Advanced Placement Physics

Course Description

AP® Physics 1 is an algebra-based course in general physics that meets for 70 minutes on alternating days for the entire school year. General physics topics presented during the course closely follow those outlined by the College Board and also mirror 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. Each unit, students participate in inquiry-based explorations and laboratories to ensure a clear conceptual understanding of key physics topics. Students spend less of their time on traditional formula-based learning and more time on developing critical thinking and reasoning skills. 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. This course teaches and reinforces skills and dispositions aligned with the ***Portrait of the Crusader,*** including thinking critically, solving problems through innovation, and communicating effectively. Laboratory investigations and in-class activities promote collaboration and respect for other student's ideas.

Course Essential Questions

- What fundamental and derived units can be used in describing our physical world?
- What are fields (such as gravitational, electric) and how can they be used to understand physical interactions?
- What types of forces exist and how do they govern the physical interactions in our universe?
- What are open and closed systems and how do they relate to energy?
- What are the Laws of Conservation and how do they describe interactions in our universe?
- How can waves transfer energy and momentum from one location to another without the permanent transfer of mass?
- How can waves serve as a mathematical model for the description of other phenomena?

Curriculum Framework

I. Kinematics

Focus Questions:

- What is kinematics and what are the kinematic equations?
- How do position and velocity graphs help us to understand motion?
- How can trigonometry and vectors be used to analyze motion in two dimensions?
- What forces govern the motion of a projectile and how can trigonometry be used to analyze its motion?

Concepts/Skills:

- Define position, velocity, acceleration and kinematics.
- Create and interpret motion graphs.
- Collect and analyze data with precision and accuracy.
- Quantify error in scientific measurements and apply that understanding to the analysis and conclusion of an experiment.
- Perform SI System unit conversions.
- Analyze the motion of objects that have constant velocity or constant acceleration.
- Add and subtract vector quantities graphically and by components.
- Determine the x and y components of a vector for an object moving in two dimensions.
- Analyze the motion of an object in 2-dimensions by resolving vectors into perpendicular components.
- Solve problems involving projectiles, both on paper and in the laboratory
- Approximate the slope of a curve to calculate instantaneous velocities and accelerations.
- Derive the Big 4 equations of motion and apply them to kinematics problems.
- Apply trigonometry and algebra to solve for unknown quantities in projectile motion problems.

Labs:

- Motion Match
- Ticker-tape Acceleration
- Chase scenario
- PirateTreasure Vector Hunt
- Vector Addition
- Projectile Velocity
- Projectile Cannon Catch

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

II. Dynamics - Forces and motion

Focus Questions:

- What are the four fundamental forces of nature?
- What are balanced and unbalanced forces?
- How do Newton's Laws of Motion describe universal dynamic truths?

Concepts/Skills:

- Identify individual forces acting on an object and draw an appropriate Free Body Diagram
- Predict an object's motion based on the forces acting on it
- Determine the forces needed to keep a body in a state of static equilibrium.
- Measure and/or calculate the relationship between the net force acting on a body, the mass of the body, and the acceleration produced (Newton's Second Law of Motion).

- Analyze and mathematically describe forces as interactions between bodies (Newton's Third Law of Motion).
- Investigate, measure, and analyze the nature and magnitude of frictional forces.

Labs:

- Inertial and gravitational mass
- Newton’s Second Law (carts, masses, and pulleys)
- Force Table Vector challenge
- Determining the Mass of a Car (using a bathroom scale)
- Coefficient of friction Lab
- Atwood’s Machine
- Circular motion in a suspended object

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

III. Circular Motion and Gravitation

Focus Questions:

- How do Newton’s Laws of Motion relate to circular motion?
- What are centripetal forces and how do they create circular motion?
- What equations can be used to describe circular motion?
- What is Newton’s Law of Universal Gravitation and how does it relate to satellite motion?

Concepts/Skills:

- Analyze and mathematically describe centripetal forces that cause circular motion.
- Explain the relationship between mass, distance and force as described by Newton's Universal Law of Gravitation.
- Apply Newton's Universal Law of Gravitation to understand the behavior of both Earthly objects and orbital motion.
- Apply Newton's Universal Law of Gravitation in calculations involving mass, force and distance.
- Derive and apply formulas for orbital (satellite) motion.

Labs:

- Circular motion in a suspended object
- The moon and earth’s satellites, drawn to scale

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

IV. Energy

Focus Questions:

- What are open and closed systems and how do they relate to conservation of energy?
- How are force and energy connected?
- What is "useful" energy?
- How do we measure energy and energy transfer?
- What are potential and kinetic energy, and what are examples of each?
- How can the Law of Conservation of Energy be applied to kinematics problems?

Concepts/Skills:

- Solve kinematics problems using the Law of Conservation of energy.
- Measure and analyze the transfer of energy by an applied force using the equation for work.
- Measure and analyze the rate at which energy is transferred using the equation for power
- Organize energy types into conservative and non-conservative types.

Labs:

- Roller coaster simulation
- Electric bill analysis
- Energy Conservation (determine percent energy conservation when a ball rolls down a ramp)
- Work done in stretching a spring

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

V. Momentum

Focus Questions:

- How does the Law of Conservation of Momentum affect our daily lives as well as universal physical interactions?
- How do we determine an object's center of mass?
- What are elastic, inelastic, and super inelastic collisions and how do they relate to energy?

Concepts/Skills:

- Use the Law of Conservation of Momentum to solve a variety of collision problems.
- Explain the differences between elastic and inelastic collisions.
- Use the Conservation Laws to predict the height of a struck pendulum.
- Compare and contrast impulse and momentum and solve appropriate problems.

Labs:

- Bumper design
- Impulse and change in momentum
- Elastic and inelastic collisions
- Ballistic pendulum

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

VI. Simple Harmonic Motion

Focus Questions:

- How are waves created and propagated?
- What are the different kinds/types of waves? What are the properties and behaviors of waves?
- Where do we see waves in our everyday lives and why are they important to us?
- How are properties and behaviors of a wave described mathematically?
- What technologies make practical use of waves?
- What is the Doppler Effect and how does it relate to both sound and light waves?

Concepts/Skills:

- Measure/calculate the frequency, period, and wavelength of waves produced in a "Slinky" toy and in a vibrating string.
- Solve wave problems using the wave equation and the relationship between period and frequency.
- Distinguish between and identify transverse and longitudinal waves.
- Predict the behavior of waves when they encounter barriers.
- Illustrate the behaviors of waves (diffraction, refraction, interference, superposition, Doppler Effect)
- Evaluate and analyze interference patterns of two sets of concentric, two-dimensional waves.
- Explain the causes of a standing wave and identify its parts.
- Explain the phenomenon of resonance and how it impacts our everyday lives.
- Predict the fundamental frequency or harmonics of various musical instruments.
- Explain how/why a sound source changes apparent pitch when moving relative to the observer.
- Use the Doppler equation to determine either the shifted frequencies given the motion or the motion given the frequencies.
- Mathematically relate the amplitude of a wave to its energy/intensity.

Labs:

- Discovering pendulum periodic oscillations
- Slinky Wave Observations
- String Tension and standing waves

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

VII. Torque and Rotational Motion

Focus Questions:

- What is torque? How does it relate to rotational motion?
- What is the difference between rotational motion and circular motion?
- Why do we use radians, not degrees, when dealing with rotational motion?
- What is Moment of Inertia and how does it affect rotation?

Concepts/Skills:

- Compare and contrast circular motion and rotation
- Explain the concept of torque and how it relates to rotational motion.
- Be fluent in the use of radians, and convert between radians and degrees.
- Predict what sorts of cylindrical items will roll down a ramp faster, and explain why.

Labs:

- Create a “Torque-mobile” or “Torque Tower”
- Investigating torque and rotation for circles in a vertical plane.
- Modeling torque with the human arm
- Conservation of Angular Momentum

Summative Assessments:

- A.P. style written assessment focused on terminology, concepts and modeling taught in the unit.

Resources

- Giancoli, Douglas C. *Physics: Principles with Applications.* Boston: Pearson Education Inc. 7th edition. 2014 (available online to students)
- PhET: Free online physics, chemistry, biology, earth science and math simulations." PhET: Free online physics, chemistry, biology, earth science and math simulations. N.p., n.d. Web. 28 June 2011. PhET Simulations
- "The People's Physics Book", The People's Physics Book (CK12 version) by emotif - Issuu
- "Teachers:Lesson Plans." Discovery Education. Web. 29 June 2011. http://www.discoveryeducation.com
- Khan Academy   www.khanacademy.org

Grading Policy

- Summative Assessments - Tests: 35 - 45 %
- Quizzes: 15 - 25 %
- Lab work: 15 - 25 %
- Classwork: 10 - 20 %
- Student Preparation: 15 - 25 %