AP Physics 1 Syllabus

Amherst County High School
Instructor: Mr. Jon Collins

Textbook
Primary Textbook: Douglas Giancoli, *Physics 5th Ed.* Upper Saddle River NJ: Prentice Hall, 1998.

Secondary Textbook: Knight, Randall D., Brian Jones, and Stuart Field. *College Physics: A Strategic Approach.* 2nd ed., AP® ed. Boston: Pearson, 2013.

Grading Overview:

10% - Homework
20%- Nine weeks exam
30%- Class work/Labs
40%- Test and Quizzes

Because this is an AP class the school has changed the grading scale to the following:
90-100% -A
80-90% -B
70-80% -C
60-70% -D
Below 60% -F

Furthermore the school will add a quality point to the grade for AP classes, so that for an "A" one would earn a 5 instead of a 4, when calculating the GPA.

What to Bring to Class:
Students will need to have: pencil/pen, scientific calculator, paper, and note cards. Also, you will need to have three distinct areas in a three ring binder, or two notebooks and a folder. One folder/area of binder will be for warm-ups. Each class will be started with a warm-up question. You must write the date, the question, and the answer every day. Make this up if you are absent, it will be collected and graded periodically. The other notebook/second area in binder is for your notes and class work. The folder/third area in binder is for labs, this will serve as a laboratory notebook all labs and data should be kept here.

Rules and Discipline:
Classroom rules:

- Come to class prepared, be in your seat, and begin working when the bell rings.
- Show respect to everyone (do not talk while teacher is lecturing, treat classmates kindly.)
- Take care of equipment and only touch it when given permission.
- Follow directions the first time they are given.
- Stay in a seat until the bell rings.

Consequences:

- Removed from lab
- Writing a paper on a topic we are currently covering
- Conference with student
- Phone call home
- Referred to administration

Make up work:

- It is the responsibility of the student to see the teacher on the day he or she returns to school to obtain assignments and schedule make-up work at the teacher's convenience.
- All work must be completed within five school days from the return to school.
- When a student is absent, if a parent requests, assignments are to be available at the school by the end of school office hours that day.
- To make up a missed lab, a student can write a two page paper on the same topic as the lab.

Safety:

Safety is an important issue and acting unsafe will result in being removed from lab, and given written work, and possibly a referral to administration as well as a phone call home. If an accident were to occur you are expected to let the teacher know immediately and if appropriate contact the main office or use the fire extinguisher. Also, a nurse (Ms. Owen) is available just down the hall. If the nurse is not available Mr. Curd, is a first responder. However, prevention is best; therefore you should never touch any piece of equipment without permission and act professionally in the laboratory.

Teaching Philosophy

This college level class is a wonderful opportunity to grow as a critical thinker, problem solver, and great communicator. You are expected to put in considerable more time working on AP Physics 1 outside of class than you would a non AP class. Expect to spend at least as much time outside of class working on AP Physics 1 as you do in class. It is hard work, but so does anything that is worthwhile.

You would never expect to win a race if you didn't train. Similarly, you can't expect to do well on an AP exam if you don't train academically. AP Physics is immensely rewarding and exciting, but you do have to take notes, study, and understand your homework. Together, we will work as teams to build the skills you need to do well on the AP Exam.

This class will include some flipped instruction, where basic notes are taken at home based from either youtube videos or textbook. The following day often there will be a basic idea quiz.

This class will also utilize inquiry based labs. Over 25% of class time will be devoted to laboratory activities. In an inquiry based lab students will be given a basic task to complete, like "Determine the acceleration due to gravity on Earth." The students will then use common classroom materials and 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 orally present their results on a white board 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.

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 typically includes 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

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.

<u>Big Ideas</u> (BI) AP Physics 1 is contained in 6 Big Ideas that weave between the Units.
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.

Units:

1. Kinematics in 1-Dim (BI 1) (BI 2)

This unit covers the basic ideas of how things move. In this unit the student will complete a Unit Converting Activity, Physics Walk Activity, Graph Match, Graph to Graph wkst, **Penny Drop guided Inquiry Lab** [In this lab students are asked to estimate the time it takes for a penny to fall to the deepest part of the ocean. They are given several vessels capable of holding water, access to a sink, several measures, and a stop watch. They are instructed to create a model of a penny falling through water using at least 6 data points. Then they are to analyze their data and use it to make their prediction (Science Practice SP: 1.1, 1.3, 1.4, 1.5, 2.1, 2.2, 3.2, 3.3, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2, 5.3, 6.1, 6.2)] , and **Determine g Open Inquiry Lab** [In this lab students are given a AAA battery, photogate timer, and ½" CPVC pipe of differing length, along with standard lab equipment. They are then instructed to determine the acceleration of the AAA batteries falling through the CPVC tubes using at least 6 data points. (SP: 2.1, 2.2, 2.3, 3.3, 4.1, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4).]

SCIENTIFIC ARGUMENTATION

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 probe assumptions, 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 **[CR8]**. One example of this comes from the Penny Drop Guided Inquiry Lab, where student determine how they will collect data in order to predict how long it would take a penny to fall to the deepest part of the ocean, estimated at 4.3 km. Once they have finished they will put findings on a white board and present to the class. The teacher will lead a discussion comparing different groups results. Students will have to defend assumptions (claims) made, such as pennies fall with a constant velocity in water. They will learn to use their data to defend their position and be given the opportunity to change their paper if needed. Also, students will ask the other groups questions about their data and assumptions.

2. Vectors/Dynamics (BI 1) (BI 2) (BI 3) (BI 4)

This unit begins by with an examination of Newton's Laws, then expands on vectors so that students can add vectors in two dimensions and use vector components. Then fuses the understanding of Newton's laws with the vectors so that students can analyze 2-d free body diagrams in light of Newton's Laws (opportunities for both accelerated center of mass (2nd Law) with unbalanced forces and zero acceleration (1st Law) with balanced forces will be done.) In this unit the student will complete a Vector Component Activity [Here students are given three spring scales which are taped in place and under tension, that have string attached to the bottom and tied in a knot. They must calculate the X and Y component of each force then add them to verify the sum is zero] , **Cart Accel with Hanging mass guided inquiry Lab** [In this lab students are prompted with how would increasing the hanging mass affect acceleration. They have a cart/track with pulley and hanging mass setup. They record the accel, then move mass from cart to hanger and repeat at least 6 times. The data is graphed and used to determine trend. Students are then asked to predict the total mass of cart and hanger system using graph.(SP: 1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 2.3, 3.3, 6.1, 6.2, 6.3, 6.4, 6.5, 7.1)], **Determine Mass of Hanging Object From Two Scales Open Inquiry Lab** [In this lab there is an unknown mass hanging from two strings that make a "V" shape. The other end of the strings are connected to spring scales. Students are instructed to determine the mass of the hanging object with out physically touching the setup. (SP: 1.1, 1.4, 2.1, 2.2 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2)] **Terminal Velocity Coffee Filter Open Inquiry Lab** [Students are given the task of determining the terminal velocity of a coffee filter. They must support their claim with data, graphs, and formulas in an oral presentation to the class.] (SP: 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 4.1, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.5, 7.1), **Inclined Plane Lab*** [Students design and perform and experiment to verigy that $a=g\sin\theta$ in the absence of friction on an inclined plane.], and FBD wkst. Students will use dynamics to analyze real world situations.

3. <u>Projectiles/Kinematics in 2-Dim</u> (BI 1) (BI 2) (BI 3)

This short unit covers projectile motion as well as velocities/accelerations/displacements in two directions. In this unit students will complete a **perfect basket open inquiry lab***[In this lab students must predict where to place a cup on the floor so that a ball that rolls off of a track on the lab table goes in the cup on the first try.] (SP: 1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 7.2) as well as analyze the monkey and hunter.

4. <u>Energy</u> (BI 3) (BI 4) (BI 5)

This unit incorporates the ideas of work, power, Hooke's' Law, the forms of Energy, and Energy conservation. The labs include: **Work to Stretch Spring open inquiry Lab***[In this lab students are asked to determine the amount of work needed to compresses a spring of a cart on a track, and verify with kinetic energy after spring is released. Students will use a graph of force vs. position to confirm W=area under the curve=$\Delta U= \frac{1}{2} K\Delta X^2= \frac{1}{2} mv^2$] (SP: 1.1, 1.4, 1.5, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1) **Barbie Bungee Lab open inquiry Lab***[In this lab student are given a Barbie and rubber band chain (bungee cord) and they must use Energy relationships to determine how high above water Barbie should be dropped to get her hair wet, but not let her face go under the water.](SP:1.2, 1.3, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.3, 5.1, 6.1, 6.2, 6.4, 7.1,7.2), and **Down the Hill guided inquiry Lab**[Student measure the velocity of a cart after it has gone various distances down a hill. They plot change in potential energy vs velocity then linearize.]*

This AP Physics strives to help students relate the content to real world applications. This can be seen in the fore-mentioned lab with bungee jumping as well as the following project included in this section.

1. PROJECT DESIGN [CR3]

ACTIVITY: Phet Skate Park Investigation

DESCRIPTION: Working in groups of two or three, students design a simple ramp using Phet's skate park that includes a vertical loop to test whether the total energy of the skater-Earth system is conserved if there are no external forces exerted on it by other objects. Students include multiple representations of energy to provide **evidence** for their **claims**. Students use a bar chart, the mathematical expression of conservation of energy represented by the graph, and the corresponding calculations to evaluate whether the outcome of the experiment supports the idea of energy conservation**.** This activity is designed to allow students to apply the following Learning Objectives:

Learning Objective 5.B.3.1

The student is able to describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy.

Learning Objective 5.B.3.2

The student is able to make quantitative calculations of the internal potential energy of a system from a description or diagram of that system.

Learning Objective 5.B.3.3

The student is able to apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system.

Learning Objective 5.B.4.2

The student is able to calculate changes in kinetic energy and potential energy of a system, using information from representations of that system.

Learning Objective 4.C.1.1

The student is able to calculate the total energy of a system and justify the mathematical routines used in the calculation of component types of energy within the system whose sum is the total energy.

Learning Objective 4.C.1.2

The student is able to predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system.

5. Momentum (BI 3) (BI 4) (BI 5)

The unit covers impulse momentum, and conservation of momentum. Here students evaluate car crashes in light of momentum, impulse, and conservation of momentum giving students a real world experience. **Momentum Lab Open Inquiry Lab***[In this lab students use cart/track and motion sensors. They are tasked at determining both momentum and energy before a collision as well as after. They evaluate both elastic and non-elastic situations.], **Impulse Open Inquiry Lab***[Students use a cart/track motion sensor or photogates along with a force probe. They are asked to determine the relationship between momentum and the forces used to change it. They graph their results and pull the formula $F\Delta t=m\Delta V$ from the graph], if time permits, video analysis of ballistic pendulum is also done.

6. Circular Motion/Gravity /SHM (BI 1) (BI 2) (BI 3) (BI 4) (BI 5)

This unit covers uniform circular motion, universal gravitation, and simple harmonic motion. As part of the unit a, **Helicopter Open Inquiry Lab*[**Students evaluate the relationship between Fc and velocity. They graph and linearize results, then determine the meaning of slope.] **Flying Bat Guided Inquiry Lab*** [Students evaluate conical circular motion of constant velocity flying bat. Then they Must do free body diagram to determine F in string] and Pendulum Open Inquiry Lab* [Students are asked to determine what affects the period of pendulum between mass of bob, angle pulled back, and length of string. They must present their findings and defend it using their data.] will be done by students. Students will also be instructed to use data from the NASA website to construct a graph whose slope is G. This incorporates real world application as well as using data from another source.

7. Rotational Motion (BI 3) (BI 4) (BI 5)

This unit includes rotational kinematics, torque with rotational dynamics, and rotational momentum and energy, along with conservation of angular momentum. As part of this unit students will complete a Torque Lab* [students balance a meter stick with two weights and an offset fulcrum. They verify the sum of torque equals zero mathematically.], and a lab where they Determine moment of Inertia from slope of line lab*.

Project 2

ACTIVITY: Torque and the Human Arm [CR4]

DESCRIPTION: This activity provides an opportunity for students to make an **interdisciplinary connection** to biological systems by investigating the structure and function of a major muscle (biceps) in the human body. Students design and build an apparatus that replicates the forearm and biceps muscle system. The objective is to determine the biceps tension when holding an object in a lifted position. Students may use the Internet to research the structure of the biceps muscle. They can use readily available materials in the classroom, such as a meter stick, a ring stand, weight hangers, an assortment of blocks, and a spring scale. In their lab journal, students are required to document the different stages of their design. Required elements include design sketches, force diagrams, mathematical representations of translational and rotational equilibrium, and numerical calculations.

Learning Objective 3.F.1.1

The student is able to use representations of the relationship between force and torque.

Learning Objective 3.F.1.2

The student is able to compare the torques on an object caused by various forces.

Learning Objective 3.F.1.3

The student is able to estimate the torque on an object caused by various forces in comparison to other situations.

Learning Objective 3.F.1.4

The student is able to design an experiment and analyze data testing a question about torques in a balanced rigid system.

Learning Objective 3.F.1.5

The student is able to calculate torques on a two-dimensional system in static equilibrium, by examining a representation or model (such as a diagram or physical construction).

8. Electrostatics (BI 1) (BI 3) (BI 5)

This unit is an overview of static electricity and charge and the conservation of charge. As part of this unit students will utilize Coulomb's Law and the electrostatic force to perform the **How much charge open inquiry lab*** [Students estimate the charge on two identical, equally charged spherical pith balls of known mass.*]

9. DC Circuits (BI 1) (BI 5)

This unit includes Ohm's Law, Kirchhoff's Law and basic circuitry. Students will complete **Ohm's Law Guided inquiry lab*** [Determine the relationship between voltage and current. They discover that the slope of line is resistance.] and which **light bulb is brighter guided inquiry lab***[students set up several different circuit configurations and determine the factors that affect the brightness of a bulb.]

10. Waves (BI 6)

This unit cover the basics of waves and sound. Students will complete waves on a string vlab*, **Harmonics on a string Open Inquiry Lab***[Students measure wavelength, frequency and velocity at different harmonics of a string fixed at one end. They analyze data and realize velocity is a function of the material and wavelength is a function of distance that is held fixed.] and **Measure speed of sound guided inquiry lab*** [Students use tubes, buckets of water and ipods producing sound of constant frequency to determine wavelength based on harmonics. The wavelength is used to calculate the speed of sound.]

*** These labs reinforce the 7 Science Practices taught in the first labs. Many of these labs require students to utilize physics across several topics.**

Additional Help:

If you are struggling in this class I am here to help you. I am willing to stay after school most days if you need additional assistance. The internet is full of great stuff as well. Below are a few of my favorites.

http://www.brightstorm.com/science/physics/ This website is full of videos and tutorials.

http://www.youtube.com/user/onlearningcurve/playlists Youtube channel with instruction on AP level physics.

www.physicsclassroom.com A great site. Click on tutorial and you can get info on about any topic in physics.

http://ocw.mit.edu/courses/physics/ This is MIT's site for released physics content, you can watch youtube videos of old lectures or get other things.

http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html#mechcon This is an interactive VIEN diagram,

http://www.khanacademy.org/ This are instructional videos, scroll down to physics to view a video.

http://www.learnapphysics.com/ Good site for practice prob. and lessons.

www.learnerator.com Practice problems

Please note: The syllabus is a working document and is subject to change throughout the school year at the instructors discretion.