Physics 1

Theme ***Physics – The Marriage of Motion and Energy***	
Strand ***Kinematics***	
Topics • Motion in one direction • Motion in two directions	**Pacing** 6 weeks
Content Statement **Learning Targets:** • I can describe the similarities and differences between vectors and scalars. • I can solve kinematics while describing the difference between velocity and speed. • I can describe accelerated motion in one and two dimensions qualitatively, quantitatively, and graphically. • I can demonstrate why free fall is considered a special case of accelerated motion.	**Content Elaborations** • Express the motion of an object using narrative, mathematical, and graphical representations • Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. • Express the motion of an object using narrative, mathematical, and graphical representations. • Design an experimental investigation of the motion of an object. • Analyze experimental data describing the motion of an object, and express the results of the analysis using narrative, mathematical, and graphical representations. • Express the motion of an object using narrative, mathematical, and graphical representations. • Express the motion of an object using narrative, mathematical, and graphical representations. • Design an experimental investigation of the motion of an object. • Express the motion of an object using narrative, mathematical, and graphical representations. • Design an experimental investigation of the motion of an object. • Analyze experimental data describing the motion of an object, and express the results of the analysis using narrative, mathematical, and graphical representations. • Express the motion of an object using narrative, mathematical, and graphical representations. • Design an experimental investigation of the motion of an object. • Analyze experimental data describing the motion of an object,

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Content Vocabulary • Distance • Displacement • Speed • Velocity • Acceleration • Scalar	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion

Physics 1

• Vector • Gravity • Freefall	• Conditions • Control • Correlate • Debate • Deduce • Derive • Design • Discover • Distinguish • Estimate • Evaluate • Explain • Explore • Express • Graph • Predict • Represent
Formative Assessments Entrance tickets Exit Tickets Questioning Response System Demonstrations	**Summative Assessments** Quizzes Exams Labs
Resources Book Lab Equipment Mimio/Smartboard Videos	**Enrichment Strategies** More challenging problems Additional Labs/Lab Questions Different Projects

Physics 1

Integrations	Intervention Strategies
Math: The use and application of math skills. English: Writing and explanations in lab write-ups. Social Studies: Social implications of Physics ideas and findings, historical importance ELA: Writing of lab reports, reading of technical reports and books	One and one instruction Small group instruction Problem flow charts Alternate quizzes and tests

Physics 1

Theme ***Physics – The Marriage of Motion and Energy***	
Strand Newton's Laws of Motion	
Topics • Newton's 1st Law • Newton's 2nd Law • Newton's 3rd Law	**Pacing** 6 weeks
Content Statement **Learning Targets**: • I can predict the behavior of objects using Newton's Laws. • I can determine if action-reaction force pairs have a cause and effect relationship. They will support their reasoning with examples and explanations. • I can analyze the physical interactions between objects using free body diagrams. • I can determine why an object cannot exert a force on itself.	**Content Elaborations** • Design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration. • Design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments. • Design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments. • Apply $F = mg$ to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems. • Analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. • Describe a force as an interaction between two objects and identify both objects for any force. • Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. • Make claims about various contact forces between objects based on the microscopic cause of those forces. • Explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and therefore having

	certain directions. • Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. • Construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of action-reaction pairs of forces. • Use Newton's third law to make claims and predictions about the action-reaction pairs of forces when two objects interact. • Analyze situations involving interactions among several objects by using free-body diagrams that include the application of Newton's third law to identify forces • Explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and therefore having certain directions. • Challenge a claim that an object can exert a force on itself. • Describe a force as an interaction between two objects and identify both objects for any force. • Predict the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a variety of physical situations with acceleration in one dimension. • Construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of action-reaction pairs of forces. • Use Newton's third law to make claims and predictions about the action-reaction pairs of forces when two objects interact. • Analyze situations involving interactions among several objects by using free-body diagrams that include the application of Newton's third law to identify forces. • Evaluate using given data whether all the forces on a system or whether all the parts of a system have been identified. • Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and

	units during the analysis of a situation. • Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. • Make claims about various contact forces between objects based on the microscopic cause of those forces • Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. • Re-express a free-body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object. • Design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces. • Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. • Analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. • Describe a force as an interaction between two objects and identify both objects for any force. • Construct explanations of physical situations involving the interaction of bodies using Newton's third law and the representation of action-reaction pairs of forces. • Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. • Analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. • Predict the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a

	variety of physical situations with acceleration in one dimension. • Design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces. • Re-express a free-body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object. • Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. • Evaluate using given data whether all the forces on a system or whether all the parts of a system have been identified.
Content Vocabulary • Action-Reaction Forces • Coefficient of Friction • Force • Free-Body Diagram • Inertia • Kinetic Friction • Mass • Normal • Static Friction • Tension • Weight	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion • Conditions • Control • Correlate • Debate • Deduce • Derive • Design • Discover • Distinguish • Estimate • Evaluate • Explain

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	• Explore • Express • Graph • Predict • Represent
Formative Assessments Entrance tickets Exit Tickets Questioning Response System Demonstrations	**Summative Assessments** Quizzes Exams Labs
Resources Book Lab Equipment Mimio/Smartboard Videos	**Enrichment Strategies** More challenging problems Additional Labs/Lab Questions Different Projects
Integrations Math: The use and application of math skills. English: Writing and explanations in lab write-ups. Social Studies: Social implications of Physics ideas and findings, historical importance ELA: Writing of lab reports, reading of technical reports and books	**Intervention Strategies** One and one instruction Small group instruction Problem flow charts Alternate quizzes and tests

Physics 1

Theme ***Physics – The Marriage of Motion and Energy***

Strand Gravitation and Circular Motion

Topics	**Pacing**
• Newton's Law of Gravitation • Uniform Circular Motion	4 weeks

Content Statement	**Content Elaborations**
Learning Targets: • I can discover and describe why a person stays in their seat while upside down on a roller coaster's vertical loop. • I can determine and describe how the motion of a falling apple is similar to the moon's orbit around the Earth. • I can determine what conditions are necessary for a planet to obtain a circular orbit around its host star. • I can demonstrate how Newton's second law of motion be related to the universal law of gravitation. • I can discover how the motion of the center of mass of a system can be altered.	• Analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. • Design a plan for collecting data to measure gravitational mass and to measure inertial mass, and distinguish between the two experiments • Articulate situations when the gravitational force is the dominant force and when the electromagnetic, weak, and strong forces can be ignored. • Apply $F = mg$ to calculate the gravitational force on an object with mass m in a gravitational field of strength g in the context of the effects of a net force on objects and systems. • Apply $g = G M/ r^2$ to calculate the gravitational field due to an object with mass M, where the field is a vector directed toward the center of the object of mass M. • Approximate a numerical value of the gravitational field (g) near the surface of an object from its radius and mass relative to those of the Earth or other reference objects. • Use Newton's law of gravitation to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion. • Use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion (for circular orbital motion only in

	Physics 1). • Apply Newton's second law to systems to calculate the change in the center-of-mass velocity when an external force is exerted on the system. • Use visual or mathematical representations of the forces between objects in a system to predict whether or not there will be a change in the center-of-mass velocity of that system. • Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time. • Create mathematical models and analyze graphical relationships for acceleration, velocity, and position of the center of mass of a system and use them to calculate properties of the motion of the center of mass of a system. • All learning objectives addressed in the unit are assessed on the summative assessment.
Content Vocabulary • Centripetal acceleration • Centripetal force • Gravitational mass • Inertial mass • Period • Uniform Circular Motion • Universal gravity	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion • Conditions • Control • Correlate • Debate • Deduce • Derive • Design

Physics 1

	• Discover • Distinguish • Estimate • Evaluate • Explain • Explore • Express • Graph • Predict • Represent
Formative Assessments Entrance tickets Exit Tickets Questioning Response System Demonstrations	**Summative Assessments** Quizzes Exams Labs
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Integrations Math: The use and application of math skills. English: Writing and explanations in lab write-ups. Social Studies: Social implications of Physics ideas and findings, historical importance ELA: Writing of lab reports, reading of technical reports and books	**Intervention Strategies** One and one instruction Small group instruction Problem flow charts Alternate quizzes and tests

Physics 1

Theme ***Physics – The Marriage of Motion and Energy***	
Strand Work, Energy, Power, and Linear Momentum	
Topics • Work • Kinetic Energy • Potential Energies • Work Energy Theorem • Conservation of Energy • Linear Momentum • Conservation of Linear Momentum	**Pacing** 4 weeks
Content Statement **Learning Targets**: • I can show and describe how society is dependent upon transformations of energy. • I can demonstrate the conditions necessary to produce work. • I can examine what factors affect the collision of two objects, and how can to determine whether the collision is elastic or inelastic. • I can determine that changes in momentum can be used to determine the forces applied to an object.	**Content Elaborations** • Set up a representation or model showing that a single object can only have kinetic energy and use information about that object to calculate its kinetic energy. • Translate between a representation of a single object, which can only have kinetic energy, and a system that includes the object, which may have both kinetic and potential energies. • Describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy. • Apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system. • Predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance. • Design an experiment to find the average force exerted on the object and the interval of time during which the force is exerted. • Analyze data to characterize the change in momentum of an object from the average force exerted on the object and the

	interval of time during which the force is exerted. • Design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time. • Classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values. • Qualitatively predict, in terms of linear momentum and kinetic energy, how the outcome of a collision between two objects changes depending on whether the collision is elastic or inelastic. • Apply the conservation of linear momentum to a closed system of objects involved in an inelastic collision to predict the change in kinetic energy. • Apply mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object. • Model verbally or visually the properties of a system based on its substructure and relate this to changes in the system properties over time as external variables are changed. • Apply the concepts of conservation of energy and the work-energy theorem to determine qualitatively and/or quantitatively that work done on a two-object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system. • Define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations. • Describe and make predictions about the internal energy of systems. • Calculate changes in kinetic energy and potential energy of a

	system, using information from representations of that system. • Make claims about the interaction between a system and its environment in which the environment exerts a force on the system, thus doing work on the system and changing the energy of the system (kinetic energy plus potential energy). • Design an experiment and analyze graphical data in which interpretations of the area under a force-distance curve are needed to determine the work done on or by the object or system. • Predict and calculate from graphical data the energy transfer to or work done on an object or system from information about a force exerted on the object or system through a distance. • Make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions. • Apply the principles of conservation of momentum and restoration of kinetic energy to reconcile a situation that appears to be isolated and elastic, but in which data indicate that linear momentum and kinetic energy are not the same after the interaction, by refining a scientific question to identify interactions that have not been considered. • Solve qualitatively and/or quantitatively for one-dimensional situations and only qualitatively in two dimensional situations. • Apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy. • Design an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome.

	• Apply mathematical routines to calculate the change in momentum of a system by analyzing the average force exerted over a certain time on the system. • Perform analysis on data presented as a force-time graph and predict the change in momentum of a system. • Plan data collection strategies to test the law of conservation of momentum in a two-object collision that is elastic or inelastic and analyze the resulting data graphically. • Analyze data that verify conservation of momentum in collisions with and without an external friction force. • Make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves. • Use net force and velocity vectors to determine qualitatively whether kinetic energy of an object would increase, decrease, or remain unchanged. • Use force and velocity vectors to determine qualitatively or quantitatively the net force exerted on an object and qualitatively whether kinetic energy of that object would increase, decrease, or remain unchanged. • Predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system. • Make predictions about the changes in the mechanical energy of a system when a component of an external force acts parallel or antiparallel to the direction of the displacement of the center of mass. • Calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, justify the use of conservation of energy principles to calculate the change in internal energy due to changes in internal structure because the object is actually a system.

	• Predict the velocity of the center of mass of a system when there is no interaction outside of the system but there is an interaction within the system (i.e., recognize that interactions within a system do not affect the center of mass motion of the system and determine that there is no external force). • Apply mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object. • Calculate the total energy of a system and justify the mathematical routines used in the calculation of component types of energy within the system whose sum is the total energy. • Make quantitative calculations of the internal potential energy of a system from a description or diagram of that system. • Calculate changes in kinetic energy and potential energy of a system, using information from representations of that system. • Design an experiment and analyze data to examine how a force exerted on an object or system does work on the object or system as it moves through a distance. • Justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force. • Justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction. • Calculate the change in linear momentum of a two-object system with constant mass in linear motion from a representation of the system (data, graphs, etc.). • Find the change in linear momentum for a constant-mass system using the product of the mass and the change in velocity of the center of mass. • Classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum as the appropriate solution method for an inelastic collision, recognize

	that there is a common final velocity for the colliding objects in the totally inelastic case, solve for missing variables, and calculate their values.
Content Vocabulary • Closed System • Elastic Collision • Energy • Gravitational Potential Energy • Impulse • Inelastic Collision • Isolated System • Kinetic Energy • Linear Momentum • Open System • Power • Spring Potential Energy • Work	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion • Conditions • Control • Correlate • Debate • Deduce • Derive • Design • Discover • Distinguish • Estimate • Evaluate • Explain • Explore • Express • Graph • Predict • Represent
Formative Assessments Entrance tickets Exit Tickets	**Summative Assessments** Quizzes Exams

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Questioning Response System Demonstrations	Labs
Resources Book Lab Equipment Mimio/Smartboard Videos	**Enrichment Strategies** More challenging problems Additional Labs/Lab Questions Different Projects
Integrations Math: The use and application of math skills. English: Writing and explanations in lab write-ups. Social Studies: Social implications of Physics ideas and findings, historical importance ELA: Writing of lab reports, reading of technical reports and books	**Intervention Strategies** One and one instruction Small group instruction Problem flow charts Alternate quizzes and tests

Physics 1

Theme ***Physics – The Marriage of Motion and Energy***	
Strand Torque and Rotational Motion	
Topics • Rotational Kinematics • Rotational Dynamics • Equilibrium	**Pacing** 4 weeks
Content Statement **Learning Targets**: • I can determine what conditions are necessary to balance a seesaw with varying differences in mass. • I can explore the conditions necessary for static equilibrium. • I can compare and contrast rotational and linear motion. • I can discover and analyze the relationships among angular momentum, angular velocity, angular acceleration, rotational inertia, and torque.	**Content Elaborations** • Use representations of the relationship between force and torque. [LO 3.F.1.1, SP 1.4] • Compare the torques on an object caused by various forces. [LO 3.F.1.2, SP 1.4] • Estimate the torque on an object caused by various forces in comparison to other situations. [LO 3.F.1.3, SP 2.3] • Design an experiment and analyze data testing a question about torques in a balanced rigid system. [LO 3.F.1.4, SP • 4.1, SP 4.2, SP 5.1] • Calculate torques on a two-dimensional system in static equilibrium by examining a representation or model (such as a diagram or physical construction). [LO 3.F.1.5, SP 1.4, • Calculate torques on a two-dimensional system in static equilibrium, by examining a representation or model (such as a diagram or physical construction). [LO 3.F.1.5, SP 1.4, • Justify the selection of a mathematical routine to solve for the change in angular momentum of an object caused by torques exerted on the object. [LO 3.F.3.2, SP 2.1] • Plan data collection and analysis strategies designed to test the relationship between torques exerted on an object and the change in angular momentum of that object. • Make predictions about the change in the angular velocity about an axis for an object when forces exerted on the object cause a

	torque about that axis. • Plan data collection and analysis strategies designed to test the relationship between a torque exerted on an object and the change in angular velocity of that object about an axis. • Describe a model of a rotational system and use that model to analyze a situation in which angular momentum changes due to interaction with other objects or systems. • Plan a data collection and analysis strategy to determine the change in angular momentum of a system and relate it to interactions with other objects and systems. • Use appropriate mathematical routines to calculate values for initial or final angular momentum, or change in angular momentum of a system, or average torque or time during which the torque is exerted in analyzing a situation involving torque and angular momentum. • Plan a data collection strategy designed to test the relationship between the change in angular momentum of a system and the product of the average torque applied to the system and the time interval during which the torque is exerted. • Plan data collection strategies designed to establish that torque, angular velocity, angular acceleration, and angular momentum can be predicted accurately when the variables are treated as being clockwise or counterclockwise with respect to a well-defined axis of rotation, and refine the research question based on the examination of data. • Make qualitative predictions about the angular momentum of a system for a situation in which there is no net external torque. • Make calculations of quantities related to the angular momentum of a system when the net external torque on the system is zero. • Describe or calculate the angular momentum and rotational inertia of a system in terms of the locations and velocities of objects that make up the system.

	• Do qualitative reasoning with compound objects. Do calculations with a fixed set of extended objects and point masses. • Use representations of the center of mass of an isolated two-object system to analyze the motion of the system qualitatively and semi quantitatively. • Predict the behavior of rotational collision situations by the same processes that are used to analyze linear collision situations using an analogy between impulse and change of linear momentum and angular impulse and change of angular momentum. • Describe a representation and use it to analyze a situation in which several forces exerted on a rotating system of rigidly connected objects change the angular velocity and angular momentum of the system.
Content Vocabulary • Torque • Angular Displacement • Angular Velocity • Angular Acceleration • Angular Momentum • Rotational Inertia • Static Equilibrium • Dynamic Equilibrium	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion • Conditions • Control • Correlate • Debate • Deduce • Derive • Design • Discover • Distinguish • Estimate

Physics 1

	• Evaluate • Explain • Explore • Express • Graph • Predict • Represent
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Integrations Math: The use and application of math skills. English: Writing and explanations in lab write-ups. Social Studies: Social implications of Physics ideas and findings, historical importance ELA: Writing of lab reports, reading of technical reports and books	**Intervention Strategies** One and one instruction Small group instruction Problem flow charts Alternate quizzes and tests

Physics 1

Theme ***Physics – The Marriage of Motion and Energy***	
Strand Simple Harmonic Motion, Waves and Sound	
Topics • Simple Harmonic Motion • Waves • Sound	**Pacing** 4 weeks
Content Statement **Learning Targets**: • I can learn the properties that determine the motion of an object in simple harmonic motion. • I can explore what a wave is and the various methods for creating one. • I can discover the relationships between velocity, wavelength, and frequency of a wave. • I can describe the relative motions of source and observer determines our perceptions of waves. • I can discover what happens when two or more waves meet.	**Content Elaborations** • Predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties. • Design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force. • Analyze data to identify qualitative or quantitative relationships between given values and variables force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown. • Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. Predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties. • Design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force. • Analyze data to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring

	constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown. • Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. Use a visual representation to construct an explanation of the distinction between transverse and longitudinal waves by focusing on the vibration that generates the wave. • Describe representations of transverse and longitudinal waves. • Describe sound in terms of transfer of energy and momentum in a medium and relate the concepts to everyday examples. • Use graphical representation of a periodic mechanical wave to determine the amplitude of the wave. • Explain and/or predict qualitatively how the energy carried by a sound wave relates to the amplitude of the wave, and/or apply this concept to a real-world example. • Use a graphical representation of a periodic mechanical wave (position versus time) to determine the period and frequency of the wave and describe how a change in the frequency would modify features of the representation. • Use a visual representation of a periodic mechanical wave to determine wavelength of the wave. Design an experiment to determine the relationship between periodic wave speed, wavelength, and frequency and relate these concepts to everyday examples. • Use representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses. • Design a suitable experiment and analyze data illustrating the superposition of mechanical waves (only for wave pulses or standing waves). • Design a plan for collecting data to quantify the amplitude variations when two or more traveling waves or wave pulses

	interact in a given medium. • Analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes. • Refine a scientific question related to standing waves and design a detailed plan for the experiment that can be conducted to examine the phenomenon qualitatively or quantitatively. • Predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. • Plan data collection strategies, predict the outcome based on the relationship under test, perform data analysis, evaluate evidence compared to the prediction, explain any discrepancy and, if necessary, revise the relationship among variables responsible for establishing standing waves on a string or in a column of air. • Describe representations and models of situations in which standing waves result from the addition of incident and reflected waves confined to a region. • Challenge with evidence the claim that the wavelengths of standing waves are determined by the frequency of the source regardless of the size of the region. • Calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples should include musical instruments. Use a visual representation to explain how waves of slightly different frequency give rise to the phenomenon of beats. • Create or use a wave front diagram to demonstrate or interpret qualitatively the observed frequency of a wave, dependent upon relative motions of source and observer. • Analyze data to identify qualitative or quantitative relationships

	between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown. • Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. • Predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. • Describe representations and models of situations in which standing waves result from the addition of incident and reflected waves confined to a region. • Challenge with evidence the claim that the wavelengths of standing waves are determined by the frequency of the source regardless of the size of the region. • Calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples should include musical instruments
Content Vocabulary • Amplitude • Beat Frequency • Diffraction • Frequency • Incident Wave • Interference • Longitudinal Wave • Oscillation • Period	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion • Conditions • Control • Correlate

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• Pulse • Reflected Wave • Refracted Wave • Refraction • Restoring Force • Simple Harmonic Motion • Standing Waves • Superposition • Transverse Wave • Wave Fronts • Wavelength	• Debate • Deduce • Derive • Design • Discover • Distinguish • Estimate • Evaluate • Explain • Explore • Express • Graph • Predict • Represent
Formative Assessments Entrance tickets Exit Tickets Questioning Response System Demonstrations	**Summative Assessments** Quizzes Exams Labs
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Physics 1

Theme	***Physics – The Marriage of Motion and Energy***
Strand	Electrostatics and Simple Electric Circuits
Topics • Electrostatics • Simple Electric Circuits	**Pacing** 4 weeks
Content Statement **Learning Targets**: • I can investigate lightning and why is it so dangerous. • I can discover the fundamental carriers of electrical charge, and how may they be used to charge objects. • I can compare and contrast gravitational and electrical force. • I can determine how voltage, current, and resistance are related in a series circuit. • I can determine how voltage, current, and resistance are related in a parallel circuit.	**Content Elaborations** • Make claims about natural phenomena based on conservation of electric charge. • Make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits. • Challenge the claim that an electric charge smaller than the elementary charge has been isolated. • Construct an explanation of the two-charge model of electric charge based on evidence produced through scientific practices. • Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges (interactions between collections of electric point charges are not covered in Physics 1 and instead are restricted to Physics 2). • Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces. • Apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule ($\Sigma\Delta V = 0$) in a circuit with only a battery and resistors either in series or in, at most, one pair of parallel branches. • Apply conservation of energy (Kirchhoff's loop rule) in calculations involving the total electric potential difference for complete circuit loops with only a single battery and resistors in

	series and/or in, at most, one parallel branch. • Apply conservation of electric charge (Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed. • Design an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed. • Use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit. • Construct or interpret a graph of the energy changes within an electrical circuit with only a single battery and resistors in series and/or in, at most, one parallel branch as an application of the conservation of energy (Kirchhoff's loop rule). • Choose and justify the selection of data needed to determine resistivity for a given material.
Content Vocabulary • Atom • Charge • Circuit • Current • Electric Potential • Electric Potential Difference • Electron • Junction • Loop • Nucleus • Parallel • Point Charge	**Academic Vocabulary** • Address • Affect • Analyze • Apply • Approximate • Conclusion • Conditions • Control • Correlate • Debate • Deduce • Derive

Physics 1

• Proton • Resistance • Resistivity • Resistor • Schematic • Series • Static Electricity • Voltage	• Design • Discover • Distinguish • Estimate • Evaluate • Explain • Explore • Express • Graph • Predict • Represent
Formative Assessments Entrance tickets Exit Tickets Questioning Response System Demonstrations	**Summative Assessments** Quizzes Exams Labs
Resources Book Lab Equipment Mimio/Smartboard Videos	**Enrichment Strategies** More challenging problems Additional Labs/Lab Questions Different Projects
Integrations Math: The use and application of math skills. English: Writing and explanations in lab write-ups. Social Studies: Social implications of Physics ideas and findings, historical importance ELA: Writing of lab reports, reading of technical reports and books	**Intervention Strategies** One and one instruction Small group instruction Problem flow charts Alternate quizzes and tests