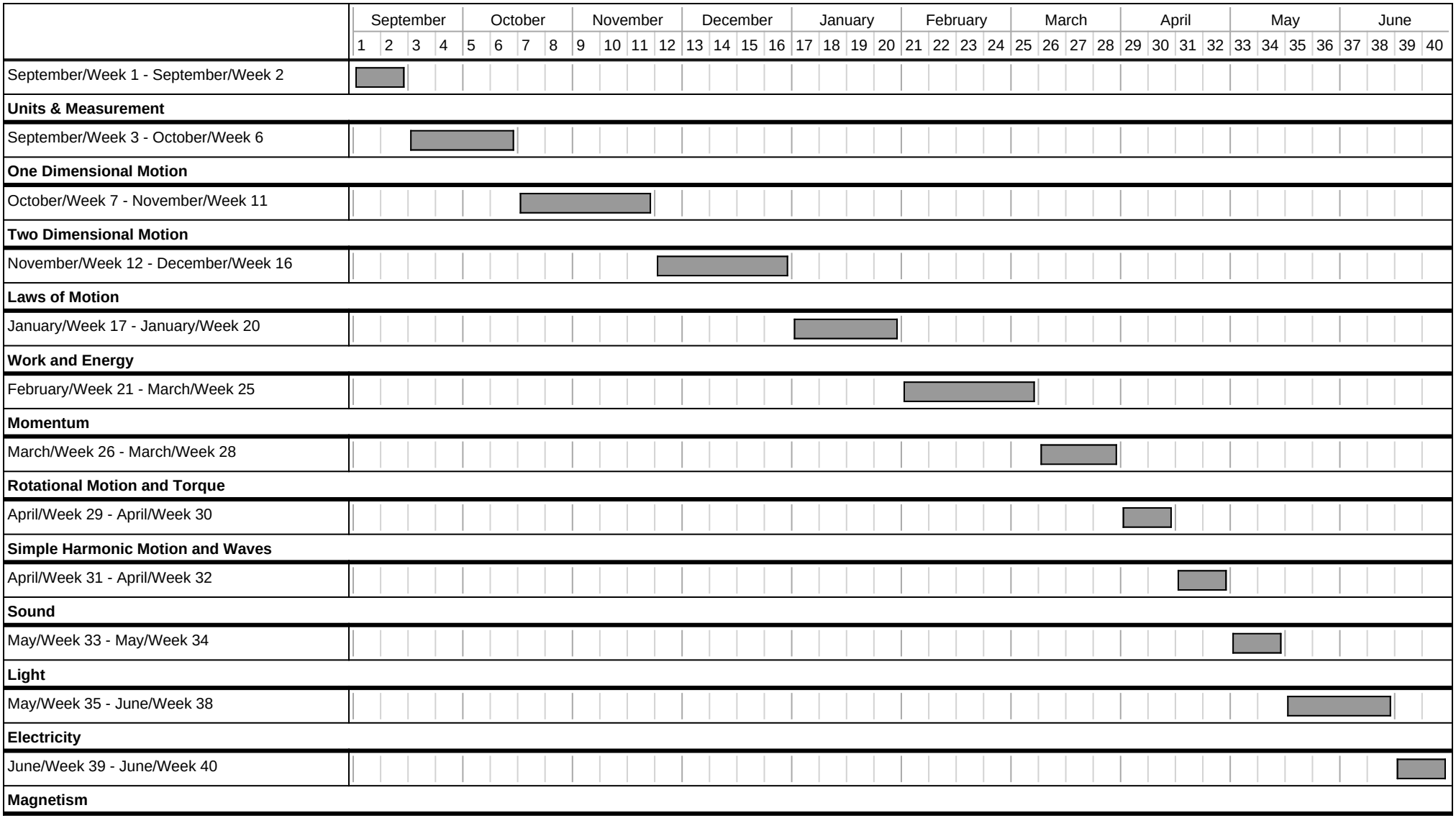
Title	**Roxbury High School Physics A**
Type	Consensus
Document	Map
Authors	Denise Glenn, Chris Blough, Michael Gottfried, Laura Hyde, Matt Scheneck
Subject	Science
Course	Physics A
Grade(s)	11 , 12
Location	Roxbury High School
Curriculum Writing History	
Notes	
Attachments	

Title : Roxbury High School Physics A
Type : Consensus



Title : Roxbury High School Physics A
Type : Consensus

Duration: September/Week 1 - September/Week 2					
UNIT NAME: Units & Measurement					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
The metric system is based on powers of ten. All graphs need proper spacing of each axis, proper scale along each axis, labels and units for each axis, and a title. The slope of a line is determined by dividing the change in the y-value of the scale by the change in the x-value of the scale. The units of each scale are divided when finding the slope of a line; used to interpret the information on the graph.	How are metric units converted? What strategies are used to convert from one unit to another? How are units combined together? What are the necessary characteristics of a proper line graph? How are line graphs interpreted?	Use the factor label method to convert from one unit to another. Construct a line graph using results of lab data. Find and interpret the slope of a line graph. Use dimensional analysis to check the validity of expressions	Converting metric units Combining units Creating and interpreting graphs Dimensional analysis problem solving		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.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.PS1.7.SEP.1-Use mathematical representations of phenomena to support claims. (HS-PS1-7) (09-12) [Regional:Next Generation

					Science Standards (NGSS)] HS.PS2.1.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.2.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.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.CNS.2-Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4) (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.CCC.1-Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HSPS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.SEP.1-Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2),(HSPS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: September/Week 3 - October/Week 6					
UNIT NAME: One Dimensional Motion					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. Systems can be designed to cause a desired effect. When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. Theories and laws provide explanations in science. Laws are statements or descriptions of the relationships among observable phenomena.	How can the motion of an object be graphically represented? How can the motion graphs generated be analyzed to find out about the object at certain times? What is free-fall? Is it the same everywhere? What equations can be derived and used to analyze the motion of an object?	Displacement is not the same as distance traveled. It can be negative. Average velocity is displacement divided by the time interval. It is not the same as speed, and can be negative. Acceleration measures the rate of change in velocity. The slope and shape of a distance vs. time or velocity vs. time graph describes the motion of the object graphed. Free-falling objects undergo constant acceleration. On earth = -9.8 m/s^2. The kinematic equations can be used to analyze the motion of objects in free fall.	Describe motion in terms of displacement, time, and velocity. Construct and interpret graphs of position vs. time. Describe motion in terms of changing velocity Construct and interpret graphs of velocity vs. time. Apply equations to calculate unknown quantities within the motion equations. Interpret problems using the gravitational acceleration constant for object in free fall.		HS.PS2.4.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-PS2-4) (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.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) (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.PS2.4.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.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.CNS.2-Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: October/Week 7 - November/Week 11					
UNIT NAME: Two Dimensional Motion					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. Theories and laws provide explanations in science. The use of trigonometry greatly simplifies the process of analyzing the motion of projectiles.	What is a vector and how can they be used to analyze motion? How can vectors be combined and taken apart into component pieces? What quantities of motion are known without being given in the problem? What is a projectile and how can the motion of them be analyzed?	Unlike scalars, vectors indicate direction. Vectors can be added and subtracted graphically. Use the Pythagorean Theorem to find the magnitude of the resultant vector. Use the tangent function to find the direction of the resultant vector. Use the sine and cosine functions to resolve vectors into their x and y components. They will simplify projectile motion. Projectile motion is free fall with an initial horizontal velocity. It's path is parabolic. The acceleration in the x-direction is zero, while it is $g = -9.8 m/s^2$ in the y-direction. At maximum height, the speed of the projectile is zero in the y-direction.	Distinguish between a scalar and a vector. Add and subtract vectors using graphical method. Apply Pythagorean Theorem and trigonometry functions to calculate magnitude and direction of a resultant vector. Resolve vectors into components using trigonometry functions. Recognize examples of projectile motion and describe their paths as parabolas. Resolve vectors into their components and apply the kinematic equations to solve problems involving projectile motion.		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.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.PS2.1.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) (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.ETS1.C.3-Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS2-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.CNS.2-Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: November/Week 12 - December/Week 16					
UNIT NAME: Laws of Motion					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use mathematical representations of phenomena to describe explanations. Communicate scientific and technical information in multiple formats. Develop graphical representations of scientific problems help in the analysis of those problems. Newton's Laws of Motion govern the movement and interaction of objects with their surroundings. Multiple forces act on objects that are stationary and in motion.	What is inertia? How does the motion of an object change? How can all the forces acting on an object be represented? What is net force and how is it used to analyze the motion of an object? What is friction and why are their multiple types?	Newton’s second law accurately predicts changes in the motion of macroscopic objects. Forces cause changes in velocity. Force is a vector and can be graphically represented in a free-body diagram. Acceleration is determined by net external force. Objects in motion tend to stay in motion. Forces always exist in pairs. Each acts on a different object. Friction opposes the applied force and depends on the surfaces in contact. Kinetic friction is less than static friction. The coefficient of friction is a ratio of the frictional and normal forces acting between two objects.	Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. Understand and apply the relationship between the net force exerted on an object, its inertial mass, and its acceleration to a variety of situations. 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. Represent and describe the two types of forces that a surface can exert on an object - a normal force, and a friction force parallel to the surface and dependent on the normal force and textures of the two surfaces. Use Newton’s Second Law along with the mathematical relationship		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.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.

			among friction force and normal force to predict unknown quantities involving one-dimensional motion with constant velocity and one-dimensional motion with constant acceleration.		(HS-PS2-1),(HS-PS2-4) (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)] HS.PS2.1.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.2.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (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.SEP.1-Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.3.DCI.ETS1.C.3-Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to 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.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) (09-12) [Regional:Next Generation

					Science Standards (NGSS)] HS.PS2.4.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.CNS.2-Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4) (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 A
Type : Consensus

Duration: January/Week 17 - January/Week 20					
UNIT NAME: Work and Energy					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. 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, and refine the design accordingly. Create a computational model or simulation of a phenomenon, designed device, process, or system. Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence,	What is the scientific definition of work? What are the standard units of work and how can work be calculated? How is work evaluated when many forces are acting on an object? What is kinetic energy and how can it be calculated? What are the various forms of potential energy? How is each form calculated? How are work and energy related? Is energy always conserved? What is power and how is it related to work and energy?	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. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. 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. Energy cannot be created or destroyed, but it can be transported from one place to another	Identify and quantify the various types of energies within a system of objects in a well-defined state, such as elastic potential energy, gravitational potential energy, kinetic energy, and thermal energy and represent how these energies may change over time. Calculate changes in kinetic energy and gravitational potential energy of a system using representations of that system. 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 objects and energy associated with the relative positions of objects. 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 and energy		HS.PS2.5.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.1.SEP.1-Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1) (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),

prioritized criteria, and tradeoff considerations. Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.		and transferred between systems. Mathematical expressions, which quantify how the stored energy in a system depends on its configuration 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. When two objects interacting through a field change relative position, the energy stored in the field is changed.	flows in and out of the system are known.		(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.3- 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.PS3.1.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.PS3.1.DCI.PS3.B.5-The availability of energy limits what can occur in any system. (HS-PS3-1) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.1.CCC.1-Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HSPS3-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] 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 position of particles (objects). (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.2.SEP.1-Develop and use a model based on evidence to illustrate the relationships between systems or between

					components of a system. (HS-PS3-2),(HSPS3-5) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS3.3.DCI.PS3.D.2- Although energy cannot be destroy ed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4) (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.PS3.4.CCC.1-When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (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 A
Type : Consensus

Duration: February/Week 21 - March/Week 25					
UNIT NAME: Momentum					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
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 limitation on the precision of the data, and refine the design accordingly. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Use mathematical representation of phenomena to describe explanations. Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects.	What does momentum describe? How is it found? What is impulse and how can it be increased or decreased? What is the law of conservation of momentum? How is the conservation of momentum used in collisions? What kinds of collisions are there? How do momentum and kinetic energy change during elastic and perfectly inelastic collisions?	Momentum describes an object's motion. Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. A change in momentum takes force and time. That change over a longer time requires more force. Stopping times and distances depend on the impulse-momentum theorem. Momentum is conserved in collisions and when objects are pushing away from each other. 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. Kinetic energy is not constant in inelastic collisions, but is conserved	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. 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. Make qualitative predictions about natural phenomena based on conservation of momentum and restoration of kinetic energy in elastic collisions. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.		HS.PS2.1.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)] HS.PS2.2.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) (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-

		in elastic collisions. Most collisions are neither elastic nor perfectly inelastic.			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.SEP.1-Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3) (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.PS2.3.DCI.ETS1.C.3-Criteria may need to be broken down into simpler ones that can be approached systematically, and

					decisions about the priority of certain criteria over others (tradeoffs) may be needed. (secondary to HS-PS2-3) (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS2.3.CCC.1-Systems can be designed to cause a desired effect. (HS-PS2-3) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: March/Week 26 - March/Week 28					
UNIT NAME: Rotational Motion and Torque					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Use mathematical representation of phenomena to describe explanations. Communicate scientific and technical information in multiple formats. Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims or determine an optimal design solution. Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. Theories and laws provide explanations in science.	How can degrees be turned into radians? How are radians used in rotational motion? What equations are used to calculate angular speed and angular acceleration? When are the kinematic equations used in rotational motion? What is tangential speed? How is it calculated? What is the difference between tangential and centripetal acceleration? How is each calculated? What is centripetal force and how is it calculated? What is torque and how is it calculated? What is the moment of inertia and how is it found for various shapes?	Angles can be measured in radians. Angular displacement describes how much an object has rotated. Angular speed describes the rate of rotation. Angular acceleration occurs when angular speed changes. Kinematic equations are used when angular acceleration is constant. Objects in circular motion have tangential speed and acceleration. Tangential acceleration and speed are perpendicular to centripetal acceleration. Circular motion is caused by a force directed toward the center of the circle. Net torque produces rotation. Torque depends on a force, a lever arm, and the angle between the two.	Relate radians to degrees. Calculate angular displacement, speed, and acceleration. Use kinematic equations to solve problems on rotational motion. Solve problems involving tangential and centripetal acceleration. Calculate the force that maintains circular motion. Explain how the apparent outward force in circular motion is inertia resisting the inward force that maintains circular motion. Distinguish between torque and force. Calculate torque on an object. Identify the center of mass of an object.		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.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.

		Equilibrium requires zero net force and zero net torque.			(HS-PS2-1),(HS-PS2-4) (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)] HS.PS2.1.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5) (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)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: April/Week 29 - April/Week 30					
UNIT NAME: Simple Harmonic Motion and Waves					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Evaluate the questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design. Use mathematical representations of a phenomena or design solutions to describe and/ or support claims and/or explanations. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. Communicate technical information or ideas in multiple formats. Construct an explanation based on valid and reliable evidence obtained from a variety of sources and the assumption that theories	What is simple harmonic motion? How do velocity, acceleration, and force change as an object undergoes simple harmonic motion? What does Hooke's Law state and how is it used? How are transverse and longitudinal waves similar? How are they different? What is the relationship between wave speed, frequency, and wavelength? What is constructive interference? When does it occur? What is destructive interference? When does it occur? How is a standing wave created? What are the parts of a standing wave?	At equilibrium position, velocity is at a maximum. At maximum displacement, spring force and acceleration reach a maximum. Restoring force is proportional to displacement. A stretched or compressed spring has elastic potential energy. For small angles, a pendulum's motion is simple harmonic. Sine waves describe particles vibrating with simple harmonic motion. Vibrations of a transverse wave are perpendicular to the wave motion. Vibrations of a longitudinal wave are parallel to the wave motion. Wave speed is equal to frequency times wavelength.	Identify the conditions of simple harmonic motion. Explain how force, velocity, and acceleration change as an object vibrates. Calculate the spring force using Hooke's Law. Interpret transverse and longitudinal waveforms. Evaluate problems to solve for wave speed, frequency, and wavelength. Relate energy and amplitude. Differentiate between constructive and destructive interference. Identify nodes and antinodes of standing waves.		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)]

and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.		Displacements in the same direction produce constructive interference. Displacements in opposite directions produce destructive interference. Standing waves have nodes and antinodes.			HS.PS3.3.DCI.PS3.A.1-A t 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.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.PS4.1.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.2-Evaluate questions about the advantages of using a digital transmission and storage of information. (09-12)[Regional:Next Generation Science Standards (NGSS)] HS.PS4.2.SEP.1-Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HSPS4-2) (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.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. (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.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:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: April/Week 31 - April/Week 32					
UNIT NAME: Sound					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
	How are sound waves created and how do they propogate? How are frequency and pitch related? Why does the speed of sound change when going through different materials? How does it change? What is the Doppler effect? How can sound intensity be measured and described? What is resonance and when does it occur? What are harmonics? How are they related to the quality of instruments?	Sound waves are longitudinal. The frequency of a sound wave determines its pitch. Ultrasonic waves produce images. Sounds waves propogate in three dimensions. The speed of sound depends on the medium and it's temperature. The relative motion between the source of waves and an observer creates an apparent frequency shift know as the Doppler effect. Decibel level is a measure of the relative intensity of a sound wave on a logarithmic scale. A forced vibration at the natural frequency of an object produces resonance in that object. The number and intensity of harmonics account for the sound qualitiy of an instrument.	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. Explain how sound waves are produced. Recognize the Doppler effect. Compare the speed of sound in various media. Relate intensity, decibel level, and perceived loudness. Explain why resonance occurs. Differentiate between the harmonics of various instruments.		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.PS4.1.CCC.1-Empirical evidence is required to differentiate between cause and

					correlation and make claims about specific causes and effects. (HS-PS4-1) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.3.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. (HSPS4-3) (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.PS4.5.SEP.1- Communicate technical information or 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). (HSPS4-5) (09-12) [Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: May/Week 33 - May/Week 34					
UNIT NAME: Light					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Evaluate questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design. Use mathematical representations of phenomena or design solutions to describe and/ or support claims and/or explanations. Communicate scientific and technical information in multiple formats. Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. Construct an 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 continue to do so in the future.	How are electromagnetic waves used to transfer energy and information? What is the speed of light through various media? How is visible light effected by the source and distance from the source of the light? How do light waves interact with flat and curved mirrors? What is the law of reflection? What are real and virtual images? How are they created? How do additive and subtractive colors behave when mixed? How do humans see various colors? What is the law of refraction? How does light interact with various lens types?	The spectrum of light waves includes more than visible light. 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. The texture of a surface affects how it reflects light. Incoming and reflected angles of light rays are equal off of a flat surface. Image location can be predicted with ray diagrams and with the mirror equation. Additive colors produce white light when combined. Subtractive colors filter all light when combined. Information can be digitized; in this form, it can be stored reliably in computer memory and sent over long distances	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling through various media. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. 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. 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		HS.PS3.1.DCI.PS3.B.3-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.PS3.1.CCC.1-Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HSPS3-1) (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

		as a series of wave pulses. Electromagnetic radiation can be modeled as a wave of changing electric and magnetic fields or as particles called photons. When electromagnetic radiation of light waves or longer wavelengths are absorbed in matter, it is generally converted into thermal energy. Shorter wavelengths can ionize atoms and cause damage to living cells. Photoelectric material emit electrons when they absorb light of high enough frequency.	energy. Evaluate questions about the advantages of using a digital transmission and storage of information.		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.PS3.3.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.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.PS4.1.CCC.1- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (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.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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.3.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. (HSPS4-3) (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.PS4.3.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)] 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.SEP.1-Communicate technical information or 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). (HSPS4-5) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS4.5.DCI.PS3.D.1- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5) (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 A
Type : Consensus

Duration: May/Week 35 - June/Week 38					
UNIT NAME: Electricity					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. Communicate scientific and technical information in multiple formats. Theories and laws provide explanations in science. Laws are statements or descriptions of the relationships among observable phenomena. Use mathematical representations of phenomena to describe explanations.	What is electric charge? How can objects gain and lose charge? What are insulators and conductors? How are they both used? What is electric force and how is Coulomb's law used? How is electric field strength calculated? How are electric field lines interpreted? What is electric current and how does it move? What are sources and types of electric current? What is resistance and potential difference in an electric circuit? How is each calculated using Ohm's Law? What is electric power and how is it calculated? How are series and parallel circuit schematics made?	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. Each atom has a charged substructure 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. Coulomb's law provides the mathematical model to describe and predict the effects of electrostatic forces between distant objects. 'Electrical energy' may mean energy stored in a battery or energy transmitted by electric currents. When two objects interacting through a field	Develop and use a model of two objects interacting through electric fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. Use mathematical representations of Coulomb's Law to describe and predict the electrostatic forces between objects. Make predictions about the sign and relative quantity of net charge of objects or systems after various charging processes. Construct an explanation of a model of electric charge, and make a qualitative prediction about the distribution of positive and negative electric charges within neutral systems as they undergo various processes.		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.SEP.1-Use mathematical representations of phenomena to describe explanations. (HS-PS2-2), (HS-PS2-4) (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS2.4.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.CNS.2-Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4) (09-12)[Regional:Next Generation Science Standards (NGSS)]

	How is each circuit type evaluated?	change relative position, the energy stored in the field is changed.			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.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.PS2.5.CCC.1-Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(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.SEP.1-Create a computational model or simulation of a phenomenon, designed device, process, or

					system. (HS-PS3-1) (09-12)[Regional:Next Generation Science Standards (NGSS)]
Plans:					

Title : Roxbury High School Physics A
Type : Consensus

Duration: June/Week 39 - June/Week 40					
UNIT NAME: Magnetism					
Enduring Understandings	**Essential Questions**	**Knowledge**	**Skills**	**Assessment**	**Standards**
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, and refine the design accordingly. Use mathematical representations of phenomena to describe explanations. Communicate scientific and technical information in multiple formats. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.	What is a magnetic field? How do magnets interact with each other? How is the magnetic field around a bar magnet modeled? What does the magnetic field produced look like around a current-carrying straight wire and around a solenoid? How do moving charges behave inside of a magnetic field? How can current be induced by a magnetic field? How do electric generators and motors work?	Forces at a distance are explained by fields (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. Like magnetic poles repel each other, and opposite poles attract each other. Solenoids produce a strong magnetic field by combining several loops or wire. A charge moving through a magnetic field experiences a force. Use the right-hand rule to find the direction of the magnetic force on a positive charge. Generators produce electrical energy from mechanical energy by turning wire in a magnetic field. Electric motors transform electrical energy into	Develop and use a model of two objects interacting through magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. 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. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. Predict whether magnets will attract or repel in certain situations. Describe and diagram the magnetic field around a permanent bar magnet. Describe the magnetic field produced by a current carrying straight wire and in a solenoid.		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.PS2.4.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-PS2-4) (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

		mechanical energy. Transformers are used to change the voltage moving through wire.	Describe how electric motors and generators work. Explain how step up and step down transformers work and what they are used for.		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.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. (09-12) [Regional:Next Generation Science Standards (NGSS)] HS.PS3.5.SEP.1-Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2),(HSPS3-5) (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:					