimensional an introduction to electromagnetics and modern physics.

STUDENT LEARNING OUTCOMES:

Upon completion of the course, the student will be able to:

1. Demonstrate an understanding of modern physics topics, detailed in the module learning outcomes below.
2. Integrate PSI materials (including presentations, labs, practice problems, etc.) to support student learning and deliver effective instruction.

PROGRESSIVE SCIENCE INITIATIVE®, PSI®, PROGRESSIVE MATHEMATICS INITIATIVE® and PMI® are registered trademarks and PROGRESSIVE TEACHING INITIATIVE and PTI are trademarks of Dr. Robert Goodman and the New Jersey Center for Teaching and Learning is the exclusive Licensee of these marks.

3. Create a social constructivist learning environment through the use of formative assessment questions, interpreting the results of this assessment to effectively facilitate student-led discussions that support deeper understanding of the content.
4. Integrate multiple attempts to demonstrate student mastery of content knowledge, as encouraged/fostered by the PSI pedagogy.
5. Implement learning plans that are aligned to NGSS standards and allow for differentiation based on the needs of learners.
6. Implement learning plans that are aligned to AP/NGSS/Common Core standards, incorporate literacy strategies and allow for differentiation.

TEXTS, READINGS, INSTRUCTIONAL RESOURCES:

Required Texts:

- PSI Algebra-Based Physics uses a free digital textbook accessible at: <https://njctl.org/materials/courses/ap-physics-2/>
- Participants will download SMART Notebook presentations, homework files, labs, and teacher resources from the PSI Algebra-Based Physics Course

Recommended Texts:

- Giancoli (2005). *Physics: Principles with Applications / Edition 6* ISBN-13: 9780130352569
- Holton, G. J., Brush, S. G., & Holton, G. J. (2001). *Physics, the Human Adventure: From Copernicus to Einstein and Beyond*. New Brunswick, N.J: Rutgers University Press. ISBN-13: 9780813529080

COURSE REQUIREMENTS:

In order to receive a Passing grade, the participant must complete the following course requirements:

1. Activities: A number of different learning activities will ensure participant engagement and learning in the course. These include:
 - Engage in video module lessons which demonstrate minimized direct instruction followed by frequent formative assessment
 - Completion of formative assessments aligned to learning objectives which include detailed analysis when answered incorrectly.
 - Interaction with module discussion boards that allow conversation with peers and course instructors about the module's content, delivering that content to students. Discussion boards also serve as a place to ask and answer questions related to the module's content.
2. Short Answer Assignment: Each module requires one (1) original response to a given prompt. These prompts are typically based upon course lessons and require teachers to analyze, reflect, and make connections between the module's content and their own classroom practice.
3. Mastery Exercises: For each module, these multiple-choice question quizzes assess the content knowledge gained in a module. Participants have the opportunity to retake; random questions are pulled from a larger question bank on each attempt ensuring varied

questions.

4. Virtual Labs: In each module, a virtual lab write-up will be submitted. Virtual Labs are interactive lab simulations that promote a deeper understanding of the content knowledge being learned through real-world applications and analysis.
5. Module Exam: One is completed at the end of each module. It is a culminating exam consisting of multiple choice and free response questions aligned to the standards and objectives of the module.
6. Reflection Paper: At the end of the course, participants are required to reflect on the knowledge taught in the course, make connections, and compare/contrast their current pedagogy with new strategies gained in this assignment.
7. Final Exam: At the end of the course, a comprehensive exam consisting of Multiple Choice and Free Response questions assesses the content knowledge learned throughout the course and aligns to the AP College Board Exams.

GRADE DISTRIBUTION AND SCALE:

Grade Distribution:

Module Exams	70%
Final Exam	10%
Labs	6%
Short Answer Assignments	6%
Mastery Exercises	6%
Reflection Paper	2%

Grade Scale:

A	93 – 100
A-	90 – 92
B+	86 – 89
B	83 – 86
B-	80 – 82
C+	77 – 79
C	73 – 76
C-	70 – 72
D	60.0 – 69.9
F	59.9 or below

GRADING RUBRIC:

The following rubric is used to score:

- Short Answer Assignment – 6% of grade
- Reflection Paper – 2% of grade

The minimum possible score for this rubric is 4 points, and the score will be converted to the minimum grade available in this module (which is zero unless the scale is used). The maximum score of 25 points will be converted to the maximum grade.

Intermediate scores will be converted respectively and rounded to the nearest available grade. If a scale is used instead of a grade, the score will be converted to the scale elements as if they were consecutive integers.

	Meets Expectation	Approaches Expectation	Below Expectation	Limited Evidence
	<i>7 points</i>	<i>5 points</i>	<i>3 points</i>	<i>1 point</i>
Content	<ul style="list-style-type: none"> • Demonstrates excellent knowledge of concepts, skills, and theories relevant to topic. 	<ul style="list-style-type: none"> • Demonstrates fair knowledge of concepts, skills, and theories. 	<ul style="list-style-type: none"> • Demonstrates incomplete or insubstantial knowledge of concepts, skills, and theories. 	<ul style="list-style-type: none"> • Demonstrates little or no knowledge of concepts, skills, and theories.
Depth of Reflection	<ul style="list-style-type: none"> • Content is well supported and addresses all required components of the assignment. 	<ul style="list-style-type: none"> • Content is partially supported; addresses most of the required components of the assignment. 	<ul style="list-style-type: none"> • Content contains major deficiencies; addresses some of the required components of the assignment. 	<ul style="list-style-type: none"> • Content is not supported and/or includes few of the required components of the assignment.
Evidence and Practice	<ul style="list-style-type: none"> • Response shows strong evidence of synthesis of ideas presented and insights gained throughout the entire course. The implications of these insights for the respondent's overall teaching practice are thoroughly detailed, as applicable. 	<ul style="list-style-type: none"> • Writing is mostly clear, concise, and well organized with good sentence/paragraph construction. Thoughts are expressed in a coherent and logical manner. There are no more than five spelling, grammar, or syntax errors per page of writing. 	<ul style="list-style-type: none"> • Response is missing some components and/or does not fully meet the requirements indicated in the instructions. Some questions or parts of the assignment are not addressed. Some attachments and additional documents, if required, are missing or unsuitable for the purpose of the assignment. 	<ul style="list-style-type: none"> • Response excludes essential components and/or does not address the requirements indicated in the instructions. Many parts of the assignment are addressed minimally, inadequately, and/or not at all.

	<i>4 points</i>	<i>3 points</i>	<i>2 points</i>	<i>1 point</i>
Writing Quality	<ul style="list-style-type: none"> • Writing is well-organized, clear, concise, and focused; no errors. 	<ul style="list-style-type: none"> • Some minor errors or omissions in writing organization, focus, and clarity. 	<ul style="list-style-type: none"> • Some significant errors or omissions in writing organization, focus, and clarity. 	<ul style="list-style-type: none"> • Numerous errors in writing organization, focus, and/or clarity.

The following rubric is used to score:

- Labs – 6% of grade

The minimum possible score for this rubric is 2 points, and the score will be converted to the minimum grade available in this module (which is zero unless the scale is used). The maximum score of 14 points will be converted to the maximum grade.

Intermediate scores will be converted respectively and rounded to the nearest available grade. If a scale is used instead of a grade, the score will be converted to the scale elements as if they were consecutive integers.

	Meets Expectation	Approaches Expectation	Below Expectation	Limited Evidence
	<i>7 points</i>	<i>5 points</i>	<i>3 points</i>	<i>1 point</i>
Completeness	<ul style="list-style-type: none"> • Lab write-up is complete with no missing fields. 	<ul style="list-style-type: none"> • Lab write-up has 1-2 missing fields. 	<ul style="list-style-type: none"> • Lab write up has 3-5 missing fields. 	<ul style="list-style-type: none"> • There are more than 5 missing fields on the lab write-up.
Calculations	<ul style="list-style-type: none"> • All answers are calculated correctly. 	<ul style="list-style-type: none"> • Most answers are calculated correctly, but there are 1-2 minor calculation errors. 	<ul style="list-style-type: none"> • Most answers are calculated correctly, but there are multiple minor calculation errors, or 1-2 gross miscalculations. 	<ul style="list-style-type: none"> • There are calculation errors throughout the lab.

The remaining types of assignments are not scored using a rubric. These assignments are scored using percentage correct to assign a letter grade. The assignments in this manner are as follows:

- Mastery Exercises – 6% of grade
- Module Exams – 70% of grade
- Final Exam – 10% of grade

Mastery Exercises can be retaken as many times as desired to ensure a high score. Due to the nature of these assignments, each time they are taken, they will be composed of unique questions pulled randomly from a larger question bank.

Module and Final Exams are scored using a curve, which allows us to keep content exams rigorous. Module Exams can be retaken one time. Final Exams cannot be retaken.

ACADEMIC STANDING:

NJCTL has established standards for academic good standing within a student's academic program. Students enrolled in any NJCTL online course must receive an 80 or higher to successfully complete a course and receive credit for that course. An 80 is equivalent to a GPA of 2.7 or B-. Additionally, students in an endorsement program must receive a cumulative GPA of 3.0 for all courses combined in order to successfully complete the program.

ACADEMIC INTEGRITY:

Students must assume responsibility for maintaining honesty in all work submitted for credit and in any other work designated by the instructor of the course. Academic dishonesty includes cheating, fabrication, facilitating academic dishonesty, plagiarism, reusing /repurposing your own work, unauthorized possession of academic materials, and unauthorized collaboration.

CITING SOURCES WITH APA STYLE:

All students are expected to follow proper writing and APA requirements when citing in APA (based on the APA Style Manual, 6th edition) for all assignments.

DISABILITY SERVICES STATEMENT:

We are committed to providing reasonable accommodations for all persons with disabilities. Any student with a documented disability requesting academic accommodations should contact the Dean of Students, Melissa Axelsson, for additional information to coordinate reasonable accommodations for students with documented disabilities (melissa@njctl.org).

NETIQUETTE:

Respect the diversity of opinions among the instructor and classmates and engage with them in a courteous, respectful, and professional manner. All posts and classroom communication must be conducted in accordance with the student code of conduct. Think before you push the Send button. Did you say just what you meant? How will the person on the other end read the words?

Maintain an environment free of harassment, stalking, threats, abuse, insults or humiliation toward the instructor and classmates. This includes, but is not limited to, demeaning written or

oral comments of an ethnic, religious, age, disability, sexist (or sexual orientation), or racist nature; and the unwanted sexual advances or intimidations by email, or on discussion boards and other postings within or connected to the online classroom.

If you have concerns about something that has been said, please let your instructor know.

CLASS SCHEDULE:

Module	Module Learning Outcomes	Assignments
1 – Mechanical Waves	<ul style="list-style-type: none"> ● Understand how waves can propagate via different oscillation modes, such as transverse and longitudinal. ● Use graphical representation of a periodic mechanical wave to determine the amplitude of the wave. ● Explain and predict qualitatively how the energy carried by a wave relates to the amplitude of the wave. ● Describe wave refraction, diffraction and interference. ● Understand how sound waves can propagate via different oscillation modes, such as transverse and longitudinal. ● Use a graphical representation of a periodic mechanical wave to determine the amplitude of the sound wave. ● Explain and predict qualitatively how the energy carried by a sound wave relates to the amplitude of the wave and apply this concept to a real-world example. ● Apply the Doppler Effect to real-life scenarios. 	<ul style="list-style-type: none"> ● Short Answer ● Lab ● Mastery Exercises ● Module Exam
2 - Electromagnetic Waves	<ul style="list-style-type: none"> ● Contrast mechanical and electromagnetic waves in terms of the need for a medium in wave propagation. ● Qualitatively apply the wave model to quantities that describe the generation of interference patterns to make predictions about interference patterns that form when waves pass through a set of openings when spacing and widths are small compared to the wavelength of the waves. ● Predict and explain, using representations and models, the ability or inability of waves to transfer energy around corners and behind obstacles in terms of the diffraction property of waves in 	<ul style="list-style-type: none"> ● Short Answer ● Lab ● Mastery Exercises ● Module Exam

	<p>situations involving various kinds of wave phenomena, including sound and light.</p> <ul style="list-style-type: none"> ● Solve for wave speed, velocity or frequency using the wave equation and solve for wavelength and velocity using Snell's Law. ● Make qualitative comparisons of the wavelengths of types of electromagnetic radiation. ● Describe representations and models of electromagnetic waves that explain the transmission of energy when no medium is present. ● Understand properties of electromagnetic radiation. 	
3 - Geometric Optics	<ul style="list-style-type: none"> ● Explain applications of EM waves in communication. ● Explain applications of EM waves in medical technology. ● Demonstrate EM wave applications to students using hands-on activities. ● Explain how light reflects and refracts on and through surfaces. ● Demonstrate how to draw ray diagrams to find the location of an image. 	<ul style="list-style-type: none"> ● Short Answer ● Lab ● Mastery Exercises ● Module Exam
4 – Quantum Physics	<ul style="list-style-type: none"> ● Use right-hand rules to analyze a situation involving a current-carrying conductor and a moving electrically charged object to determine the direction of the magnetic force exerted on the charged object due to the magnetic field created by the current-carrying conductor. ● Plan a data collection strategy appropriate to an investigation of the direction of the force on a moving electrically charged object caused by a current in a wire in the context of a specific set of equipment and instruments and analyze the resulting data to arrive at a conclusion. ● Connect the strength of electromagnetic forces with the spatial scale of the situation, the magnitude of the electric charges, and the motion of the electrically charged objects involved. ● Apply Newton's 2nd Law and derived magnetic force formulas to solve magnetic force and field problems. 	<ul style="list-style-type: none"> ● Short Answer ● Lab ● Mastery Exercises ● Module Exam

5 – Nuclear Physics	<ul style="list-style-type: none"> ● Construct an explanation of the function of a simple electromagnetic device in which an induced emf is produced by a changing magnetic flux through an area defined by a current loop (i.e., a simple microphone or generator) or of the effect on behavior of a device in which an induced emf is produced by a constant magnetic field through a changing area. ● Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. ● Apply Faraday’s Law to calculate magnetic flux and electromotive force. ● Explain and describe a Faraday Cage. 	<ul style="list-style-type: none"> ● Short Answer ● Lab ● Mastery Exercises ● Module Exam
6 – Overview & Assessment	<ul style="list-style-type: none"> ● Review course topics in preparation for final exam ● Zoom meetings with instructor and discussion board posts 	<ul style="list-style-type: none"> ● Reflection Paper ● Final Exam