Title	**Roxbury High School Physics Honors**
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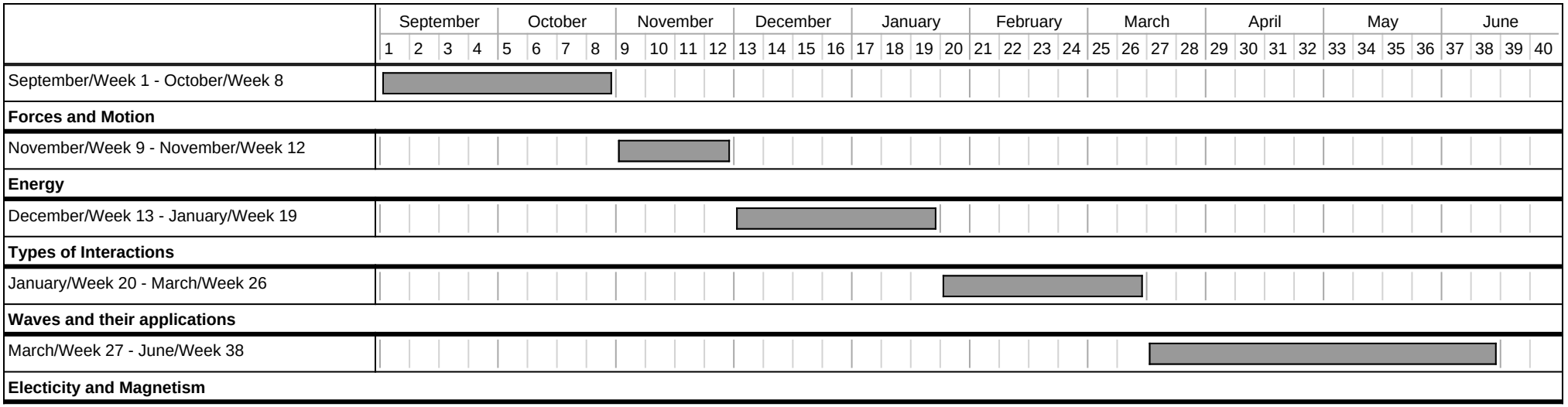
Subject	Science
Course	Physics Honors
Grade(s)	11 , 12
Location	Roxbury High School
Curriculum Writing History	
Notes	
Attachments	

Title : Roxbury High School Physics Honors
Type : Consensus



Title : Roxbury High School Physics Honors
Type : Consensus

Duration: September/Week 1 - October/Week 8					
UNIT NAME: Forces and Motion					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Cause and Effect: - Evidence is needed to make a claim using the scientific method -systems can be designed to create a desired effect (laboratory, for example) **Connection to Nature:** -Theories and laws provide explanation -Laws are statements of relationships of observable phenomena	-Can the student observe an object in 1-Dimentional motion and sketch the motion on a position vs time and a velocity vs time graph? -What is the velocity, speed, acceleration, and direction of an object while viewing a position vs. time and a velocity vs. time graph? -How can one predict the motion of an object in 1-D or 2-Dimensions? -What is the relationship between net force, mass, and acceleration of an object? -What observable data is present to 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? -What evidence is available to predict the change in momentum of an object from the average	**Forces and Motion:** -Newton's 2nd law of motion accurately predicts changes in motion of a macroscopic object -Momentum is defined as mass times velocity of an object -if a system interacts with objects outside itself, the total momentum of the system can change, however, any such changes are balanced by changes in momentum of the outside objects **Defining an engineering problem:** -criteria and constraints also include satisfying any requirements set by society, such as issues of risk **Optimizing design solutions:** -Criteria may need to be broken down into simple forms that can be approached systematically, and decisions about the priority of certain criteria may be needed	**Planning and carrying out investigations:** -Plan accordingly and conduct an investigation both individually and collaboratively to produce data to serve as a basis for evidence. Decide on how much data to produce reliable evidence. Always consider limitations of your experiment. **Analyzing and Interpreting data:** -Analyze using tools, technology, and/or models in order to make scientific claims based on using the scientific method **Applying Mathematics:** -use mathematics to describe phenomena and derive explanations **Constructing explanations and designing solutions:** -Apply scientific data and ideas to solve a design problem while taking into account possible unanticipated effects		RST.11–12.1-Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (11, 12) [State:Common Core State Standards (CCSS)] RST.11–12.7-Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.7-Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (11, 12) [State:Common Core

	force exerted and the interval of time needed? -What mathematical evidence is presented that proves the total momentum on a closed system is conserved? -Is there a correlation between conservation of momentum and conservation of energy in elastic and inelastic collisions? (overlap of energy unit) -What scientific evidence is available to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision? -What is a free body diagram and how is it applied to Newton's laws? -How can one apply Newton's laws to predict the motion of two bodies connected to one another via a rope and pulley? -what is a scalar and what is a vector? -How could you apply trigonometry to vectors? in 2 dimensions?				State Standards (CCSS)] WHST.11–12.9-Draw evidence from informational texts to support analysis, reflection, and research. (11, 12)[State:Common Core State Standards (CCSS)] N.Q.1-Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (09-12)[State:Common Core State Standards (CCSS)] N.Q.3-Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (09-12)[State:Common Core State Standards (CCSS)] N.VM.1-(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v). (09-12)[State:Common Core State Standards (CCSS)] N.VM.2-(+) Find the

					components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. (09-12) [State:Common Core State Standards (CCSS)] N.VM.3-(+) Solve problems involving velocity and other quantities that can be represented by vectors. (09-12)[State:Common Core State Standards (CCSS)] N.VM.4-(+) Add and subtract vectors. (09-12) [State:Common Core State Standards (CCSS)] N.VM.4.a-Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. (09-12)[State:Common Core State Standards (CCSS)] N.VM.4.b-Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. (09-12)[State:Common Core State Standards (CCSS)] N.VM.4.c-Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w

					and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. (09-12) [State:Common Core State Standards (CCSS)] N.VM.5-(+) Multiply a vector by a scalar. (09-12) [State:Common Core State Standards (CCSS)] N.VM.5.a-Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$. (09-12) [State:Common Core State Standards (CCSS)] N.VM.5.b-Compute the magnitude of a scalar multiple cv using ||cv|| = |c| v. Compute the direction of cv knowing that when |c| v $\neq$ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0). (09-12)[State:Common Core State Standards (CCSS)] A.REI.3-Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. (09-12)[State:Common

					Core State Standards (CCSS)] A.REI.4-Solve quadratic equations in one variable. (09-12)[State:Common Core State Standards (CCSS)] A.REI.6-Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. (09-12) [State:Common Core State Standards (CCSS)] HS.PS3.3.CCC.1-Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HSPS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CCC.1-Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. (HS - ESS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.2.CET.1-Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D

					projects may involve scientists, engineers, and others with wide ranges of expertise. (HSESS1-2), (HS-ESS1-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.3.SEP.1-Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.5.CCC.1-Empirical evidence is needed to identify patterns. (HS-ESS1-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.ESS1.6.CNS.1-A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory

					before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.ESS1.6.CNS.2-Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.1-Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.1.SEP.1-Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HSPS2-1) (09-12)

					[Regional:Next Generation Science Standards (NGSS)] HS.PS2.1.DCI.PS2.A.1-Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics Honors
Type : Consensus

Duration: November/Week 9 - November/Week 12					
UNIT NAME: Energy					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Cause and Effect: -cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about microscopic systems within the larger, macroscopic system **Systems and Models:** -the boundaries and initial conditions need to be defined when utilizing a model of a system -models can be used to predict the behavior of a system, but these predictions are limited due to your model's limitations **Energy and Matter:** -Energy flows into, out of, and through a system -Energy can not be created nor destroyed, but only transfer from one from to another or flow between systems **Influence of science on society and the natural world:** -Modern civilizations depend on technology to survive. Engineers	-What kinds of energy are present in a system such as elastic and gravitation potential, or the energy of motion such as kinetic? -What is the change in kinetic and potential energies when the energy is transferred from one form to another? -What is the relationship between thermal equilibrium after energy is transferred to or from the system? -What appropriate model is available to discuss the interactions of molecules in a system based on its overall total enegy? -What computational model will accurately predict the transfer of energy from one system to another and from one form to another?	**Definitions of Energy:** -Energy of system depends on the motion and interactions of matter and radiation in that system. Total energy is conserved, so energy can not be created nor destroyed. Energy is continuously transferred from one system to another. -At the macroscopic level, energy manifests itself in multiple ways, such as motion, sound, light, and thermal energy -Energy relationships are better understood on the microscopic level. Energy can be stored in fields, such as the electric or magnetic fields. This energy moves across space **Conservation of energy and energy transfer** -Total energy transferred into a system is equal to the total energy transferred out of that system -Energy can not be created nor destroyed, only transferred -Energy can be of motion	**Developing and using models:** -Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system **Panning and carrying out investigations:** -Plan and construct and investigation individually and collaboratively to produce data to serve as a basis for evidence. In the design, decide on the type, how much, and the accuracy of data needed to satisfy your objective but also considering limitations. Redesign investigation accordingly. **Using Mathematics and computational thinking:** -Create a computational model or simulation of a phenomenon, designed device, process, or system **Constructing explanations and designing solutions:** -Define, evaluate, and refine a solution to a complex, real world		RST.11–12.7-Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.7-Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (11, 12) [State:Common Core State Standards (CCSS)] N.Q.1-Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (09-12)[State:Common

continuously modify these systems by applying scientific knowledge to increase the benefits while decreasing the risk to nature **Scientific Knowledge assumes an order and consistency in natural systems:** -Science assumes the universe is a vast, single system in which basic laws are consistent		or stored, such as kinetic energy (motion) and potential energy such as gravity and compression of springs. -energy limits what can occur in a system **Relationship between energy and forces:** -when two objects interacting through a field change relative position, the energy stored in the field is changed **Defining and Delimiting and engineering problem:** -Criteria and constraints include satisfying and requirements set by society such as risk, cost, and benefit to society	problem based on scientific knowledge, evidence, prioritized criteria, and other logical considerations.		Core State Standards (CCSS)] N.Q.3-Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (09-12)[State:Common Core State Standards (CCSS)] A.REI.6-Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. (09-12) [State:Common Core State Standards (CCSS)] HS.PS1.1.SEP.1-Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.1.CCC.1-Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1), (HS-PS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.3.SEP.1-Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly . (HS-PS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.6-Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.6.SEP.1-Communicate scientific and technical information (e.g. about the process of development and the

					design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.2.SEP.1-Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' ow n investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.4.CCC.1-Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS1.5.SEP.1-Apply scientific principles and

					evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.7.SEP.1-Use mathematical representations of phenomena to support claims. (HS-PS1-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.7.CNS.1-Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS1.7.CCC.1-The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.1.CNS.1-Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.1.CNS.2-Laws

					are statements or descriptions of the relationships among observ able phenomena. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.2.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] 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.* (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.5.SEP.1-Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly .

					(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.1.DCI.PS3.A.1-Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1), (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.1.DCI.PS3.B.2-Conservation of energy means that the total change of energy in any

					system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.1.DCI.PS3.B.4- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.DCI.PS3.A.1- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various

					possible forms. (HSPS3-1), (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.DCI.PS3.A.2-At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy . (HSPS3-2) (HS-PS3-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.DCI.PS3.A.3-These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)]

					HS.PS3.2.CCC.1-Energy cannot be created or destroy ed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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.* (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.3.SEP.1-Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HSPS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.3.CCC.1-Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HSPS3-3) (09-12) [Regional:Next Generation Science Standards

					(NGSS)] HS.PS3.4.DCI.PS3.B.1-Energy cannot be created or destroy ed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.4.DCI.PS3.B.2-Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.5.DCI.PS3.C.1-When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics Honors
Type : Consensus

Duration: December/Week 13 - January/Week 19					
UNIT NAME: Types of Interactions					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Patterns: -Different patterns observed can provide evidence for causality in explanations of phenomena **Cause and Effect:** -Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects **Systems and system models:** -when investigating or describing a system, the boundaries and initial conditions of the system need to be defined **Structure and Function:** -this requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function **Scale, Proportion, and Quantity** -Mathematical evidence is needed to examine	-What is the net gravitational force on two or more objects in 1-Dimension and 2-Dimensions? -What is the relationship between the period, orbital radius, and speed of an object in a circular orbit? -How can you apply Newton's Laws of Gravitation and Kepler's Laws of planetary motion to predict the motion of orbiting objects in the solar system? -What is the normal force and how does it relate to the frictional properties between two objects? -How does the frictional force affect the outcome of motion of an object and what happens to its energy? -What is a contact force? -Why is the molecular level structure of an object important in its connection to its frictional properties?	**Forces and Motion:** -Newton's second law accurately predicts changes in the motion for both linear and angular of macroscopic objects. **Structure and Properties of Matter:** -each atom has a charged structure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons -the structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms **Types of interactions:** -Newton's Laws of gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects -Forces at a distance are explained by fields permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields, electric	**Using mathematics and computational thinking:** -Use mathematical representations of phenomena to describe explanations **Obtaining, evaluating, and communicating information:** -Communicate scientific and technical information in multiple formats which include graphically, textually, orally, and mathematically.		RH.11–12.1-Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole. (11, 12) [State:Common Core State Standards (CCSS)] RH.11–12.7-Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.2-Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (11, 12)[State:Common Core State Standards (CCSS)] WHST.11–12.7-Conduct short as well as more sustained research projects to answer a question (including a self-

scientific data and predict the effect of a change in one variable or another **Science models, Laws, Mechanisms, and Theories explain natural phenomena:** -Theories and laws provide explanations in science -Laws are statements or descriptions of the relationships among observable data	-What is the fundamental difference between force and field? -How can Newton's laws be applied to objects in circular motion? -Why is torque analogous to a twisting force? -What is the net torque created on an object in both dynamic and static equilibrium? -How does angular motion relate to torque?	charges or changing magnetic fields cause electric fields -Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects **Earth and the solar system:** -Kepler's Laws describe common feature of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to a change in potential energy or from a collision with another object in the solar system			generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.8-Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.9-Draw evidence from informational texts to support analysis, reflection, and research. (11, 12)[State:Common Core State Standards (CCSS)] N.VM.1-(+) Recognize vector quantities as having both magnitude and

					direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v). (09-12) [State:Common Core State Standards (CCSS)] N.VM.2-(+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. (09-12) [State:Common Core State Standards (CCSS)] N.VM.3-(+) Solve problems involving velocity and other quantities that can be represented by vectors. (09-12)[State:Common Core State Standards (CCSS)] N.VM.4-(+) Add and subtract vectors. (09-12) [State:Common Core State Standards (CCSS)] N.VM.4.b-Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. (09-12)[State:Common Core State Standards (CCSS)] N.Q.1-Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units

					consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (09-12)[State:Common Core State Standards (CCSS)] A.REI.6-Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. (09-12) [State:Common Core State Standards (CCSS)] HS.PS1.7.SEP.1-Use mathematical representations of phenomena to support claims. (HS-PS1-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.7.CCC.1-The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.1.CNS.1-Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.2.DCI.PS2.A.1-Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.2.DCI.PS2.A.2-If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.2.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.3.DCI.PS2.A.1-If a system interacts with objects outside itself, the

					total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.DCI.PS2.B.1-Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.DCI.PS2.B.2-Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer

					energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics Honors
Type : Consensus

Duration: January/Week 20 - March/Week 26					
UNIT NAME: Waves and their applications					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Cause and Effect: -empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects -cause and effect relationships can be suggested and predicted for complex systems given the understanding of the microscopic perspective -systems can be designed to cause a desired effect **System and System models:** -Models can be used to simulated systems and interactions. These models are based on mathematics, computer analysis, and logic. Stability and Change: -systems can be designed for greater or lesser stability **Energy and Matter:** -energy can not be created nor destroyed, but rather transfer from one state to another. **Influence and**	-What mathematical representations can be used to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media? -How could you evaluate the validity and reliability of claims in published materials of the effects the different frequencies of electromagnetic radiation have when absorbed by matter? -What distinguishing facts can be used to determine if the wave model or the particle model of electromagnetic radiation is appropriate? -How could you communicate technical information about how devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and enrgy? -Why is digital transmission of	**Energy and chemical processes:** -solar cells are human made devices that capture electromagnetic waves and produce electrical energy **Wave properties:** -the wavelength and frequency of a wave are related to one another by the speed of the wave, which depends on the type of wave and the medium in which it travels through -information can be digitized in this form in a series of wave pulses -superposition of waves indicate waves can add or cancel one another as they cross, depending on their relative phase **Electromagnetic radiation:** -electromagnetic radiation can be models as a wave or changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, while the particle model	**Asking questions and defining problems:** -evaluate questions that challenge the premises of an argument, the interpretation of a data set, or the suitability of a design **Using mathematics and computational thinking:** -use mathematical representations of phenomena or design solutions to describe and/ or support claims and explanations **Engaging in argument from evidence:** -evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits or arguments **Obtaining, evaluating, and communicating information:** -evaluate the validity and reliability of multiple claims that appear in scientific and technical texts, verifying data when possible -communicate technical		RH.11–12.1-Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole. (11, 12) [State:Common Core State Standards (CCSS)] RH.11–12.7-Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem. (11, 12) [State:Common Core State Standards (CCSS)] RH.11–12.8-Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.8-Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations

interdependence of Science and Technology: -science and technology go hand in hand in a cycle known as research and development -Engineers continuously modify these technological systems by applying current scientific knowledge and engineering design practices to increase the benefits to society **Science Models, Laws, Mechanisms, and Theories explain natural phenomena:** -a scientific theory is a substantiated explanation of some aspect of the natural world based on a plethora of facts and observations. Theories are modified when new evidence arises **Scientific Knowledge assumes an order and consistency in natural systems:** -Science is based on the assumption that the natural laws on earth or anywhere in the universe exists on a consistent basis -science assumes the universe is a vast, single system with the same set	information an advantage or a disadvantage over analog transmission of information? -How do waves travel through different mediums? -What are the fundamental differences between longitudinal and transverse waves? -How does the Doppler effect relate to waves? -Why does light "bend" when it enters a more or less dense medium? -What is a octave or harmonic? -What is simple harmonic motion?	describes of features -when light or longer wavelengths is absorbed in matter, it is generally converted into thermal energy. Shorter wavelengths are more dangerous, and can cause damage to living organisms -photoelectric materials emit electrons when they absorb light of a high frequency (threshold frequency) **Information Technologies and Instrumentation:** -multiple technologies based on waves and their interactions with matter are part of everyday experiences in the modern world and in scientific research. **The universe and its stars:** -the stars spectra and brightness is used to identify compositional elements of the stars, their movements, and their distance from Earth -the big bang theory is supported by observations of distant galaxies receding from our own, and the measure composition of stars and other gases.	information or ideas in multiple formats which include, oral, graphical, textual, and mathematical **Constructing explanations and designing solutions:** -construct and explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories and laws that describe the natural world operate today as they did in the past and will in the future		of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (11, 12) [State:Common Core State Standards (CCSS)] A.SSE.1.a-Interpret parts of an expression, such as terms, factors, and coefficients. (09-12) [State:Common Core State Standards (CCSS)] A.SSE.3-Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. * (09-12) [State:Common Core State Standards (CCSS)] A.CED.1-Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* (09-12) [State:Common Core State Standards (CCSS)] A.CED.2-Create equations in two or more variables to represent relationships

of laws		-nuclear fusion within stars creates matter as we know it (other than the original matter created from the big bang itself) **Electromagnetic radiation:** -Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities			between quantities; graph equations on coordinate axes with labels and scales. (09-12) [State:Common Core State Standards (CCSS)] A.REI.3-Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. (09-12)[State:Common Core State Standards (CCSS)] HS.PS3.3.CCC.1-Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HSPS3-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.1-Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS4.1.SEP.1-Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

					(09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS4.1.DCI.PS4.A.1-The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS4.2.DCI.PS4.A.1-Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HSPS4-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.3.DCI.PS3.A.1-At the macroscopic scale, energy manifests itself in multiple way s, such as in motion, sound, light, and thermal energy . (HSPS3-2) (HS-PS3-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.CCC.1-Energy cannot be created or destroy ed—only moves

					between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.3.DCI.PS4.A.1- [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary : The discussion at this grade level is qualitative only ; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.3.DCI.PS4.B.3- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model

					explains other features. (HS-PS4-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.4.DCI.PS4.B.1-When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-ray s, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] 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.* (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS4.5.DCI.PS4.A.2-Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series

					of wave pulses. (HS-PS4-2), HSPS4-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.5.DCI.PS4.B.3- Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.5.DCI.PS4.C.4- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics Honors
Type : Consensus

Duration: March/Week 27 - June/Week 38					
UNIT NAME: Electicity and Magnetism					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Patterns: -Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena **Cause and Effect:** -empirical evidence is required to differentiate between cause and correlation? -cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system **Structure and Function:** -investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and the connections of components to reveal its function and/or solve a problem.	-What model can be developed and used for two objects interacting through electric and magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction? -What appropriate mathematic model can be used to represent Coulomb's Law to describe and predict the electrostatic force between one or more objects in multiple dimension? -What prediction can be made about the sign and relative quantity of net charge of objects or systems after various charging processes? -What plan would be used to construct 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? -How could you	**Types of Interactions:** -Newton's Law of gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects -Forces at a distance are explained by fields permeating space that can transfer energy through space. -Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and the transformations of matter, as well as the contact forces between material objects **Definitions of Energy:** -Electrical energy may mean energy stored in a battery, energy stored in an electric field, or energy stored in a magnetic field **Relationship between energy and forces:** -when two objects interacting through a field change relative position, the energy stored in the field is changed	**Planning and carrying out investigations:** -plan and construct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design decide on types, how much, and accuracy of data needed to produce reliable data. **Using Mathematical and computational thinking:** -use mathematical representations of phenomena to describe explanations **Obtaining, evaluating, and communicating information:** -communicate scientific and technical information in multiple formats which include oral, graphical, textual, and mathematical **Developing and using models:** -Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system		WHST.11–12.2-Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (11, 12)[State:Common Core State Standards (CCSS)] WHST.11–12.7-Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (11, 12) [State:Common Core State Standards (CCSS)] WHST.11–12.8-Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text

Science Models, Laws, Mechanisms, and Theories explain natural phenomena: -Theories and laws provide explanations in science -Laws are statements or descriptions of the relationships among observable phenomena	communicate the scientific and technological information about why the molecular level structure is important in the functioning of designed materials? -How could you design build, and refine a device that works within given constraints to convert one form of energy into another? -What difference is created between a dynamic moving electric charge and a static charge? -How can the right hand rule predict the direction of the magnetic force? -How can Coulomb's law be applied to determine the net electric field and force in 1-D and 2-Dimensions? -How does conservation of energy apply to Lenz law?				selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (11, 12) [State:Common Core State Standards (CCSS)] N.Q.1-Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (09-12)[State:Common Core State Standards (CCSS)] N.VM.1-(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v). (09-12) [State:Common Core State Standards (CCSS)] N.VM.2-(+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. (09-12) [State:Common Core State Standards (CCSS)] N.VM.3-(+) Solve

					problems involving velocity and other quantities that can be represented by vectors. (09-12)[State:Common Core State Standards (CCSS)] N.VM.4-(+) Add and subtract vectors. (09-12) [State:Common Core State Standards (CCSS)] N.VM.4.a-Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. (09-12)[State:Common Core State Standards (CCSS)] N.VM.4.b-Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. (09-12)[State:Common Core State Standards (CCSS)] A.SSE.3-Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. * (09-12) [State:Common Core State Standards (CCSS)] A.CED.1-Create equations and inequalities in one variable and use them to solve problems. *Include*

					equations arising from linear and quadratic functions, and simple rational and exponential functions. (09-12) [State:Common Core State Standards (CCSS)] A.CED.2-Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (09-12) [State:Common Core State Standards (CCSS)] A.REI.1-Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. (09-12) [State:Common Core State Standards (CCSS)] A.REI.3-Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. (09-12)[State:Common Core State Standards (CCSS)] A.REI.6-Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in

					two variables. (09-12) [State:Common Core State Standards (CCSS)] RH.11–12.1-Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole. (11, 12) [State:Common Core State Standards (CCSS)] HS.PS1.1.DCI.PS2.B.3-Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS1-1),(HS-PS1-3), (HSPS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.3.SEP.1-Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine

					the design accordingly . (HS-PS1-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.3.DCI.PS1.A.1- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3), (secondary to HS-PS2-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS1.3.DCI.PS2.B.2- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS1-1),(HS-PS1-3), (HSPS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.6.DCI.PS1.A.1- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3), (secondary to HS-PS2-6) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.6.DCI.PS2.B.2-

					Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS1-1),(HS-PS1-3), (HSPS2-6) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.2.SEP.1- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' ow n investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.4.CCC.1- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4) (09-12)[Regional:Next Generation Science

					Standards (NGSS)] HS.PS1.7.SEP.1-Use mathematical representations of phenomena to support claims. (HS-PS1-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS1.7.CCC.1-The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.1.CNS.1-Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.DCI.PS2.B.1-Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the

					effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.DCI.PS2.B.2- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.5.DCI.PS2.B.1- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.

					Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.5.DCI.PS3.A.2-… and “electrical energy ” may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.1.DCI.PS3.B.2-Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1) (09-12)[Regional:Next Generation Science

					Standards (NGSS)] HS.PS3.2.DCI.PS3.A.2-At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy . (HSPS3-2) (HS-PS3-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.DCI.PS3.A.3-These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.CCC.1-Energy cannot be created or destroy ed—only moves between one place and

					another place, between objects and/or fields, or between systems. (HS-PS3-2) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.5.DCI.PS3.C.1-When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.2.CET.1-Modern civilization depends on major technological sy stems. (HS-PS4-2), (HSPS4-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.3.CCC.1-Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions — including energy , matter, and information flows—within and between systems at different scales. (HS-PS4-3) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					