AP Physics 1

AP Syllabus

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Textbook

Serway and Faughn. (2012). Physics. Orlando, Fl: HOLT McDougal Houghton Mifflin Harcourt.

Other Resources

Jacobs, G (2018). 5 Steps to a 5: AP Physics 1 Algebra-Based 2018. McGraw-Hill Education.

AP Physics 1 Practice Questions (2017). Boston, MA: Sterling Test Prep.

Edx.org AP Physics 1 Course

Course Overview

The AP Physics 1 course will meet for 80 minutes every day. Lab work is integral to the understanding of the concepts in this course. The AP Physics 1 course has been designed by the College Board as a course equivalent to the algebra-based college-level physics class. At the end of the course, students will take the AP Physics 1 Exam, which will test their knowledge of both the concepts taught in the classroom and their use of the correct formulas.

The course focuses on the interconnections between the various strands and units contained in the course syllabus and how each contributes to the "Big Ideas" that provide a core foundation for this science course. Problem solving techniques and strategies are fined tuned throughout the year, and students are continually tasked with connecting physics applications learned in different units in order to synthesize solutions to complex problems. The emphasis on theoretical topics, critical thinking and problem solving makes this class challenging. Mathematics is used to illuminate physical situations rather than to show off a student's manipulative abilities. Students must be strong in both math and science to be successful in this course. Conceptual understanding of the material is a requirement for success. Students will be expected to write justifications and explanations of physics concepts.

Students have the opportunity to meet the learning objectives in a variety of ways and to apply their knowledge to real world experiences and society issues. Instructional time involves a

variety of student-centered activities. Students have the opportunity to work cooperatively to solve challenging problems and to present their solutions to the class. Throughout the year, connections to the world are explored in discussions, group projects, and class demonstrations. Laboratory work, described below, offers frequent opportunities to work collaboratively, explore ideas, and present information. Outside of class, students read the assigned text and complete homework assignments that support and reinforce each lesson as well as what has been learned in the laboratory setting.

The content for the course is based on six big ideas:

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 occurs 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 phenomenon.

Grading/Evaluation

Students will earn grades on classwork/participation (including laboratory work), demonstrations of learning (includes tests, quizzes and projects), academic public speaking, homework/independent learning, and Senior Monday. Tests are typically worth 100 – 150 points and will consist of questions similar to ones students will see on the AP Exam. Other assignments and quizzes will consist of problems and concepts from the textbook, supplements, and old AP Exams. Projects are long term, and typically will involve groups developing a plan, collecting data and/or research, and presenting conclusions in a meaningful way. Laboratory work is student centered and inquiry based. Grades are tabulated using the ratio of the total points earned to total points available.

Grade breakdown is per school policy of:

Classwork/Participation 35%
Demonstrations of Learning 25%
Academic Public Speaking 10%
Homework/Independent Learning 20%
Senior Monday 10%

Course Outline

Unit	Chapter	Learning Objectives
1. Kinematics (Big Idea 3) * One dimensional motion: constant velocity and uniform accelerated motion * Vectors: components & resultant * Two dimensional motion: projectile motion	2,3	3.A.1.1, 3.A.1.2, 3.A.1.3, 4.A.1.1, 4.A.2.1, 4.A.2.3
2. Dynamics (Big Ideas 1, 2, 3, 4) * Forces & free body diagrams * Newton's 1st Law * Newton's 2nd Law * Newton's 3rd Law * Applications of Newton's 2nd Law (Inclines, Atwood's, etc.) * Friction	4	4 1.C.1.1, 1.C.3.1, 2.B.1.1, 3.A.2.1, 3.A.3.1, 3.A.3.2, 3.A.3.3, 3.A.3.4, 3.A.4.1, 3.A.4.2, 3.A.4.3, 3.B.1.1, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.4.1, 3.C.4.2, 4.A.1.1, 4.A.2.1, 4.A.2.2, 4.A.2.3, 4.A.3.1, 4.A.3.2
3. Circular Motion (Big Ideas 1, 2, 3, 4) * Uniform circular motion * Dynamics of uniform circular motion * Universal Gravitation	7.1+2	1.C.3.1, 2.B.1.1, 2.B.2.1, 2.B.2.2, 3.A.3.1, 3.A.3.3, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.1.1, 3.C.1.2, 3.G.1.1, 4.A.1.1, 4.A.2.1, 4.A.2.2, 4.A.2.3
4. Energy (Big Ideas 3, 4, 5) * Work * Power * Kinetic energy * Potential energy (gravitational, elastic) * Conservation of Energy	5	3.E.1.1, 3.E.1.2, 3.E.1.3, 3.E.1.4, 4.C.1.1, 4.C.1.2, 4.C.2.1, 4.C.2.2, 5.A.2.1, 5.B.1.1, 5.B.1.2, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2, 5.B.5.1, 5.B.5.2, 5.B.5.3, 5.B.5.4, 5.B.5.5, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.3

5. Momentum (Big Ideas 3, 4, 5) * Impulse * Momentum * Conservation of Momentum * Elastic & Inelastic Collisions	6	3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3, 3.D.2.4, 4.B.1.1, 4.B.1.2, 4.B.2.1, 4.B.2.2, 5.A.2.1, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.2, 5.D.2.3, 5.D.2.4, 5.D.2.5, 5.D.3.1
6. Rotational Motion (Big Ideas 3, 4, 5) * Torque * Center of Mass * Rotational kinematics * Rotational dynamics and rotational inertia * Rotational energy * Angular momentum * Conservation of angular momentum	7.3+4	3.F.1.1, 3.F.1.2, 3.F.1.3, 3.F.1.4, 3.F.1.5, 3.F.2.1, 3.F.2.2, 3.F.3.1, 3.F.3.2, 3.F.3.3, 4.A.1.1, 4.D.1.1, 4.D.1.2, 4.D.2.1, 4.D.2.2, 4.D.3.1, 4.D.3.2, 5.E.1.1, 5.E.1.2, 5.E.2.1
7. Simple Harmonic Motion (Big Ideas 3 & 5) * Restoring forces * SHM Graphs * Simple Pendulum * Mass-spring systems	11.1+2	3.B.3.1, 3.B.3.2, 3.B.3.3, 3.B.3.4, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2
8. Mechanical Waves (Big Idea 6) * Traveling waves * Wave characteristics * Sound * Superposition * Standing waves on a string * Standing sound waves	11.3+4, 12	6.A.1.1, 6.A.1.2, 6.A.2.1, 6.A.3.1, 6.A.4.1, 6.B.1.1, 6.B.2.1, 6.B.4.1, 6.B.5.1, 6.D.1.1, 6.D.1.2, 6.D.1.3, 6.D.2.1, 6.D.3.1, 6.D.3.2, 6.D.3.3, 6.D.3.4, 6.D.4.1, 6.D.4.2, 6.D.5.1
9. Electrostatics (Big Ideas 1, 3, 5) * Electric charge & conservation of charge * Electric force: Coulomb's Law	16	1.B.1.1, 1.B.1.2, 1.B.2.1, 1.B.3.1, 3.C.2.1, 3.C.2.2, 5.A.2.1
10. DC Circuits (Big Ideas 1, 5) * Electric resistance * Ohm's Law * DC Circuits * Series & Parallel Circuits	17,18	1.B.1.1, 1.B.1.2, 1.E.2.1, 5.B.9.1, 5.B.9.2, 5.B.9.3, 5.C.3.1, 5.C.3.2, 5.C.3.3

* Kirchhoff's Laws		

Laboratory Investigations

Students spend at least 25% of the instructional time engaged in laboratory work (1 day per week for most labs). Experiments designed by the instructor are used to demonstrate procedural guidelines and to learn how to use specific laboratory equipment. The majority of labs are inquiry-based where students are given an objective and a set of materials. They are tasked with designing a procedure and collecting data to determine specific quantities, determine the relationship between variables, and/or to derive fundamental physics equations. Laboratory design, experimentation, data gathering, data presentation, analysis, drawing conclusions, and experimental error analysis are elements in these lab activities.

Laboratory work is recorded in a laboratory notebook/binder, and students will have opportunities to present their laboratory work to their peers. Lab reports will consist of the following components:

- 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)

Labs are labeled as Open Inquiry (OI), Guided Inquiry (GI), or Directed (D) in student notebooks. At least half of all labs will be inquiry-based. At the end of completing lab work for the investigations that are labeled "Guided-Inquiry," the students will present their method, data, and conclusions on whiteboards.

The class will then engage in peer critique of each group's results, and discuss strategies to decrease error and suggest further investigations.

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.

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.

Physics Principles and AP Science Practices	BI 1	BI 2	BI 3	BI 4	BI 5	BI 6
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			X			
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			X			
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			X			
4. Projectile Motion 2: students have to build a catapult and shoot a ball on a target at a particular location when launched at an angle. Open Inquiry Investigation 1.1, 1.4, 2.1, 2.2, 3.3, 5.1, 6.1			X			
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	X	X	X	X		
6. Students determine the best structure for a bridge that will be tested for structural integrity. Open Inquiry Investigation 1.4, 2.1, 2.2, 3.3, 5.1, 5.2, 6.2	X	X	X	X		

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	X	X	X	X		
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	X	X	X			
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	X	X	X			
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			X		X	
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			X		X	
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			X	X	X	
13. Car Crash Physics: students design a car that will safely protect an egg being dropped off a roof. Open-Inquiry Investigation			X	X	X	

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			X	X	X	
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			X	X	X	
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			X	X	X	
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			X	X	X	
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			X	X	X	
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	X		X		X	
Simple DC Circuits						
20. Electric Circuit Lab: students determine voltage and current relationships in simple circuit	X				X	

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						X
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						X

Real World Activities

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.

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 from 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.