SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Advanced Placement Physics C - Mechanics	**Length of Course:** Full Year
Grade Level(s): 11 - 12	**Periods Per Cycle:** 9
Units of Credit: 1.5	**Length of Period:** 40 Minutes
Classification: Core or Elective	**Total Instructional:** 180 Hours

Course Description

This course is designed to prepare students for the College Board Advanced Placement Exam, which is administered in May, therefore it is fast paced and rigorous. The course will be presented at a much more rapid pace than Physics 1. In addition, AP Physics C - Mechanics will offer a variety of in-depth laboratory experiences with the use of electronic data gathering equipment such as the LabQuest. *Prerequisites: Successful completion of with a passing grade of 85% or teacher recommendation. or while enrolled in Calculus AB.*

Instructional Strategies, Learning Practices, Activities, and Experiences

Bell Ringers Class Discussion Flexible Groups APL Strategies Posted Objectives and Agenda	Teacher Demonstration Detailed Laboratory Experiments Inquiry Laboratory Experiments Textbook Reading Homework	Practice AP Exams and Essays Formal Assessments Guided Practice Online Tutorials/Resources Critical Thinking

Assessments

Quiz Lab Analysis In-Class Problems	Exam Qualitative From Observation	Problem Sets Class Discussion

Materials/Resources

Textbook Calculator Lab Equipment	Vernier Lab Equipment iPad Additional Text Resources	Gizmo – Lab Simulations Phet – Lab Simulations

Adopted: 5/22/23
Revised:

Kinematics	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
1. Motion in One Dimension 2. Motion in 2 Dimensions Key Concepts - Vectors, Vector Algebra, Components of Vectors, Coordinate Systems, Displacement, Velocity, and Acceleration Labs: Mathematical Modeling from Data – Circumference of a Circle; Kinematics of Sliding Blocks; Projectile Motion with Video; Projectile Motion with Target; Record-Player Kinematics.	1. The student will be able to differentiate between a vector and a scalar quantity. 2. The student will be able to identify mathematical relationships from typical graph shapes. 3. The student will be able to calculate average speed as well as velocity. 4. The student will be able to determine quantities from motion graphs. 5. The student will be able to describe, in words, the motion of an object by looking at a motion graph. 6. The student will be able to calculate all quantities associated with acceleration. 7. The student will be able to use and define the acceleration due to gravity. 8. The student will be able to solve horizontally launched projectile problems. 9. The student will be able to solve for the vertical and horizontal components of the muzzle velocity of a projectile. 10. The student will be able to solve projectile launched at an angle problems when there is no overall vertical displacement and when there is overall vertical displacement. **HS-PS2-1 - Forces and Interactions -** 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. **Science and Engineering Practices** Asking questions, for science, and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations, for science, and designing solutions, for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Systems and system models Structure and function Stability and change

<table>
<tr><th colspan="2">Newton's Laws of Motion</th></tr>
<tr><th>CONTENT/KEY CONCEPTS</th><th>OBJECTIVES/STANDARDS</th></tr>
<tr><td>1. Static Equilibrium
2. Dynamics of a Single Particle
3. Systems of Two or More Objects

Key Concepts – Force, Net Force, Equilibrium, Sum of the Forces, Friction, Equilibrant, Normal Force, Tension, Weight

Labs:
Equilibrium Balance;
Three-Dimensional Dangling Equilibrium;
Coffee Filter Drop and Terminal Velocity;
Measurement and Modeling of Friction;
Inclined Plane with Soft Landing.</td><td>1. The student will be able to define the term reference frame and identify motion in a frame of reference.
2. The student will be able to explain the difference between and inertial and a non-inertial reference frame.
3. The student will be able to apply newton's 3 laws of motion to common situations.
4. The student will be able to draw free body diagrams and use them in multiple force systems where there is acceleration or constant velocity.
5. The student will be able to resolve a force into component vectors.
6. The student will be able to identify the major classes of friction and explain situations involving each.
7. The student will be able to use an Atwood's Machine to model systems with more than two masses.

HS-PS2-1 - Forces and Interactions - 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.

Science and Engineering Practices
Asking questions, for science, and defining problems (for engineering)
Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data
Constructing explanations, for science, and designing solutions, for engineering
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

Crosscutting Concepts
Patterns
Systems and system models
Structure and function
Stability and change</td></tr>
</table>

Work, Energy, Power	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
1. Work and Work-Energy Theorem 2. Forces and Potential Energy 3. Conservation of Energy 4. Power Key Concepts – Work, Power, Energy, Potential, Kinetic, Reference Level, Energy Conservation, Conservative Forces, Nonconservative Forces Labs: Bungee-Jump Conservation of Energy Modeling Elastic Force and Work Flaming Razor Blade	1. The student will be able to explain what is meant by energy and identify examples where measurable work was not accomplished. 2. The student will be able to apply the work energy principle to energy applications. 3. The student will be able to contrast conservative versus non-conservative forces and their implication in the conservation of mechanical energy. 4. The student will be able to use the law of conservation of energy in situations such as roller coasters, water slides, propelling something into the air. 5. The student will be able to analyze power situations with work. **HS-PS3-1 – Energy** - 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 – Energy** - Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). **HS-PS3-3 – Energy** - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. **Science and Engineering Practices** Asking questions, for science, and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations, for science, and designing solutions, for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Systems and system models Structure and function Stability and change

Systems of Particles, Linear Momentum	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
1. Center of Mass 2. Impulse and Momentum 3. Conservation of Linear Momentum 4. Collisions Keys Concepts – Center of Mass, Inertia, Impulse, Momentum, Elastic Collision, Inelastic Collision Labs: Ballistic Pendulum Simulation of an Air Bag	1. The student will be able to apply the impulse momentum theorem to various scenarios such as sports collisions, elastic one dimensional collisions, elastic and inelastic two-dimensional collisions. 2. The student will be able to apply the conservation of momentum and energy in perfectly elastic one-dimensional collisions. 3. The student will be able to apply momentum and energy conservation to a ballistic pendulum. 4. The student will be able to analyze center of gravity situations with regularly and irregularly shaped objects. 5. The student will be able to explain the behavior of the center of mass of an object exhibiting translational motion. **HS-PS2-2 – Forces and Interactions -** 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 - Forces and interactions -** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. **Science and Engineering Practices** Asking questions, for science, and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations, for science, and designing solutions, for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Systems and system models Structure and function Stability and change

<table>
<tr><td colspan="2">Circular Motion and Rotation</td></tr>
<tr><th>CONTENT/KEY CONCEPTS</th><th>OBJECTIVES/STANDARDS</th></tr>
<tr><td>
1. Uniform Circular Motion
2. Torque And Rotational Statics
3. Rotational Kinetics and Dynamics
4. Angular Momentum and Its Conservation

Key Concepts- Torque, Angular Velocity, Angular Acceleration, Moment of Inertia, Angular Momentum

Rolling Downhill
Numerical Integration and Rotational Inertia
</td><td>
1. The student will be able to identify and explain the 3 types of forces.
2. The student will be able to analyze circular motion situations.
3. The student will be able to contrast centripetal versus centrifugal forces.
4. The student will be able to apply uniform circular motion to centrifugation, vertical circular motion, a car rounding a flat bend, and banked curves.
5. The student will be able to explain and analyze non-uniform circular motion including centripetal and tangential accelerations and forces.

HS-PS2-1 - Forces and Interactions - 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.

Science and Engineering Practices
Asking questions, for science, and defining problems (for engineering)
Developing and using models
Planning and carrying out investigations
Analyzing and interpreting data
Constructing explanations, for science, and designing solutions, for engineering
Engaging in argument from evidence
Obtaining, evaluating, and communicating information

Crosscutting Concepts
Patterns
Systems and system models
Structure and function
Stability and change
</td></tr>
</table>

Oscillations and Gravitation	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
1. Simple Harmonic Notion 2. Mass on a Spring 3. Pendulum and Other Oscillations 4. Newton's Law of Gravity 5. Orbits of Planets and Satellites Key Concept Labs: Spring-Oscillator Clock Orbital-Period Modeling Gravitational Simulator	1. The student will be able to apply Newton's Law of gravitation to orbiting satellites and planets. 2. The student will be able to explain and apply the principles of a geosynchronous satellite. 3. The student will be able to apply Kepler's three law of planetary motion. 4. The student will be able to identify apparent weightlessness in orbit and analyze why astronauts are not actually weightless. 5. The student will be able to analyze simple harmonic motion as it pertains to a pendulum and a mass on a spring. 6. The student will be able to use a pendulum to determine the acceleration due to gravity and the mass of the earth. **HS-PS2-5 – Forces and Interactions -** Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. **Science and Engineering Practices** Asking questions, for science, and defining problems (for engineering) Developing and using models Planning and carrying out investigations Analyzing and interpreting data Constructing explanations, for science, and designing solutions, for engineering Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Patterns Systems and system models Structure and function Stability and change