AP® Physics 2 Sample Syllabus 3

Syllabus 1066439v1

Curricular Requirements		Page(s)
CR1	Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.	1
CR2a	The course design provides opportunities for students to develop understanding of the foundational principles of thermodynamics in the context of the big ideas that organize the curriculum framework.	1
CR2b	The course design provides opportunities for students to develop understanding of the foundational principles of fluids in the context of the big ideas that organize the curriculum framework.	1
CR2c	The course design provides opportunities for students to develop understanding of the foundational principles of electrostatics in the context of the big ideas that organize the curriculum framework.	1
CR2d	The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.	1
CR2e	The course design provides opportunities for students to develop understanding of the foundational principles of magnetism and electromagnetic induction in the context of the big ideas that organize the curriculum framework.	1
CR2f	The course design provides opportunities for students to develop understanding of the foundational principles of optics in the context of the big ideas that organize the curriculum framework.	1
CR2g	The course design provides opportunities for students to develop understanding of the foundational principles of modern physics in the context of the big ideas that organize the curriculum framework.	2
CR3	Students have opportunities to apply AP Physics 2 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.	5
CR4	The course provides students with opportunities to apply their knowledge of physics principles to real world questions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.	5
CR5	Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.	2
CR6a	The laboratory work used throughout the course includes a variety of investigations that support the foundational AP Physics 2 principles.	2
CR6b	The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.	2, 3, 4
CR7	The course provides opportunities for students to develop their communication skills by recording evidence of their research of literature or scientific investigations through verbal, written, and graphic presentations.	5
CR8	The course provides opportunities for students to develop written and oral scientific argumentation skills.	2

Course Introduction

Textbooks: Students will have access to a print copy of Giancoli, D. *Physics: Principles with Applications*. 6th Edition. Upper Saddle River, NJ: Prentice Hall/Pearson Education, 2005. ISBN 0-13-060620-0. They will also have access to an electronic version of Coletta, V. P., *Physics Fundamentals*, 2010, Physics Curriculum and Instruction, ISBN 978-0-9713134-2-2. **[CR1]**

Chart of topics covered and related big ideas (BI):

Topic	Content
Coordinate systems and special relativity	A review of coordinate systems from AP Physics 1 and an overview of special relativity
Thermodynamics *BI 1, 4, 5, and 7* **[CR2a]**	Thermal energy transfer by conduction, convection and radiation, laws of thermodynamics, entropy and ideal gases, and kinetic theory
Fluid statics and dynamics *BI 1, 3, and 5* **[CR2b]**	Buoyant force, Bernoulli's equation, and the continuity equation
Electric forces, fields, and potential *BI 1, 2, 3, 4, and 5* **[CR2c]**	Coulomb's law, electric fields, and electric potential
Electric circuits *BI 1, 4, and 5* **[CR2d]**	DC circuits and steady-state RC circuits; analysis of circuits using Ohm's law and Kirchhoff's laws
Magnetism *BI 2, 3, and 4* **[CR2e]**	Properties of magnets and how electricity is related to magnetism - magnetic forces and fields
Electromagnetic induction *BI 2, 3, and 4*	How magnetism is related to electricity
Geometirc optics *BI 6* **[CR2f]**	Reflection, refraction, and diffraction
Physical optics *BI 6*	Interference, Young's Two-Slit Experiment, Diffraction, Thin Film Interference

CR1— Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.

CR2a— The course design provides opportunities for students to develop understanding of the foundational principles of thermodynamics in the context of the big ideas that organize the curriculum framework.

CR2b— The course design provides opportunities for students to develop understanding of the foundational principles of fluids in the context of the big ideas that organize the curriculum framework.

CR2c— The course design provides opportunities for students to develop understanding of the foundational principles of electrostatics in the context of the big ideas that organize the curriculum framework.

CR2d— The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.

Topic	Content
Atomic physics *BI 1, 3, 4, 5, 6, and 7*	Energy levels of the electrons in atoms
Nuclear physics *BI 1, 3, 4, 5, 6, and 7* **[CR2g]**	Nuclear reactions
Quantum physics *BI 1, 3, 4, 5, 6, and 7*	

Laboratory investigations and their associated science practices (SP): [CR6a] [CR6b]
Laboratory work is an integral part of physics and students are introduced to a variety of different laboratory experiences. Some labs are expected to develop a specific skill. Others are open ended; based on a given objective and an equipment list, the students are required to design their own procedure, data gathering, and analysis. Class time is used to introduce the lab; students can design the lab in their own time and then more class time is given to conduct the experiment and record data. The analyses and report generation are completed as homework. Students perform labs either to discover a fundamental concept or to apply a concept previously discussed. Most laboratory experiences are designed to encourage students to develop their own hypothesis, experiments ,and conclusions. Labs also provide the opportunity to gather and analyze data, and to hone critical thinking skills. Part of the lab experience will require students to present their findings to their peers for a peer review and critique. Students must use the evidence they found in the lab to defend their conclusions. **[CR8]**

Students are engaged in hands-on laboratory work, integrated throughout the course, which accounts for 25% of instructional time.**[CR5]**

Note: the following list of labs are labeled as (G) for Guided-Inquiry or (D) for Directed.

Lab	Topic	Description
Index of refraction (D)	Geometric optics	Use refraction dishes or laser refraction tanks to determine the index of refraction of water. SP 1.4, 2.2, 4.2, 4.3, and 5.1
The magnetic field of a Slinky (G)/(D)	Magnetism	Determine the relationship between magnetic field and current, and magnetic field and number of turns for a solenoid. Determine an experimental value for the permeability of free space. SP 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, and 6.2

CR2e— The course design provides opportunities for students to develop understanding of the foundational principles of magnetism and electromagnetic induction in the context of the big ideas that organize the curriculum framework.

CR2f— The course design provides opportunities for students to develop understanding of the foundational principles of optics in the context of the big ideas that organize the curriculum framework.

CR2g— The course design provides opportunities for students to develop understanding of the foundational principles of modern physics in the context of the big ideas that organize the curriculum framework.

CR6a— The laboratory work used throughout the course includes a variety of investigations that support the foundational AP Physics 2 principles.

CR6b— The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.

Lab	Topic	Description
Interference (D)	Physical optics	Use a diffraction grating to determine the wavelength of a laser pointer. SP 1.2, 1.4, 2.2, 3.1, 4.1, 4.3, and 5.1
Interference (G) **[CR6b]**	Physical optics	Investigate the relationship between slit spacing and the interference pattern. SP 1.2, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, and 6.1
The Current Balance (D)	Magnetism	Use the current balance apparatus to measure the force on a current-carrying wire in a magnetic field. SP 1.4, 2.1, 2.2, 3.1, 4.1, 5.1, and 5.2
Internal resistance (G) **[CR6b]**	Electric circuits	Measure the internal resistance of various batteries. SP 1.4, 2.1, 2,2, 3.1, 4.1, 4.2, and 5.1
Electric fields (D)	Electrostatics	Determine the electric field pattern for certain 2D shapes. SP 1.4, 2.1, 2.2, 3.1, 4.1, and 5.1
Deflection of an electron beam (G) **[CR6b]**	Magnetism	Use a cathode ray tube apparatus to determine the relationship between deflection and the deflecting and accelerating voltages. SP 1.4, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.1, 5.2, and 7.1
Induction (G) **[CR6b]**	Electromagnetic induction	Qualitatively observe the factors that determine the amount of induced current, such as the number of coils of wire and motion of magnet. SP 1.4, 3.1, 3.2, 3.3, 4.2, 5.1, 5.2, and 6.1
Transformers (G) **[CR6b]**	Electromagnetic induction	Qualitatively observe the transfer of energy between two coils. Determine how the ratio of number of coils affects the voltage and current in each coil. SP 1.2, 3.1, 3.2, 3.3, 4.2, 4.3, 5.1, 5.2, and 6.1

CR8— The course provides opportunities for students to develop written and oral scientific argumentation skills.

CR5— Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.

CR6b— The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.

Lab	Topic	Description
Back emf (D)/(G)	Electromagnetic induction	Observe back emf effects (and internal resistance effects) with a small dc motor. SP 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, and 5.1
Measuring Planck's constant (D)	Quantum physics	Use the forward voltage across LEDs and the wavelength of light emitted to calculate Planck's constant. Use the Vernier spectrometer to measure the wavelength of the peak output of each LED. SP 1.2, 1.4, 2.2, 4.3, and 5.1
Photoelectric effect (D)	Quantum physics	Use apparatus to measure the energy of emitted electrons and calculate the work function of the metal. SP 1.1, 2.2, 4.3, 4.4, and 5.1
Mass of the electron (D)	Magnetism	Use a tuning eye tube to calculate the mass of the electron. SP 1.2, 1.4, 2,2, 3.3, 4.3, 4.4, 5.1, and 6.1
Density and the buoyant force (G) **[CR6b]**	Fluid mechanics	Students design an experiment, using a force sensor, to allow them to calculate the density of an unknown rock and an unknown fluid. SP 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, and 5.2
Determine the focal length of a concave mirror or convex lens (G) **[CR6b]**	Geometric optics	Using a selection of standard lab equipment, determine the focal length of a concave mirror or convex lens. SP 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, and 5.1
Investigate heat engines (G)/(D)	Thermodynamics	Using pressure and temperature sensors on a confined sample of gas, students examine some thermodynamic processes to understand how the internal energy of the system (E_{int} or U) is affected by exchanges of energy between the system and the surroundings. SP 1.1, 1.2, 2.2, 3.1, 4.1, 4.2, 5.1, 5.3, and 6.1

CR6b— The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.

Lab	Topic	Description
Energy levels of hydrogen (D)	Atomic physics	Using the Vernier spectrometer, determine the principal lines in the hydrogen spectrum. Calculate the energies of the transitions and relate them to transitions between energy levels. SP 1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, and 6.2

Lab portfolio:

Each student is required to keep a lab portfolio. The portfolio may include reports presented in both poster format and video format, as well as components of those alternative formats. Lab reports are expected to include a statement of the problem/question, a description of the experimental procedure, data and/or observations, analysis (calculations, graphs and errors), discussion, and conclusions. **[CR7]**

CR7— The course provides opportunities for students to develop their communication skills by recording evidence of their research of literature or scientific investigations through verbal, written, and graphic presentations.

Real World Applications:

- Students investigate how the human eye works and conduct experiments to determine which types of lenses are appropriate to correct visual eye defects such as myopia and hyperopia. As an extension, the students may investigate how laser eye surgery (LASIK) works. This activity allows students to apply the following learning objectives (LO):

LO 6.A.1.2: The student is able to describe representations of transverse and longitudinal waves.

LO 6.E.3.3: The student is able to make claims and predictions about path changes for light traveling across a boundary from one transparent material to another at non-normal angles resulting from changes in the speed of propagation.

LO 6.E.5.1: The student is able to use quantitative and qualitative representations and models to analyze situations and solve problems about image formation occurring due to the refraction of light through thin lenses.

LO 6.E.5.2: The student is able to plan data collection strategies, perform data analysis and evaluation of evidence, and refine scientific questions about the formation of images due to refraction for thin lenses. **[CR3]**

CR3— Students have opportunities to apply AP Physics 2 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.

- Students are required to write two short essays on physics topics to help develop their ability to explain physics concepts. Two possibilities include asking the students to describe the structure, function, and applications of the MRI (Magnetic Resonance Imaging), or asking them to explain how electricity is produced and transported to their house. Essays must include the physics explanations and application. **[CR4]**

CR4— The course provides students with opportunities to apply their knowledge of physics principles to real world questions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.