AP® Physics 1 Syllabus

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 kinematics in the context of the big ideas that organize the curriculum framework.	2
CR2b	The course design provides opportunities for students to develop understanding of the foundational principles of dynamics in the context of the big ideas that organize the curriculum framework.	2
CR2c	The course design provides opportunities for students to develop understanding of the foundational principles of gravitation and circular motion in the context of the big ideas that organize the curriculum framework.	2
CR2d	The course design provides opportunities for students to develop understanding of the foundational principles of simple harmonic motion in the context of the big ideas that organize the curriculum framework.	2
CR2e	The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum in the context of the big ideas that organize the curriculum framework.	2
CR2f	The course design provides opportunities for students to develop understanding of the foundational principle of energy in the context of the big ideas that organize the curriculum framework.	2
CR2g	The course design provides opportunities for students to develop understanding of the foundational principles of rotational motion in the context of the big ideas that organize the curriculum framework.	2
CR2h	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.	2
CR2i	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.	2
CR2j	The course design provides opportunities for students to develop understanding of the foundational principles of mechanical waves in the context of the big ideas that organize the curriculum framework.	2
CR3	Students have opportunities to apply AP Physics 1 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.	6
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.	6
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.	5
CR6a	The laboratory work used throughout the course includes investigations that support the foundational AP Physics 1 principles.	3, 4, 5
CR6b	The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.	3, 4, 5
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, 6
CR8	The course provides opportunities for students to develop written and oral scientific argumentation skills.	5

Course Introduction

AP® Physics 1 is an algebra-based course in general physics that meets for 55 minutes each day for the entire school year. General physics topics presented during the course closely follow those outlined by the College Board and also mirrors an introductory level university physics course.

AP® Physics 1 is organized around six big ideas that bring together the fundamental science principles and theories of general physics. These big ideas are intended to encourage students to think about physics concepts as interconnected pieces of a puzzle. The solution to the puzzle is how the real world around them actually works. The students will participate in inquiry-based explorations of these topics to gain a more conceptual understanding of these physics concepts. Students will spend less of their time in traditional formula-based learning and more of their effort will be directed to developing critical thinking and reasoning skills.

Textbook

Giancoli. *Physics* 6th edition UC Berkeley, 2012. **[CR1]**

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

Big Ideas for AP® Physics 1

Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.

Big Idea 2: Fields existing in space can be used to explain interactions.

Big Idea 3: The interactions of an object with other objects can be described by forces.

Big Idea 4: Interactions between systems can result in changes in those systems.

Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

The big ideas for AP® Physics 1 are correlated to the content of the course and to the lab and inquiry-based investigations done throughout the school year in the following table.

Outline of AP® Physics 1 Principles and Correlation to Big Ideas (BI):

Physics Principles	BI 1	BI 2	BI 3	BI 4	BI 5	BI 6
Kinematics [CR2a]						
Chap 1: Vectors and Mathematical Concepts		X				
Chap 2: One Dimensional Kinematics			X	X		
Chap 3: Two Dimensional Motion and Projectile Motion			X	X		
Dynamics of Force and Motion [CR2b]						
Chap 4: Newton's Laws of Motion	X	X	X	X		
Chap 5: Circular Motion, Rotation, and Gravity	X	X	X	X		
Universal Law of Gravitation [CR2c]						
Chap 4: Newton's Laws of Motion	X	X	X	X		
Chap 5: Circular Motion, Rotation, and Gravity	X	X	X	X		
Simple Pendulum and Mass-Spring Systems [CR2d]						
Chap 4: Newton's Laws of Motion			X	X	X	
Chap 10: Oscillations & Simple Harmonic Motion			X		X	
Impulse, Linear Momentum, and Conservation of Linear Momentum [CR2e]						
Chap 7: Impulse, Momentum, and Collisions			X	X	X	
Work, Energy, and Conservation of Energy [CR2f]						
Chap 6: Work, Energy, and Power			X	X	X	
Rotational Kinematics and Conservation of Angular Momentum [CR2g]						
Chap 8: Rotational Kinematics & Rotational Energy			X	X	X	
Chap 9: Torque & Rotational Dynamics			X	X	X	
Electrostatics [CR2h]						
Chap 18: Conservation of Electric Charge, Electric Forces & Fields	X		X		X	
Chap 19: Electrostatics; Conductors, Capacitors	X					
Simple DC Circuits [CR2i]						
Chap 20: Electric circuits, Ohm's law, Kirchhoff's laws	X				X	
Waves and Sound						
Chap 16: Mechanical Waves and Sound **[CR2j]**						X
Chap 17: The Principle of Linear Superposition and Interference Phenomena						X

CR2a— The course design provides opportunities for students to develop understanding of the foundational principles of kinematics 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 dynamics 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 gravitation and circular motion 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 simple harmonic motion in the context of the big ideas that organize the curriculum framework.

CR2e— The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum 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 principle of energy 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 rotational motion in the context of the big ideas that organize the curriculum framework.

CR2h— 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.

AP Test Review for the time remaining until the AP Test.

Time after AP Test will be spent on Relativity, Astronomy, and other topics.

Outline of AP® Physics 1 Labs and investigations with Correlation to Big Ideas (BI):

Physics Principles and AP® Science Practices [CR6a] [CR6b]	BI1	BI2	BI3	BI4	BI5	BI6
Kinematics						
1. Car Velocity Lab: students determine the velocity and acceleration of a toy car. 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2			□			
2. Reaction Time: students figure out a method to determine their reaction time. *Guided-Inquiry Investigation* 1.4, 2.1, 2.2, 3.1, 4.2, 5.1, 6.1, 6.2, 7.2			□			
3. Projectile Motion 1: students determine the landing location of a ball launched horizontally from a table. 1.1, 1.4, 2.1, 2.2, 3.3, 5.1, 6.1			□			
4. Projectile Motion 2: students have to shoot a ball through a hoop placed at a particular location when launched at an angle. 1.1, 1.4, 2.1, 2.2, 3.3, 5.1, 6.1			□			
Dynamics of Force and Motion						
5. Force Table and Vectors: students determine missing forces to produce translational equilibrium. 1.4,2.1,2.2,3.3,5.1,5.2,6.2	□	□	□	□		
6. Atwood's Machine: students determine the formula for the acceleration of a simple Atwood's machine. 1.4, 2.1, 2.2, 3.3, 5.1, 5.2, 6.2	□	□	□	□		
7. Inclined Planes Forces and Friction: students determine what effect an incline has on the value of friction and determine coefficients of friction for various objects. *Guided-Inquiry Investigation* 1.4, 2.1, 2.2, 3.1, 4.2, 5.1, 5.2, 6.1, 7.2	□	□	□	□		
Universal Law of Gravitation						
8. Galileo Ramps: students use ramps at different angles to determine what happens to the acceleration. 1.1, 1.4, 2.1, 2.2, 3.2, 4.1, 5.1, 5.2, 6.2, 7.2	□	□	□			
9. Kepler Exoplanet Data: students determine Kepler's laws by analyzing actual data. *Inquiry Investigation* 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 6.2, 6.3, 7.2	□	□	□			

CR2i— 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.

CR2j— The course design provides opportunities for students to develop understanding of the foundational principles of mechanical waves in the context of the big ideas that organize the curriculum framework.

CR6a— The laboratory work used throughout the course includes investigations that support the foundational AP Physics 1 principles.

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

Physics Principles and AP® Science Practices [CR6a] [CR6b]	BI1	BI2	BI3	BI4	BI5	BI6
Simple Pendulum and Mass-Spring Systems						
10. Hooke's Law: students determine the relationship between distance stretched and force. 1.1, 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2, 7.2			☐		☐	
11. Pendulum Properties: students determine what factors affect the period of a pendulum *Guided-Inquiry Investigation* 1.1, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2			☐		☐	
Impulse, Momentum, and Conservation of Momentum						
12. Momentum and Collisions: students determine momentum before and after in different types of collisions. 1.1, 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2			☐	☐	☐	
13. Car Crash Physics: students design a car that will safely protect an egg in a crash. *Open-Inquiry Investigation* 1.1, 1.4, 2.1, 2.2, 3.1, 3.3, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2			☐	☐	☐	
Work, Energy, and Conservation of Energy						
14. Ballistics Pendulum: students determine the initial speed of a "bullet." *Guided-Inquiry Investigation* 1.1, 1.4, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2			☐	☐	☐	
15. Energy to Work Lab: students determine how work changes energy. 1.1, 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2			☐	☐	☐	
Rotational Kinematics and Conservation of Angular Momentum						
16. Torque Lab: students determine factors that affect the rotational motion of an object. 1.1, 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2			☐	☐	☐	
17. Rolling Cylinders: students determine how the type of cylinder rolled affects time of roll. 1.1, 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2			☐	☐	☐	
18. Flying Pigs and Centripetal Force: students determine the factors that affect centripetal force. *Guided-Inquiry Investigation* 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2			☐	☐	☐	

CR6a— The laboratory work used throughout the course includes investigations that support the foundational AP Physics 1 principles.

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

Physics Principles and AP® Science Practices [CR6a] [CR6b]	BI 1	BI 2	BI 3	BI 4	BI 5	BI 6
Electrostatics						
19. Coulomb's Law: students determine the relationship between force, charge and distance between charges. *Guided-Inquiry Investigation* 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2	□		□		□	
Simple DC Circuits						
20. Electric Circuit Lab: students determine voltage and current relationships in simple circuit orientations (series and parallel). *Open-Inquiry Investigation* 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2	□				□	
Waves and Sound						
21. Resonance Apparatus Lab: students determine the speed of sound by using resonance in a tube. *Guided-Inquiry Investigation* 1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 7.2						□
22. Beats and Standing Waves: students determine how beats and standing waves are produced. 1.1, 1.4, 2.1, 2.2, 3.3, 4.1, 5.1, 6.2						□

CR6a— The laboratory work used throughout the course includes investigations that support the foundational AP Physics 1 principles.

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

Additional Course Information

Labs & Classwork

Labs are all "hands-on" and placed throughout the instructional year. Students will spend at least 25% of class time in laboratory investigations. **[CR5]** Labs can be either teacher directed or student directed/open-ended. During a teacher-directed lab, the students are given instruction on the operation of lab equipment and guidance in the process of the experiment. Student-directed labs are when the students are given an objective, e.g. "Determine the acceleration due to gravity on Earth," and standard materials needed to conduct a lab. Students are allowed to create their own experimental design and collect data, which can be analyzed through graphical methods. These inquiry-based investigations or student-directed labs have an extra element added to the lab report. After these labs, each student group must present their results to the class and defend their results. They will also evaluate one other group's approach to the problem and offer a critique of their procedures and results. **[CR8]**

Students work in lab groups, but each student must submit a lab report which is turned in the day after the conclusion of each activity, then graded and returned. The report must include the following components: **[CR7]**

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.

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

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.

- Statement of the problem
- Hypothesis
- Discussion or outline of how the procedure will be carried out
- Data collected from the experiment
- Data analysis
- Conclusion including error analysis
- Peer review (if included in this lab)

Students are required to keep the reports in an organized lab notebook. This lab notebook will kept by the students for the entire year and must include the completed lab reports as well as the raw data tables and any notes made during the execution of the labs done in the course. **[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.

Two lab investigations during the year are extended projects that require using data collected by outside sources. Students will utilize this data to find out answers to questions posed by the instructor and also questions they formulate themselves.

Real World Activity:
Car Crash Physics: This past year a lawyer approached me with a problem. His client was hurt in a crash, but the insurance company was claiming there was not enough force generated in the crash to cause injuries. The students will be given the same problem and asked to come up with an answer to the insurance company. They will research information needed and write a report detailing their conclusions. Each group will present their findings to the class and also review and critique another group's conclusions and methods used to come up with their answer. As one group presents their findings as experts, the other group will be acting as the insurance company trying to find holes in their argument. **[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.

Kepler Telescope Exoplanet Discovery: The Kepler telescope has been discovering evidence about new planets around other stars for the last few years. Some of this data is posted on the Internet and we will use it to determine properties of these planets. Students will have a new planet to investigate and determine as many physical properties about that planet as possible form the data set. The investigation requires the students to utilize Learning Objectives 2.B.2.1, 3.A.2.1, 3.A.4.2, 3.B.2.1, 3.C.1.2, and 4.A.1.1. **[CR3]**

CR3— Students have opportunities to apply AP Physics 1 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.