AP Physics 1 Syllabus

Course Overview

AP Physics 1 will meet for 90 minutes on A-B scheduling and for 45 minutes on regular scheduling. Class activities will include lecture, demonstration, problem solving sessions, and lab. On regular scheduling, the entire class period will be devoted to lab time when labs are scheduled. On A-B scheduling, 50 minutes will be scheduled for lab, while the rest of the period may be used for other activities.

CR1 AP Physics Text Book:

College Physics : A Strategic Approach (3rd ed.) Knight, Jones, Field, Pearson: Boston, Massachusetts, 2015.

In addition to the text book, the web based program "Mastering Physics" will be used to supplement and to reinforce instruction. Many of the homework assignments will be web based.

Materials Required and Used:

The AP Physics 1 Course will utilize computer based laboratory equipment and real time technology, such as the Pasco 750 Science Workshop and video analysis software. Students will have access to computers and the internet on a regular basis, if/when needed. In addition to advanced real time technology, some traditional labs will be used. TI 30 XIIS calculators will be provided, but it is recommended that students supply their own graphing calculators.

CR2 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.

CR3 Instruction emphasizes the cohesion of the various topics that comprise the physics curriculum. Each unit's investigation begins by referencing and applying models already studied. As the course progresses, each activity involves an increased amount of the learning objectives in increasing levels of difficulty.
Two examples of such activities include a video analysis project where students will video various common objects, animals, playground equipment, etc. which may exhibit motion such as constant, accelerated, rotational, and oscillatory motion. Video analysis software will be utilized to gather quantitative data. The other project will employ the use of accelerometers, possibly in the form of phone apps, and require the measurement of the acceleration of everyday occurrences. Analysis in both projects will be performed to describe displacement, velocity, and acceleration. The appropriate models constructed, and the student's findings will then be shared. LO: 1.C.1.1, 3.A.1.1, 3.A.1.2, 3.A.1.3, 4.A.2.1, 4.A.2.2, 4.A.2.3,

CR5 CR7 Lab Procedure:

Lab activities will comprise a minimum of 25 percent of allotted class time. Students may be required to produce lab reports and documentation on their own time. Some labs will be student-designed/developed while others will be predesigned. Students will work in groups ranging from two to four students, depending on class size. All students will be required to submit lab reports. Students will be required to keep a lab portfolio for verification of college level lab work. Lab reports will include the following:

- a statement of the problem
- an hypothesis
- a procedure
- the data recorded
- graphs and data analysis
- a conclusion, including error analysis

Some of the labs will involve problem solving to determine unknown variables. (For example, in the electronics lab, students will design a method for determining the value of unknown resistors). In many cases, the students will have access to a variety of lab equipment with no specific directions as to how to carry out the lab. It will be up to the students to develop a method to determine the unknown values, or to test the effects of changing variables.

CR8 In the course, students become familiar with the three components of scientific argumentation. The first element is the claim, which is the response to a prediction. A claim provides an explanation for why or how something happens in a laboratory investigation. The second component is the evidence, which supports the claim and consists of the analysis of the data collected during the investigation. The third component consists of questioning, in which students examine and

defend one another's claims. Students receive explicit instruction in posing meaningful questions that include questions of clarification, questions that provoke hypothesis, and questions that probe implications and consequences. As a result of the scientific argumentation process, students are able to revise their claims and make revisions as appropriate.

One example of such an activity is the discussion that will occur prior to and post of the spring cart on an incline lab. Students will create models using tools such as energy graphs and particle models to predict the quantitative effect of changing various parameters such as incline angle or spring constant of a spring cart-incline system. Prior to the lab students will present and defend their models. In addition, the opportunity will be provided for students to challenge each other's models and predictions. After the lab is complete and the data is analyzed, the students will defend their findings or explain variation from their original theories while other students may challenge or provide constructive criticism.

Course Outline

Big Ideas **Times are approximate**	**Units CR2a-j**	**Chapters**	**Labs and Scientific PracticesCR5 CR6a-b**
BI 3 5 weeks	**Unit 1: One-Dimensional and Two-Dimensional Motion** a. kinematics b. vectors c. projectile motion	1-3	Lab Equipment Introductory Activity with Motion Sensors Cart on an Incline Kinematics Graphing Lab – Using real time software and lab equipment students will predict and then analyze the motion of a dynamics cart on an incline. SP 1.2, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2 OI Free Fall and Measuring the Acceleration of Gravity Lab – Students will predict the effect of mass and measure the acceleration due to gravity by various methods. SP 1.4, 2.1, 2.2, 3.1, 4.2, 4.3, 4.4, 5.1, 5.3, 6.1, 6.4, 7.2 Projectile Motion Lab- Students will predict projectile paths and calculate time of flight and range and compare to measured values. SP 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.2, 6.1, 6.4, 7.2

BI 1, 2, 3, 4 4 weeks	**Unit 2: Forces and Newton's Laws** a. forces b. free-body diagrams c. Newton's Laws and applications d. friction e. interacting Objects	4-5	GI Atwood Lab- Students will create models and derive formulas to calculate the tension force and acceleration for the system and compare to actual values. SP 1.1, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2 OI Newton's 2nd Law Lab with Dynamics – Students will predict and test the effects of changing the masses of various parts of a dynamic cart and suspended mass system. SP 1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2 Coefficient of Friction Lab- Students will determine the coefficients of friction for various materials. SP 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
BI 1, 2, 3, 4 2 weeks	**Unit 3: Gravitation and Circular Motion** a. uniform circular motion b. dynamics of uniform circular motion c. Law of Universal Gravitation	6	Centripetal Force Lab – Students will calculate and test the velocity of a mass on a string traveling in a circle needed to keep a suspended mass in equilibrium. (Students will construct equipment.) SP 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2 GI Orbital Research Lab – Students will research orbital data and calculate the velocities for various objects, planets, etc. The research will then be shared and discussed. SP 1.1, 1.2, 4.4, 5.1, 6.2, 6.3, 7.1
BI 3 ,4 ,5 5 weeks	**Unit 4: Work, Energy, and Power** a. work b. power c. energy d. kinetic energy e. potential energy: gravitational and elastic f. conservation of energy	10-11	OI Spring Cart on an Incline Lab – Students will investigate changing various parameters of a spring cart-inclined track system. SP 1.1,1.2, 1.4, 3.2, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 6.1

	Unit 4 continued		GI Energy and Non-Conservative Forces Lab – Students predict and estimate the effects of the energy dissipated by friction of a system consisting of a modified Atwood's machine. Data will be collected and then analyzed. SP 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 6.5, 7.2
BI 3, 4, 5 3 weeks	**Unit 5: Center of Mass and Linear Momentum** a. center of mass b. internal and external forces on a system c. impulse and momentum d. conservation of momentum e. collisions: elastic and inelastic	7.4, 9	Center of Mass Lab – Students will estimate and then determine the mass of a meter stick by placing a mass at various locations and plotting the data. SP 2.1, 2.3, 4.2, 4.3, 5.1, 5.3 GI Elastic and Inelastic Collision Lab – Students will predict and measure the velocities for dynamics carts in both types of collisions in a closed system and compare these to actual values. SP 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
BI 3, 4, 5 3 weeks	**Unit 6: Rotational Motion** a. torque and static equilibrium b. rotational kinematics c. rotational dynamics and inertia d. rotational energy e. angular momentum f. conservation of angular momentum	7-8.2	Rotational Kinematics Graphing Lab – Using a rotary motion sensor, students will measure various rotational parameters and produce the appropriate graphs. SP 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2 OI Conservation of Angular Momentum Lab – Students will predict and test the effects of changing various parameters of a rotating mass-suspended mass system. SP 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

BI 3, 5 2 weeks	**Unit 7: Oscillations** a. restoring force and simple harmonic oscillation b. simple harmonic motion graphs c. pendulums d. mass-spring systems	8.3-8.4, 14	GI Mass-Spring System Graphing Lab – Students will record displacement, velocity, and acceleration of a spring-mass system and appropriate graphs. Various masses and springs will be used to observe the changes in period and amplitude and to compare them to calculated values. In addition, analysis of the kinematics, dynamics and energetics will be performed. SP 1.2, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
BI 6 2 weeks	**Unit 8: Waves** a. traveling waves b. standing waves c. wave properties d. sound	15-16	Various demonstrations will be performed to display the properties of waves. Wave Properties Lab – Students will design an experiment to determine or test the relationship between wavelength, frequency and propagation speed. SP 1.4, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.4, 7.2
BI 1, 3, 5 2 weeks	**Unit 9: Electrostatics** a. electric charge and it's conservation b. electric force: Coulomb's Law	20-21	Qualitative Electrostatics Lab – Using the electrostatics lab equipment, the students will observe various electrostatic phenomena such as charging by conduction and induction. SP 1.2, 3.1, 4.1, 4.2, 5.1, 6.2, 7.2
BI 1, 5 2 weeks	**Unit 10: DC Circuits** a. electric resistance b. Ohm's Law c. DC circuits d. series and parallel circuits e. Kirchhoff's Laws	22-23.5	Basic DC Circuits Light Bulb Lab– Students will learn the basics of wiring DC circuits and making voltage measurements. The measurements will be compared to calculated values. SP 1.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2 GI Series and Parallel Circuits Lab – Using resistors and wiring boards, students will construct circuits and then test them to see if they perform as expected. SP 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

CR4 Real World Application:

The opportunity for students to make interdisciplinary connections will be provided through at least two projects. For the first project, students will research and build water bottle rockets. The rockets will be launched to collect data for analysis. The second project will be an end of the year project where students will choose a real world situation such as sports, medical applications, social issues, and technological innovations in which physics can be applied. Throughout the year the students will research their projects and how physics applies to them. The students will prepare a presentation using various forms of media, models, or student originated products which will be presented to the class at the end of the year. The purpose of the presentations is to explain how physics applies to various real world situations.

GI – Guided Inquiry Lab
OI – Open Inquiry Lab
BI – Big Idea
SP – Scientific Practices
CR – Course Requirements
LO – Learning Objective