SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Physics Honors **Grade Level(s):** 10 - 12 **Units of Credit:** 1 **Classification:** Core or Elective	**Length of Course:** Full Year **Periods Per Cycle:** 6 **Length of Period:** 40 Minutes **Total Instructional Time:** 120 Hours

Course Description

The purpose of this course is for the student to study the basic concepts of matter, energy, forces, and motion. Fluid, wave, and thermal properties are also studied. This course also includes a formal laboratory which culminates in a written lab report on the results gained within the laboratory group. This course will have a strong math component and is geared towards students interested in a science-related or engineering field. *Prerequisite: Successful completion of Algebra 1.*

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: 2/21/90
Revised: 9/3/91, 6/17/98, 11/15/01, 8/20/07, 5/22/23

The Mathematics of Physics	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. SI Units/Unit Analysis B. Significant Figures C. Scientific Methods D. Measurement E. Graphing Data F. Algebraic Applications Labs: Measurement Constant Speed	**1.** The student will be able to identify parts of the scientific method and utilize method in reporting lab results. **2.** The student will be able to identify variables in an investigation. use a meter stick. **3.** The student will be able to record measurements in metric units. **4.** The student will be able to create a clear, concise data table. **5.** The student will be able to use significant digits in recording lab data and perform computations using significant digits. **6.** The student will be able to identify mathematical relationships and corresponding equations from typical graph shapes **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

Linear Motion	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Velocity vs. Speed B. Vector vs. Scalar B. Acceleration C. Motion Diagrams Labs: Constand Speed but Varying Distance Constant Distance and Varying Speed Acceleration Due to Gravity	1. The student will be able to compare and contrast constant velocity, average velocity and instantaneous velocity. 2. The student will be able to solve speed and acceleration problems. 3. The student will be able to describe constant speed graphs and construct graphs for accelerated motion. 4. The student will be able to determine relative speed. 5. The student will be able to use slopes and areas of velocity and acceleration graphs to find motion related quantities. 6. The student will be able to determine the acceleration due to gravity. **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

Forces	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Forces B. Newton's Laws of Motion Labs: Atwood's Machine Friction Friction Types	1. The student will be able to define force, name nature's basic forces and classify common forces. 2. The student will be able to apply Newton's laws of motion to explain motion, changes in motion or effects of motion. 3. The student will be able to define the Newton as the unit of force. 4. The student will be able to identify the mathematical relationship between any variable in Newton's Second Law. 5. The student will be able to differentiate between mass and weight. 6. The student will be able to identify resistance forces such as friction and how they interact with other forces in the same system. 7. The student will be able to identify factors that affect friction. **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

Vectors	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Two Dimensional Forces B. Two Dimensional Motion Labs: Equilibrium Uniform Circular Motion Projectile Motion Projectile Launched at an Angle	1. The student will be able to differentiate between vector and scalar quantities. 2. The student will be able to draw vectors to scale. 3. The student will be able to add colinear vectors. 4. The student will be able to add vectors by drawing and mathematically. 5. The student will be able to identify and solve for components of a vector. 6. The student will be able to break the weight of an object on an incline into meaningful components. **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

Universal Gravitation

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
A. Universal Gravitation B. Kepler's Laws of Planetary Motion Labs: Circular Motion	1. The student will be able to draw an ellipse. 2. The student will be able to state and explain Kepler's laws of planetary motion. 3. The student will be able to apply Kepler's laws to solve problems. 4. The student will be able to use Newton's law of universal gravitation to calculate gravitational force, orbital motion, and gravitational acceleration at an altitude. 5. The student will be able to identify and calculate critical velocity. 6. The student will be able to calculate the mass of a planet with a satellite orbiting it. 7. The student will be able to explain "apparent weightlessness" and how it applies to space travel. **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

Circular Motion	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Rotational Dynamics B. Equilibrium C. Uniform Circular Motion Labs: Moment of Inertia Conservation of Angular Momentum	1. The student will be able to escribe and calculate angular quantities. 2. The student will be able to express linear motion quantities/equations in angular terms. 3. The student will be able to differentiate between period and frequency as well as centripetal and centrifugal. 4. The student will be able to identify the general structure of a solid and use it to calculate the moment of inertia. 5. The student will be able to calculate torques on rotating objects. 6. The student will be able to use Newton's Second Law for rotation. **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

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<tr><th colspan="2">Momentum</th></tr>
<tr><th>CONTENT/KEY CONCEPTS</th><th>OBJECTIVES/STANDARDS</th></tr>
<tr><td>A. Impulse and Momentum
B. Conservation
C. Two Dimensional Collisions

Labs:
Linear Collisions
Conservation of Momentum
Simulated Air Bag</td><td>1. The student will be able to use the impulse-momentum theorem in when momentum is not conserved.
2. The student will be able to calculate the momentum of an object.
3. The student will be able to use the conservation of momentum to solve problems dealing with collisions and explosions.
4. The student will be able to apply the conservation of momentum to one and two dimensional collisions.
5. The student will be able to relate the conservation of momentum to Newton's third law.

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.

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<tr><th colspan="2">Energy and Work</th></tr>
<tr><th>CONTENT/KEY CONCEPTS</th><th>OBJECTIVES/STANDARDS</th></tr>
<tr><td>A. Work and Energy
B. Conservation of Energy
C. Forms of Energy

Labs:
Conservation of Energy on an Incline
Work Energy Theorem</td><td>1. The student will be able to calculate work and power of an action.
2. The student will be able to identify and calculate potential and kinetic energy.
3. The student will be able to apply the work-energy theorem to the conservation of energy.
4. The student will be able to explain and demonstrate the influence of elasticity in the outcome of a collision.
5. The student will be able to discuss when is meant by the term energy crisis.

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.

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Thermodynamics	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Temperature B. Change of State C. Liquid Forces D. Solids Labs: Law of Heat Exchange Specific Heat Heat of Fusion	1. The student will be able to explain the difference between heat and temperature. 2. The student will be able to convert temperatures from one scale to another. 3. The student will be able to calculate the change in length or volume due to a change in temperature. 4. The student will be able to calculate the heat gain or loss of a substance during a temperature change or a change in state. 5. The student will be able to determine the final equilibrium temperature of two substances when they are in thermal contact. 6. The student will be able to read a change in state graph identifying relative size of the heat of fusion and heat of vaporization. 7. The student will be able to understand and calculate the mechanical equivalent of heat. 8. The student will be able to explain how heat is transferred through conduction, convection or radiation. 9. The student will be able to determine the best insulator or how a change in insulation will change conductivity and therefor minimize heat loss/gain. **HS-PS3-4 – Energy -** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). **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

Vibrations and Waves	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Periodic Motion B. Wave Properties C. Wave Behavior Labs: Speed of Sound in Air Resonance Snell's Law	1. The student will be able to explain the 3 main categories of waves and give examples of each. 2. The student will be able to explain the 3 types of mechanical waves. 3. The student will be able to calculate quantities associated with wave such as wavelength, frequency, speed and period. 4. The student will be able to describe, sketch and label a standing wave. 5. The student will be able to explain what happens when a wave encounters another wave or a boundary. 6. The student will be able to state and explain the Principle of Superposition including the types of interference. 7. The student will be able to state and explain the Law of Reflection. 8. The student will be able to describe the effects of waves being in phase and out of phase. 9. The student will be able to explain the connection between Simple Harmonic Motion and wave motion. 10. The student will be able to explain the difference between the 3 different types of damping. 11. The student will be able to understand the use of and quantities associated with a "Simple Pendulum". **HS-PS4-1 – Waves and their Applications** - Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. **HS-PS4-3 – Waves and their Applications** - Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. 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

Sound and Light	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
A. Generation B. Propagation and Interference C. Color, Interference and Diffraction D. Lenses, Mirrors and Applied Optics Labs: Formation of and Image Mirrors Lenses Double Slit Diffraction	1. The student will be able to explain how wave theory is supported by the observations of interference and diffraction. 2. The student will be able to use double slit and single slit equations to calculate problems. 3. The student will be able to explain the visible spectrum in terms of wavelength, color, etc. 4. The student will be able to explain dispersion through a prism. 5. The student will be able to explain why thin-film interference occurs. 6. The student will be able to explain what polarization is and how it occurs. 7. The student will be able to determine the location and type of image formed by mirrors and lenses. **HS-PS4-1 – Waves and their Applications** - Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. **HS-PS4-3 – Waves and their Applications** - Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. **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