Pine Hill Public Schools Curriculum			
Content Area:	Science		
Course Title/ Grade Level:	Honors Physics / Gr. 11 & 12		
Unit 1:	Introduction, Measurement, Estimating	Duration:	1 week
Unit 2:	Describing Motion: Kinematics in One Dimension	Duration:	3 week
Unit 3:	Kinematics in Two Dimensions; Vectors	Duration:	2 weeks
Unit 4:	Dynamics: Newton's Laws of Motion	Duration:	3 weeks
	Benchmark Exam #1	Duration:	1 day (Administered on the 9th instructional Week)
Unit 4:	Dynamics: Newton's Laws of Motion	Duration:	3 weeks
Unit 5:	Circular Motion; Gravitation	Duration:	5 weeks
Unit 6:	Work and Energy	Duration:	1 week
	Benchmark Exam #2	Duration:	1 day (Administered on the 18th instructional Week)
Unit 6:	Work and Energy	Duration:	4 week
Unit 7:	Linear Momentum	Duration:	3 weeks
Unit 8:	Rotational Motion	Duration:	2 weeks
	Benchmark Exam #3	Duration:	1 day (Administered on the 27th instructional Week)
Unit 8:	Rotational Motion	Duration:	2 weeks
Unit 9:	Oscillations and Waves	Duration:	2 weeks
Unit 10:	Sound	Duration:	2 weeks
Unit 11:	Electric Charge and Electric Fields & Electric Potential	Duration:	8 days + 4 days = 12 days
Unit 12	Electric Current	Duration:	1 week
Unit 13	DC Circuits	Duration:	1 week
	Benchmark Exam #4	Duration:	3 day (Administered on the 36th instructional Week)
BOE Approved date:	June 29, 2016		

Pine Hill Public Schools Science Curriculum		
Unit Title: Introduction, Measurement, Estimating (Ch1)		Unit #1
Course or Grade Level: Honors Physics		Length of Time: 1 week
NGSS Performance Expectations (PE's)	2-1. 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 scientific 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-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.	

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☐Energy and Matter in Systems ☐Structure and Function ☐Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☒Constructing explanations and designing solutions ☐Engaging in argument from evidence ☒Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Models, theories, and laws - Significant figures - Units, standards, and the SI system

	- Converting units - Rapid Estimating - Dimensional analysis - Types of measurements - Rules for rounding measurements - Scientific notation - Scientific method of problem solving - Writing a lab report
Skills	- Display information and interpret information on various types of graphs (line graphs, histograms, pie charts…) - Express measurements using appropriate labels and units - Perform calculations and report answers with the appropriate amount of significant digits - Express measurements metric units - Express measurements in various magnitudes using metric prefixes - Use the rule for expressing answers to calculations with the correct number of significant digits - Express numbers in scientific notation - Analyze information using experimental error
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Chapter study guides - Oral presentation of chapter concepts - Laboratory exercises related to subject matter • Bambi/Rudolph Lab • Measurement lab#1 • Conversion Lab

Pine Hill Public Schools Science Curriculum		
Unit Title: Describing Motion: Kinematics in One Dimension (Ch2)		Unit #2
Course or Grade Level: Honors Physics		Length of Time: 3 weeks
NGSS Performance Expectations (PE's)	2-1.	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-PS2-3.	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
	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-PS3-3.	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

Cross Cutting Concepts	Science and Engineering Practices
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Content	- Reference frames and displacement - Average Velocity

	- Instantaneous Velocity - Acceleration - Motion at Constant acceleration - Solving Problems - Free Falling Objects - Graphical Analysis of Linear Motion
Skills/Learning Objectives	- Differentiate between scalar and vector measurements - Solve vector problems using graphical techniques and computational methods - Calculate the resultant of two or more vector quantities - Resolve a vector into its horizontal and vector components
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Speed Lab • Deriving equations of motion • Acceleration Due to Gravity #1 • Acceleration Due to Gravity #2 - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Kinematics in Two Dimensions		Unit #3
Course or Grade Level: Honors Physics(Ch's 2,3, & 6)		Length of Time: 2 weeks
NGSS Performance Expectations (PE's)	2-1.	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 scientific 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-PS2-6.	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*
	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 motions 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.*

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns	☒Asking questions and defining problems
☒Cause and Effect	☒Developing and using models
☒Scale, Proportion, and Quantity	☒Planning and carrying out investigations
☐Systems and Systems Models	☒Analyzing and interpreting data
☐Energy and Matter in Systems	☒Using mathematics and computational thinking
☐Structure and Function	☒Constructing explanations and designing solutions
☐Stability and Change in Systems	☒Engaging in argument from evidence
Nature of Science (NOS)	

☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Vectors and Scalars - Addition of Vectors, and Multiplication of a Vector by a Scalar - Adding vectors by components - Projectile motion - Solving projectile motion problems - Projectile motion is parabolic
Skills/Learning Objectives	- Use Pythagorean Theorem and trig functions to determine the vector forces acting on an object - Determine the net force acting on an object allowing for frictional effects - Calculate the velocity, acceleration or position of a freely falling body - Construct a vector diagram to show the resultant acting on a body - Use vector addition to show the resultant force and the equilibrant - Solve incline plane problems using trig function express the motion of an object using narrative, mathematical, and graphical representations. - Design an experimental investigation of the motion of an object. - Analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study

Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Projectile Motion lab1 • Projectile Motion lab2 • Projectile Bingo Lab - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Dynamics: Newton's Laws of Motion (Ch4)		Unit #4
Course or Grade Level: Honors Physics		Length of Time: 6 weeks
NGSS Performance Expectations (PE's)	2-1.	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 scientific 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-PS2-5.	Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
	HS-PS2-6.	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*
	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-PS3-4.	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).

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns	☒Asking questions and defining problems
☒Cause and Effect	☒Developing and using models
☒Scale, Proportion, and Quantity	☒Planning and carrying out investigations
☒Systems and Systems Models	☒Analyzing and interpreting data
☒Energy and Matter in Systems	☒Using mathematics and computational thinking
☒Structure and Function	☒Constructing explanations and designing solutions
☐Stability and Change in Systems	

<table>
<tr><td colspan="2">Nature of Science (NOS)
☒NOS-Science is a Way of Knowing
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☒NOS-Science is a Human Endeavor
☒NOS-Science Addresses Questions About the Natural and Material World</td><td>☒Engaging in argument from evidence
☒Obtaining, evaluating, and communicating information

Nature of Science (NOS)
☒Scientific Investigations Use a Variety of Methods
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<tr><td>Content</td><td colspan="2">- Force
- Newton's First Law of Motion
- Mass
- Newton's 2nd Law of Motion
- Newton's 3rd Law of Motion
- Weight and the force of Gravity and the Normal Force
- Solving problems with Newton's Laws: Free-Body Diagrams
- Problems involving friction and inclines</td></tr>
<tr><td>Skills/Learning Objectives</td><td colspan="2">Model verbally or visually the properties of a system based on its substructure and to relate this to changes in the system properties over time as external variables are changed.

Design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration.

Design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments.

Apply F = mg to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems.

Approximate a numerical value of the gravitational field (g) near the surface of an object from its radius and mass relative to those of the Earth or other reference objects.</td></tr>
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	Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Analyze situations involving interactions among several objects by using free-body diagrams that include the application of Newton's third law to identify forces. Make predictions about the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a variety of physical situations with acceleration in one dimension. Design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces. Draw a free-body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Identifying Forces lab • Drawing FBD's • Calculating Force lab • Tension Lab • Static Friction lab • Kinetic Friction Lab #1 • Kinetic Friction Lab #2 • Kinetic Friction Lab #3 - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Dynamics: Circular Motion; Gravitation(Ch's 6,7)		Unit #5
Course or Grade Level: Honors Physics		Length of Time: 6 weeks
NGSS Performance Expectations (PE's)	2-1.	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-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 motions of particles (objects) and energy associated with the relative positions of particles (objects).

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☐Energy and Matter in Systems ☐Structure and Function ☐Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☒Constructing explanations and designing solutions ☐Engaging in argument from evidence ☒Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence

☒NOS-Science Addresses Questions About the Natural and Material World	☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Kinematic of Uniform Circular Motion - Dynamics of Uniform Circular Motion - Highway Curves: Banked and unbanked - Nonuniform Circular Motion - Newton's Law of Universal Gravitation - Gravity near Earth's Surface - Satellites and "Weightlessness" - Planets, Kepler's Laws, and Newtonian Synthesis - Moon Rises an hour later each day - Types of forces in nature
Skills/Learning Objectives	- Solve problems involving freely falling bodies - Solve problems for moving objects in two dimensions - Determine the position of a body moving with an initial velocity as it moves in two dimension - Calculate the velocity and acceleration of a body moving in two dimensions - Using Kepler's Laws determine the period and radius of an orbiting object - Apply Universal Law of Gravitation to determine the mass of an object or the distance it is from another object - Apply F =mg to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems. - Analyze situations involving interactions among several objects by using free-body diagrams that include the application of Newton's third law to identify forces. - Predict the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a variety of physical situations with acceleration in one dimension. - Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively.

	- Use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Flying Pig Lab • Circular motion lab • Motion Detector lab - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Work and Energy (Ch10,11)		Unit #6
Course or Grade Level: Honors Physics		Length of Time: 5 weeks
NGSS Performance Expectations (PE's)	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 scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
	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 motions 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-PS4-1.	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☒Energy and Matter in Systems ☒Structure and Function ☒Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☒Constructing explanations and designing solutions ☐Engaging in argument from evidence ☒Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence

☒NOS-Science Addresses Questions About the Natural and Material World	☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Work done by constant force - Work done by varying force - Kinetic energy, and the Work-Energy Principle - Potential energy - Conservative and neoconservative forces - Mechanical Energy and its conservation - Problem solving using conservation of mechanical energy - Other forms of energy and energy transformations: The Law of Conservation of Energy - Energy conservation with dissipative forces: solving problems - Power
Skills/Learning Objectives	Apply F =mg to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems. Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Describe a force as an interaction between two objects and identify both objects for any force. Make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves. Use net force and velocity vectors to determine qualitatively whether kinetic energy of an object would increase, decrease, or remain unchanged. Use force and velocity vectors to determine qualitatively or quantitatively the net force exerted on an object and qualitatively whether kinetic energy of that object would increase, decrease, or remain unchanged. 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.

	Predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system. Apply the concepts of Conservation of Energy and the Work-Energy theorem to determine qualitatively and/or quantitatively that work done on a two-object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system. Describe and make predictions about the internal energy of systems. Calculate changes in kinetic energy and potential energy of a system, using information from representations of that system. Design an experiment and analyze data to examine how a force exerted on an object or system does work on the object or system as it moves through a distance. Predict and calculate from graphical data the energy transfer to or work done on an object or system from information about a force exerted on the object or system through a distance.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Friction Lab revisited with work and energy • Work and Energy lab • Potential energy and Kinetic energy lab • Revisit the velocity of a marble lab using the work and energy theorems - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Linear Momentum (Ch9)		Unit #7
Course or Grade Level: Honors Physics		Length of Time: 3 weeks
NGSS Performance Expectations (PE's)	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 scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
	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 motions 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.*

Cross Cutting Concepts	Science and Engineering Practices
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☒NOS-Science Addresses Questions About the Natural and Material World	☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
Content	- Momentum and its relation to force - Conservation of Momentum - Collisions and impulse - Conservation of energy and momentum in collisions - Elastic collisions in one dimension - Inelastic collisions - Collision in two dimensions - Center of Mass - Center of mass for the human body - Center of mass and translational motion
Skills/Learning Objectives	Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Able to justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force. Predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. Analyze data to characterize the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. Design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time. Calculate the change in linear momentum of a two-object system with constant mass in linear motion from a representation of the system (data, graphs, etc.). Analyze data to find the change in linear momentum for a constant-mass system using the product of the mass and the change in velocity of the center of mass. Apply mathematical routines to calculate the change in momentum of a system by analyzing the average force exerted over a certain time on the system.

	Make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions. Apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy. Design an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome. Plan data collection strategies to test the law of conservation of momentum in a two-object collision that is elastic or inelastic and analyze the resulting data graphically. Analyze data that verify conservation of momentum in collisions with and without an external friction force.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Pendulum Lab • Ramp lab • Revisit the velocity of a marble lab using momentum - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Rotational Motion (Ch8)		Unit #8
Course or Grade Level: Honors Physics		Length of Time: 4 weeks
NGSS Performance Expectations (PE's)	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 scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
	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 motions 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.*

Cross Cutting Concepts	Science and Engineering Practices
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☒NOS-Science Addresses Questions About the Natural and Material World	☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
Content	- Momentum and its relation to force - Conservation of Momentum - Collisions and impulse - Conservation of energy and momentum in collisions - Elastic collisions in one dimension - Inelastic collisions - Collision in two dimensions - Center of Mass - Center of mass for the human body - Center of mass and translational motion
Skills/Learning Objectives	Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Able to use representations of the relationship between force and torque. Design an experiment and analyze data testing a question about torques in a balanced rigid system. Determine the center of mass of an isolated two-object system Analyze the motion of the system qualitatively and semi-quantitatively. Learning Objective (4.D.2.1): The student is able to describe a model of a rotational system and use that model to analyze a situation in which angular momentum changes due to interaction with other objects or systems. Make calculations of quantities related to the angular momentum of a system when the net external torque on the system is zero. Describe or calculate the angular momentum and rotational inertia of a system in terms of the locations and velocities of objects that make up the system. Students are expected to do qualitative reasoning with compound objects. Students are expected to do calculations with a fixed set of extended objects and point masses.

Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Elastic collision lab • Inelastic collision lab • Find the Center of mass of an irregular shape • Bat Speed lab - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Oscillations and Waves (Ch 14)		Unit #9
Course or Grade Level: Honors Physics		Length of Time: 2 weeks
NGSS Performance Expectations (PE's)	HS-PS1-1.	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
	HS-PS1-2.	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
	HS-PS1-7.	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
	HS-PS1-8.	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
	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 motions 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-PS3-4.	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).

	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-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
	HS-PS4-3.	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.
	HS-PS4-4.	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
	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.*

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☒Energy and Matter in Systems ☒Structure and Function ☒Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☐Constructing explanations and designing solutions ☐Engaging in argument from evidence ☐Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Simple Harmonic motion - Energy in simple harmonic motion - The period and sinusoidal nature of SHM - The simple pendulum - Damped harmonic motion - Forced oscillations; Resonance - Wave Motion - Types of waves and their speeds - Energy Transported by waves - Reflection and transmission of waves - Interference; Principle of Superposition - Standing waves; Resonance - Refraction - Diffraction - Mathematical representation of traveling wave
Skills/Learning Objectives	Apply F =mg to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems. Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties. Design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force. Analyze data to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown. Calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments

	- Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Pendulum Lab #2 • Damped Harmonic Motion Vs. Undamped • Resonance lab • Lenses lab • Mirror/reflection lab - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Sound (Ch 15,16)		Unit #10
Course or Grade Level: Honors Physics		Length of Time: 2 weeks
NGSS Performance Expectations (PE's)	HS-PS1-1.	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
	HS-PS1-2.	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
	HS-PS1-7.	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
	HS-PS1-8.	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
	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 motions 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-PS3-4.	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).
	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-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.

	HS-PS4-3.	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.

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☒Energy and Matter in Systems ☒Structure and Function ☒Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☐Constructing explanations and designing solutions ☐Engaging in argument from evidence ☐Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Characteristics of sound - Intensity of sound: Decibels - Sources of sound: Vibrating strings and air columns - Interference of sound waves; Beats - Doppler effect
Skills/Learning Objectives	Describe representations of transverse and longitudinal waves. Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. Use graphical representation of a periodic mechanical wave to determine the amplitude of the wave. Explain and/or predict qualitatively how the energy carried by a sound wave relates to the amplitude of the wave, and/or apply this concept to a real-world example.

	Use a visual representation of a periodic mechanical wave to determine wavelength of the wave. Analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes. Predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. Calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples should include musical instruments. Use a visual representation to explain how waves of slightly different frequency give rise to the phenomenon of beats
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Building a speaker lab • Speed of sound lab - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: Electric Charge and Electric Field, Electric Potential (Ch's 20,21)		Unit #11
Course or Grade Level: Honors Physics		Length of Time: 8 + 4 = 12 days (only 4 days on electric potential)
NGSS Performance Expectations (PE's)	HS-PS1-1.	Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
	HS-PS1-2.	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
	HS-PS1-3.	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
	HS-PS1-7.	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
	HS-PS1-8.	Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
	HS-PS3-4.	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).
	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-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
	HS-PS4-3.	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.
	HS-PS4-4.	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
	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.*

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☒Energy and Matter in Systems ☐Structure and Function ☐Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☐Constructing explanations and designing solutions ☐Engaging in argument from evidence ☒Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	Ch 16 - Static Electricity: Electric charge and its conservation - Insulators and Conductors - Coulomb's law - Solving problems involving Coulomb's Law and vectors - The electric field - Electric field lines and Conductors Ch 17 - Electric Potential Energy and Potential Difference

	- Capacitance
Skills/Learning Objectives	Make claims about natural phenomena based on conservation of electric charge. Construct an explanation of the two-charge model of electric charge based on evidence produced through scientific practices. Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Electroscope/Charge lab • Virtual Lab on Electric field lines - - Chapter study guides - Oral presentation of chapter concepts

Unit Title: Electric Current (Ch 22)		Unit #12
Course or Grade Level: Honors Physics		Length of Time: 1 week
NGSS Performance Expectations (PE's)	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 motions 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-PS3-4.	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).
	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-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
	HS-PS4-3.	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.
	HS-PS4-4.	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
	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.*

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns	☒Asking questions and defining problems
☒Cause and Effect	☒Developing and using models
☒Scale, Proportion, and Quantity	☒Planning and carrying out investigations

☒Systems and Systems Models ☒Energy and Matter in Systems ☐Structure and Function ☐Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☒Constructing explanations and designing solutions ☒Engaging in argument from evidence ☐Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- The electric battery - Electric Current - Ohm's Law: Resistance and Resistors - Resistivity - Electric power
Skills/Learning Objectives	Make claims about natural phenomena based on conservation of electric charge. Construct an explanation of the two-charge model of electric charge based on evidence produced through scientific practices. Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges (interactions between collections of electric point charges are not covered in Physics 1 and instead are restricted to Physics 2). Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities

	- Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Set up a Bread Board lab • Analyze resistance lab • Analyze current lab • Analyze voltage lab • RC circuits lab - Chapter study guides - Oral presentation of chapter concepts

Pine Hill Public Schools Science Curriculum		
Unit Title: DC Circuits (Ch 23)		Unit #13
Course or Grade Level: Honors Physics		Length of Time: 1 week
NGSS Performance Expectations (PE's)	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 motions 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-PS3-4.	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).
	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-PS4-2.	Evaluate questions about the advantages of using a digital transmission and storage of information.
	HS-PS4-3.	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.
	HS-PS4-4.	Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
	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.*

Cross Cutting Concepts	Science and Engineering Practices
☒Patterns ☒Cause and Effect ☒Scale, Proportion, and Quantity ☒Systems and Systems Models ☐Energy and Matter in Systems ☐Structure and Function ☐Stability and Change in Systems Nature of Science (NOS) ☒NOS-Science is a Way of Knowing ☒NOS-Scientific Knowledge Assumes an Order and Consistency in Natural Systems ☒NOS-Science is a Human Endeavor ☒NOS-Science Addresses Questions About the Natural and Material World	☒Asking questions and defining problems ☒Developing and using models ☒Planning and carrying out investigations ☒Analyzing and interpreting data ☒Using mathematics and computational thinking ☒Constructing explanations and designing solutions ☐Engaging in argument from evidence ☒Obtaining, evaluating, and communicating information Nature of Science (NOS) ☒Scientific Investigations Use a Variety of Methods ☒Scientific Knowledge is Based on Empirical Evidence ☒Scientific Knowledge is Open to Revision in Light of New Evidence ☒Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

Content	- Emf and Terminal Voltage - Resistors in series and in parallel - Kirchoff's Rules - EMF's in series and in parallel: charging a battery
Skills/Learning Objectives	Make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits. Can choose and justify the selection of data needed to determine resistivity for a given material.

	Apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule in a circuit with only a battery and resistors either in series or in, at most, one pair of parallel branches. Apply conservation of energy (Kirchhoff's loop rule) in calculations involving the total electric potential difference for complete circuit loops with only a single battery and resistors in series and/or in, at most, one parallel branch. Apply conservation of electric charge (Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed. Design an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed. Use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit.
Assessments	- Teacher evaluation of special projects - Quizzes and chapter tests - Homework/class work assignments - Experiments/lab reports
Interventions/ differentiated instruction	- Provide advanced notice for tests - Present materials suitable to student's level of functioning - Include hands on activities - Provide options for independent study
Lesson resources/Activities	- Hands on activities - Laboratory exercises related to subject matter • Node rule lab • Loop rule lab • Building a boat Project - RC circuits lab - Chapter study guides - Oral presentation of chapter concepts

Resources

Textbook

Zitzewitz, Haase, & Harper. *Physics: Principles and Problems.*New York, NY: McGraw-Hill Companies, 2014.

Equipment

- Computers
- Motion Detectors
- Internet
- Microsoft Office (Excel, Word, and PowerPoint)
- Multi-meters
- Breadboards
- Power Supplies
- Resistors, LED's, and Capacitors
- Logger Pro Software
- Capital or Budget for projects
- Calculators
- Stop watches
- Photo-gates and accompanying software