AP Physics 1

Board Approval Date: August 26, 2019

Curricular Requirements		Page
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.	1
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.	1
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.	7
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 investigations that support the foundational AP Physics 1 principles.	3
CR6b	The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.	3, 4, 5, 6
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.	2
CR8	The course provides opportunities for students to develop written and oral scientific argumentation skills.	6, 7

Textbook
Knight, Randall, Brian Jones and Stuart Field. *College Physics*. AP Edition. Pearson. 2015 **[CR1]**

About this course:
The AP Physics 1 course will meet for 43 minutes every day, with two additional 43 minute lab periods per six day cycle. 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 may 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. Students who take the AP test will receive AP weighting on their final course grade. Students who choose not to take the AP test will receive honors weighting on their final grade.

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 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.

Evaluation:
Students will get grades on homework, quizzes, laboratory work, projects, and exams. Exams are typically worth 100 points and will consist of questions similar to ones students will see on the AP Exam. Homework assignments and quizzes will consist of problems
from the textbook, supplements, old AP Exams, and Mastering Physics (program included with textbook). Projects are long-term, and typically will involve groups of students developing a plan, collecting data and/or research, and presenting conclusions in a meaningful way. Laboratory work is student centered and inquiry based and is discussed below.

Grades will be calculated using the weighted scale below:
- Tests and Quizzes: 50%
- Labs: 25%
- Homework/Assignments: 25%

Topics Covered:
1. Kinematics (Big Idea 3) **[CR2a]**
    a. Vectors/Scalars
    b. One Dimensional Motion (including graphing position, velocity, and acceleration)
    c. Two Dimensional Motion

CR2c— The course design provides opportunities for understanding the foundational principles of gravitation and circular motion in the context of big ideas that organize 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 in the context of the big ideas that organize framework.

course design for students to develop understanding of foundational principle of energy in the context of big ideas that organize framework.

course design for students to develop understanding of foundational principles of rotational motion in the context of the big ideas that organize framework.

course design for students to develop understanding of foundational of electrostatics in the xt of the big ideas organize the curriculum framework.

course design for students to develop understanding of foundational principles of electric in the context of the big ideas that organize framework.

2. Dynamics (Big Ideas 1, 2, 3, and 4) [CR2b]
    a. Newton's Laws of Motion and Forces
3. Universal Law of Gravitation (Big Ideas 1, 2, 3, and 4) [CR2c]
    a. Circular Motion
4. Simple Harmonic Motion (Big Ideas 3 and 5) [CR2d]
    a. Simple Pendulums
    b. Mass-Spring Oscillators
5. Momentum (Big Ideas 3, 4, and 5) [CR2e]
    a. Impulse and Momentum
    b. The Law of Conservation of Momentum
6. Energy (Big Ideas 3, 4, and 5) [CR2f]
    a. Work
    b. Energy
    c. Conservation ofEnergy
    d. Power
7. Rotation (Big Ideas 3, 4, and 5) [CR2g]
    a. Rotational Kinematics
    b. Rotational Energy
    c. Torque and Rotational Dynamics
    d. Angular Momentum
    e. Conservation of Angular Momentum
8. Electrostatics (Big Ideas 1, 3, and 5) [CR2h]
    a. Electric Charge
    b. The Law of Conservation of Electric Charge
    c. Electrostatic Forces
9. Circuits (Big Ideas 1 and 5) [CR2i]
    a. Ohm's Law
    b. Kirchhoff's Laws
    c. Simple DC Circuits
10. Mechanical Waves and Sound (Big Idea 6) [CR2j]

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 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

<u>Laboratory Activities:</u>

Twenty five percent of the course will be lab work. [CR5] Labs may take several in-class days to finish, and students may have to do work outside of class as well.

Students are expected to keep a lab notebook where they will maintain a record of their laboratory work. Lab reports will consist of the following components: [CR7]

Title

- Objective/Problem
- Design (if applicable): If the lab has no set procedure, what is to be done? Why are you doing it this way?
- Data: All data gathered in the lab will go here
- Calculations/Graphs: Calculations are done here. Any graphs that need to be made go here.
- Conclusion: Data analysis occurs here, and a statement can be made about what was learned in the lab. Error analysis and evaluation of the lab occurs here as well.

Every major unit will have an inquiry-based lab, and inquiry-based labs will make up no less than half of the laboratory work. Collectively, laboratory work will engage students in all seven science practices.

Laboratory activities and simulations in this class are included the following table.
[CR6a] The inquiry-based labs are noted in the second column.

Name	**Open- or Guided-Inquiry? [CR6b]**	**Description**	**Science**
Meeting Point		Students will predict where two battery---operated cars will collide if they are released from opposite ends of the lab table at different times.	2.1, 2.2, 4.2, 1
		computer simulation of	1.4, 2.2, 4.3, 1
		Students design experiment to determine	1.2, 1.4, 2.2, 4.1, 4.2, 1
in Cup Lab		Students determine paper cup needs to be placed the so that a rolled of the edge of a table will land in	1.4, 2.1, 2.3,
tion Challenges		a projectile students be a series of challenges such as a ring stand at the height, or a cup at the point where the	1.4, 2.1, 4.1, 4.2,
		is the relationship the mass of a and acceleration of the system?	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 6.1, 6.2, 1

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.

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.

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.

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.

Name	Open- or Guided-Inquiry? [CR6b]	Description	Science
	O		1.1, 1.4, 2.1, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 1, 6.4, 7.2
	G		1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
s Moons		Students do research Jupiter and four of its moons. on this research, s up the mass of Jupiter. They this information o the accepted value.	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2, 6.4, 7 1
Lab		factor(s) control period of a pendulum?	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
Mass-Spring Lab		Students must determine the spring constant k of a spring and the mass of three unknown masses. Students must also investigate the conservation of energy of system.	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
Conservation of tum Lab		a track and students seven different and make about momentum conservation in real life	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2, 6.4, 7

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

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

Name	**Open- or Guided-Inquiry? [CR6b]**	**Description**	**Science**
		Students will design a paper bumper that will soften the impact of the collision between a cart and a fixed block of wood. Their designs are evaluated by the shape of an acceleration-time graph	1.4, 2.1, 4.3, 5.1, 5.2, 5.3, 1, 6.2, 6.4, 7.2
Introductory Motion Lab		is kept what is the relationship the radius of motion the period of motion? speed?	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
Circular Motion Station Lab			1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
Conservation of Angular Lab		is the r between the moment of of a and the of a system?	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
orq		Students use a meter stick on a fulcrum with varying masses hung from it to study r equilibrium.	1.1, 1.4, 4.3, 1
Coulomb's Lab		is the charge stored on pair of charged balloons that repelling each	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
Electrostatics Simulation	O	a computer simulation positive g explore the electrostatic force of repulsion between charges, the accelerations of the charges, and the force and acceleration changes with	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,

Name	Open- or Guided-Inquiry? [CR6b]	Description	Science
Lab		a number of resis or explore current and voltage in resistors hooked up to a power resistors are wired in series one another they are in parallel one	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
on a Lab		Students wavelength, frequency, and the tension in at s on a wire.	1.1, 1.4, 2.1, 3.3, 4.1, 4.3, 4.4, 1 6.1, 6.2,
in Lab		Students the frequency of sound out of a speaker to create standing in to determine the speed of sound in the classroom.	1.1, 1.4, 2.1, 3.3, 4.1, 5.1, 6.1, 6.2,

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

Science Practices

- Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.
- Science Practice 2: The student can use mathematics appropriately.
- Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
- Science Practice 4: The student can plan and implement data collection strategies in relation to a particular scientific question.
- Science Practice 5: The student can perform data analysis and evaluation of evidence.
- Science Practice 6: The student can work with scientific explanations and theories.
- Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

Outside the Classroom Lab Experience: [CR3]

In addition to labs, students will be required to do one exercise outside of the laboratory experience. Students may pick one of the following at the end of our rotation unit (end of mechanics):

- Students will use a video analysis program (Logger Pro) to analyze the motion of a toy as it moves (either in straight line or in a circle). Students will provide the toy and do their own videotaping. They will then present a description of the analysis both quantitatively and qualitatively, including graphs. Their presentation will be peer critiqued and/or questioned, and they will answer the questions with supporting evidence. **[CR8]** (3.A.1.1, 3.A.1.3, 1.C.1.1)
- Using an accelerometer app for their smart phone (SPARKvue is one), students will analyze accelerations they experience every day. They can take the data while moving down the hall between classes, while on the school bus, on an amusement park ride, or anything else they want (within reason – safety first!). Students will present a description of the motion they experienced (not only acceleration, but velocity and displacement, too), both quantitatively and quantitatively, including graphs. Their presentation will be peer critiqued and/or questioned, and they will answer the questions with supporting evidence. **[CR8]** (3.A.1.1, 3.A.1.3, 1.C.1.1)
- Students will take two pictures – one of an object in translational equilibrium, and one of an object in rotational equilibrium. The objects also must have more than three forces acting on them. They will then construct free-body diagrams for each object, and determine the magnitude of each force acting on each object. For the object in rotational equilibrium, students will also find the magnitude of each torque acting on the object. Students will present their work in class. Their presentation will be peer critiqued and/or questioned, and they will answer the questions with supporting evidence. **[CR8]** (3.13.1.3, 3.13.2.1, 3.F.1.1, 3.F.1.2, 3.F.1.5)

CR3 - Students have opportunities to Physics 1 learning objectives connecting across endur ing understandings as described in the curriculum framework. These occur in addition o those within laboratory ın vestigations. opportunities must

CR8 - course opportunities for students to written and oral argumentation skills.

Real World Physics Solutions:

In order for students to become scientifically literate citizens, students are required to use their knowledge of physics while looking at a real world problem. **[CR4]** Students may pick one of the following solutions:

- Students will pick a Hollywood movie and will point out three (or more) instances of bad physics. They will present this information to the class, describing the inaccuracies both qualitatively and quantitatively.
- Students will research a thrill ride at an amusement park. They will present information to the class on the safety features of the ride, and why they are in place.
- Students will present information to the class on noise pollution, and it's danger to both human and animal life. They will also propose solutions to noise pollution problems.
- Students will go to the insurance institute of highway safety website (iihs.org) and will look at the safest cars in a crash. They will present information as to why these cars are safer and how the safety features keep people safe.

CR4 - Thecourse provides students with opportunities to apply their knowledge of physics principles to r eal or qu estions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.