Pequannock Township School District
Curriculum Syllabus

AP Physics Curriculum
Grades 10-12

Course Description:

The AP Physics course outlined in this curriculum reflects a commitment to what physics teachers, professors, and researchers have agreed is the main goal of a college-level physics course: to help students develop a deep understanding of the foundational principles that shape classical mechanics and the introduction to electrostatics. By confronting complex physical situations or scenarios, the course is designed to enable students to develop the ability to reason about physical phenomena using important science practices, such as creating and analyzing representations of physical scenarios, designing experiments, analyzing data, and using mathematics to model and to solve problems. To foster this deeper level of learning, this AP Physics course defines concepts, skills, and understandings required by representative colleges and universities for granting college credit and placement. Students will practice reasoning skills used by physicists by discussing and debating, with peers, the physical phenomena investigated in class, as well as by designing and conducting inquiry-based laboratory investigations to solve problems through first-hand observations, data collection, analysis, and interpretation.

Course Standards:

The following is a list of NJSLS that describe what students are expected to know and be able to do as a result of successfully completing this course. The following NJSLS are the basis of the assessment of student achievement. The learner will demonstrate mastery of:

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3: Apply science and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Scope and Sequence

Unit 1: Kinematics	Sep. 16-19 days Q1	Although motion is considered an accepted phenomenon because it can easily be seen, discerning—and eventually understanding—why objects move requires more observation. Unit 1 introduces students to kinematics, particularly one-dimensional, two-dimensional, and projectile motion. Students will not only learn how to define each kinematic quantity (position, velocity, acceleration, and time), but also how to distinguish between them, and how to graphically and mathematically represent the relationships among them.

Unit 2: Dynamics	Oct. 16-19 days Q1	To understand how and why objects move, students must first understand the role forces play in motion. Unit 2 investigates Newton's laws of motion, which describe the relationship among moving objects and the forces acting on them. Students will learn how forces can change the motion of an object (first law); about the relationship between force, mass, and motion (second law); and why balanced forces become unbalanced (third law). These laws form the foundation of classical mechanics, and in subsequent units, students will evolve their understanding by applying Newton's laws of motion to a variety of physics phenomena.
Unit 3: Circular Motion and Gravitation	Oct.-Nov. 10-13 days Q1/2	In Unit 3, students will apply Newton's Laws in a polar coordinates and continue to enhance their understanding of the physical world using models and representations to create a more complete and complex model of motion, particularly as it relates to gravitational mass and inertial mass. Again, translation and connections are essential—students must be able to use content and science practices from the previous two units and apply them in different ways.
Unit 4: Energy	Nov- Dec 16-19 days Q2	In Unit 4, students will explore the relationship between work, energy, and power and will be introduced to the principle of conservation as a foundational model of physics, as well as the concept of work as an agent of change for energy. Students are not only expected to functionally define and calculate work, energy, and power, but must also be comfortable graphically and mathematically representing them. Understanding these relationships will help students make connections to other content presented in the course.
Unit 5: Momentum	Dec- Jan 10-13 days Q2	Unit 5 introduces students to these factors through the concepts of center of mass, impulse and momentum, and the conservation of linear momentum. Students will learn the relationship between impulse and momentum via application or calculations. The conservation of linear momentum and how it's applied to collisions is also addressed. Unit 4 offers a complete picture of the motion of a system, which is explored primarily through impulse and changes in momentum.
Unit 6: Rotations	Jan - Feb 16-19 days Q2/3	In this unit, students will investigate torque and rotational statics, kinematics, and dynamics, in addition to angular momentum and its conservation, to gain an in-depth and comprehensive understanding of rotation. Students are provided with opportunities to make connections between the content and models explored in the first four units, as well as with

		opportunities to demonstrate the analogy between translational and rotational kinematics.
Unit 7: Mathematical Aspects of Mechanics and Simple Harmonic Motion	Feb- Mar 10-13 days Q3	In this unit, students will formally be introduced to the instantaneous rate of change of a function and how it relates to kinematic and dynamic quantities. Additionally, the area under a curve between two points will be generalized to include continuous functions and represented as the inverse instantaneous rate of change of a function. This will facilitate the general approach to solving systems where the acceleration is velocity or position dependent, ex. aerodynamic linear drag. The Unit will end with the investigation of simple harmonic motion.
Unit 8: Mechanical Waves and Sound	Mar 10-13 days Q3	In Unit 8, students will extend the main themes of the previous units and learn about mechanical waves. Although concepts like oscillation, energy, and motion carry over into the study of waves, students will be introduced to new tools to communicate scientific phenomena and solve scientific models. Standing wave models, for example, are applied in Unit 8 to support a more in-depth knowledge of musical instruments and sounds.
Unit 9: Electricity	Mar - Apr 13-16 days Q3/4	As in earlier units, the foundation of this unit includes the study of relationships and change: Students are expected to be able to discuss what happens to force when there is a change in the separation between charges or the magnitude of charges. Throughout this unit, students will also apply and make predictions about conserved quantities. The unit culminates with the study of electrical circuits where students will draw on their knowledge of electricity and apply it to the conservation of charge in electric circuits.

Assessments

Evaluation of student achievement in this course will be based on the following:

Assessment Types
Lab, Reading Quizzes, Homework Quizzes, Review Quizzes, Unit Exams.

Labs
All lab work and lab reports will be done **legibly** inside your Quadruled composition lab notebook during your lab block using pencil, no typed labs. Your lab notebook will be submitted at the end of the lab period and returned to you at the start of the next lab day. Labs do not go home to be completed. Labs may require 1, 2 or 3 lab periods to complete depending on the complexity of the experiment.

Assessment Policy
Each assignment is assigned a certain number of points, which varies. The Final Grade is determined by Number of Points Earned Divided by Total Points.

Curriculum Resources

Textbook: Physics: Principles with Applications, 6th Edition by Douglas Giancoli,

Supplemental Textbooks: Blue Physics, D. Derbes; An Introduction to Mechanics 2nd Edition by Daniel Kleppner, Robert Kolenkow; University Physics with Modern Physics (13th Edition) by Hugh D. Young, Roger A. Freedman

Home and School Connection

The following are suggestions and/or resources that will help parents support their children:

Solve assigned homework problems and complete free response packets for every unit.

Invest in study/review time on a daily basis.

Online video resources: Fundamentals of Physics I - Yale Open Course