	Course Title: Foundations of Physics **Course Description: Foundations of Physics is an inquiry-centered course which combines both conceptual and advanced mathematical approaches to learning physics. The major themes explored in this course are: forces and motion, matter and energy, electromagnetism, heat, waves, and optics. Through critical thinking activities, integrated technology, and mathematical reasoning, students learn to analyze physics concepts, formulate and answer questions about the physical world, and solve real-world problems related to physics. The course requires students to investigate many of the physical phenomena through hands-on and minds-on lab experiments and performance tasks.** **Length of Course (semester long, or year-long) – 2 semesters/ 1 year** **Term 1 (August-November)**	
Essential Questions	*How and why can we use initial conditions and knowledge of Newton's Laws to predict an object's motion?* *What important conclusions can be drawn about an objects motion if we know that it is subjected to balanced or unbalanced forces?* *How and why can we use initial conditions and knowledge of Newton's Laws to predict an object's motion?* *How and why can we use initial conditions and knowledge of Newton's Laws to predict an object's motion?* *What is gravity?*	
Standards	IP 1.1 Compare and contrast vector quantities (e.g., displacement, velocity, acceleration force, linear momentum) and scalar quantities (e.g., distance, speed, energy, mass, and work). IP1.2 Distinguish between displacement, distance, velocity, speed, and acceleration. Solve problems involving displacement, distance, velocity, speed, and constant acceleration. IP1.3 Create and interpret graphs of 1-dimensional motion, such as position vs. time, distance vs. time, speed vs. time, velocity vs. time, and acceleration vs. time where acceleration is constant. 1.4 Interpret and apply Newton's three laws of motion. 1.5 Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects. 1.6 Distinguish qualitatively between static and kinetic friction, and describe their effects on the motion of objects. 1.7 Describe Newton's law of universal gravitation in terms of the attraction between two objects, their masses, and the distance between them. 1.8 Describe conceptually the forces involved in circular motion.	
Concepts and Skills	**Motion** Use of scientific tools, timer, photogates, meter stick, electronic scale, physics stand, straight track, ramp, knob, steel ball, plastic ball **Forces** Use of scientific tools, physics stand, straight track,	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **Mathematics Framework** 8NS Know that there are numbers that are not rational, and approximate them by rational numbers. 8EE Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations. Analyze and solve linear equations and pairs of simultaneous linear equations.

	knob, timer, photogates, meter stick, ultimate pulley set, 2.5N, 5N, 10N, 20N spring scale, electronic scale, friction block, sandpaper, different weights, washers, extension and compression springs, protractor, ring, steel ball, plastic ball, loop track **Practices** •Ask questions that arise from careful observations of phenomena. •Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (teach) •Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. (Teach) •Conduct an investigation individually and collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data (teach) •Select appropriate tools to collect, record, analyze, and evaluate data. (teach) •Manipulate dependent and independent variables and collect data about a proposed process or system. (teach) •Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (teach) •Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach) •Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. (teach)	8F Define, evaluate, and compare functions. Use functions to model relationships between quantities. 8G Understand and apply the Pythagorean Theorem. Solve real-world and mathematical problems involving volume of cylinders, cones and spheres. 8SP Investigate patterns of association in bivariate data. **CCR Reading Standards** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 1. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 2. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 3. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. 4. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*). 5. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. 6. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 7. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **CCR Writing Standards** 1. Write arguments focused on *discipline-specific content*. 2. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. 6. Conduct short as well as more sustained research projects to answer a question (including a self-

	•Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. (reteach) •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. (reteach) •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. (reteach) •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems (reteach) •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. (reteach) •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. (reteach) •Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. (reteach) •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats	generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 7. Draw evidence from informational texts to support analysis, reflection, and research.

	(e.g., visually, quantitatively) in order to address a scientific question or solve a problem.	
Content Objectives	• Explain what makes up the universe. • Describe how the scientific method is used. • Explore the usefulness of Physics in different fields such as engineering, medicine, business, art and music, and other sciences. • Convert length, time, and mass units using both the English and metric systems. • Use scientific notation to represent large and small numbers. • Estimate and accurately measure mass, distance and time using both metric and English systems. • Apply the speed formula to find speed, distance or time. • Distinguish between speed and velocity. • Measure and analyze the speed of a model (marble) rolling down an incline using the photogates and timer. • Analyze and draw distance versus time graphs. • Define acceleration and calculate it. • Compare and contrast acceleration and velocity. • Distinguish between positive, negative, and zero acceleration. • Predict and find a relationship between acceleration and angle of incline. • Analyze and draw velocity versus time graphs. • Find height, speed or time of flight in free fall problems. • Explain how air resistance makes objects of different masses fall with different accelerations. • Identify scalar and vector quantities. • Explain why quantities are scalar or vector in different contexts. • Add and subtract vectors in one, two, and three dimensions. • Project vectors on the x, y, and z-axes. • Calculate the x, y, and z components of vectors. • Express vectors in polar and xyz coordinates. • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. • Present findings of an investigation to whole class or small groups using appropriate vocabulary.	

	• Investigate how the law of inertia affects the motion of an object. • Examine how changing the mass or the force acting on an object can affect its acceleration. • Verify experimentally Newton's 2nd law by explaining the relationship between force and motion. • Explain real-life situations using Newton's 1st, 2nd, and 3rd laws. • Apply Newton's Laws to solve one dimensional and two dimensional problems (inclined planes). • Calculate the net force for two or more forces in one and two dimensions. • Determine whether an object is in equilibrium by analyzing the forces acting on it. • Draw and analyze free-body diagrams. • Differentiate between mass and weight in different locations. • Explain how mass and distance impacts the gravitational force of attraction. • Apply the law of universal gravitation to solve problems involving two masses. • Interpret how the gravitational force keeps planets and satellites in orbit. • Identify the causes of friction. • Differentiate between static & kinetic friction. • Explain the advantages and disadvantages of friction. • Investigate the effect of different variables on static and kinetic friction. • Identify the characteristics of springs. • Apply Hooke's law to find the restoring force, spring constant, or deformation on a spring. • Investigate the factors that affect the deformation of different springs. • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. • Present findings of an investigation to whole class or small groups using appropriate vocabulary.
Assessments/ Products	**Investigations** 2.1-2.2 Distance, Length, and Time, 3.1-3.2-3.3 Speed, Motion, Graphs, 4.1-4.2-4.3 Acceleration, Free Fall, 5.1-5.2-5.3 Newton's 3 laws 6.1-6.2-6.3 Mass, weight, gravity, friction, equilibrium of forces 7.1-7.2 Vectors, projectile motion 8.1-8.2-8.3 Circular motion, centripetal force, universal law of gravitation **Reading Connections:**

	Nanotechnology pp31-32, Slow Motion Photography pp 51-52, Antilock Brakes pp 72-73, Robot Navigation pp138-139, Biomechanics pp 91-92, The Design of Structure pp112-113, Satellite Motion pp 155-156 **End of chapter review concepts and vocabulary, problem solving, apply your knowledge, research and write,** 32-34, 53-56, 74-76, 93-94, 114-116, 140-142, 157-158 **Formative assessment:** ExamView CD Chapters 1-2-3-4 5-6-7-8 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others? Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Physics MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Physics MCAS question list. Embedded throughout by use of focus/probing questions: • How is physics related to other fields? • Why are powers of ten useful in physics? • Why is it important to change one variable at a time in an experiment? • Why do skydivers move upwards after opening their parachutes? • How can we predict the speed of a ball rolling down an inclined plane?

	• Is time travel possible? • Can a human survive a free fall from an airplane crash? • Can a penny dropped from the Empire State Building have enough velocity to kill a person on the sidewalk below? Explain your thinking. • Can a toy car win a race with an actual race car down a slope? • Is it possible for a hammer and a feather to hit the ground at the same time when dropped from the same height? Why or why not? • How do basketball players who jump hang in the air for several seconds? • How are cars designed to overcome Newton's 1st law? • How can you perform magic tricks using Newton's 1st law? • Why can't we use a balance to measure mass in space? • Why doesn't the Earth move when you jump? • What are two ways a person can feel weightless? • At what angle should a ball be thrown to reach its maximum distance? • At what angle should you throw a banana to a monkey falling off a branch? • How does the first law apply to objects at rest and in motion? • How can you describe and model friction? • Why are you thrown to the outside edge of a car seat when the car makes a sharp turn? • Is it possible to swing 360 degrees? • Can a tissue box at the backseat of a car kill a passenger during an accident? • How can you predict the landing spot of a projectile?
Texts, Materials, and Resources	**Textbook:** Foundations of Physics **Materials and Resources:** Teacher's CD Ancillaries, Skill and Practice Worksheets Video Segments of Greatest Discoveries with Bill Nye: Physics www.discoveryeducation.com Video - Powers of Ten www.youtube.com Video - Time Travel www.discoveryeducation.com Mythbusters – free fall flight attendant www.discoveryeducation.com Science of sports – Newton's laws, projectile motion, circular motion (www.nbclearn.com/nfl) Video – Weightlessness, fun in the space station (www.youtube.com) Simulation – Forces and motion, Gravity force lab, vector addition, Lunar lander, Friction, projectile motion, springs and masses (phet.colorado.edu) Video – law of universal gravitation www.discoveryeducation.com Mythbusters – swing 360 degrees, tissue box

	www.discoveryeducation.com	
	Term 2 (November-January)	
Essential Questions	*How do we know that an object has energy?* *Why is Conservation of Energy an important concept in Physics?* *How does our understanding of Conservation of Energy all us to better experience the world around us?* *How and why can we use initial conditions and knowledge of Newton's Laws to predict an object's motion?* *What is heat?* *What happens when heat is transferred to and from an object?*	
Standards	2.1 Interpret and provide examples that illustrate the law of conservation of energy. 2.2 Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energy and vice versa. 2.3 Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy. 2.4 Describe both qualitatively and quantitatively the concept of power as work done per unit time. 2.5 Provide and interpret examples showing that linear momentum is the product of mass and velocity, and is always conserved (law of conservation of momentum). Calculate the momentum of an object. 3.1 Explain how heat energy is transferred by convection, conduction, and radiation. 3.2 Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached. 3.3 Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling, and warming. 3.4 Explain the relationships among temperature changes in a substance, the amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.	
Concepts and Skills/Practices	**Momentum** Use of scientific tools, ultimate pulley set, physics stand, colliding pendulum, spring scales, electronic scales, meter stick, washers, loop track, timer, photogates, steel and marble balls, straight track **Heat transfer**	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **Mathematics Framework** 8NS Know that there are numbers that are not rational, and approximate them by rational numbers. 8EE Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations. Analyze and solve linear equations and pairs of simultaneous

	Use of scientific tools, hot plate, thermometer, graduated cylinder, beakers, tongs, safety goggle, clamps, stand, stirring rod, washers, electronic scale, nails, lamp, spectrometer, pressure gauge **Practices** •Ask questions that arise from careful observations of phenomena. •Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. (reteach) •Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. reteach) •Conduct an investigation individually and collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data (reteach) •Select appropriate tools to collect, record, analyze, and evaluate data. (reteach) •Manipulate dependent and independent variables and collect data about a proposed process or system. (reteach) •Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. (reteach) •Compare and contrast various types of data sets to examine consistency of measurements and observations. (reteach) •Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. (reteach) •Use mathematical or algorithmic representations of	linear equations. 8F Define, evaluate, and compare functions. Use functions to model relationships between quantities. 8G Understand and apply the Pythagorean Theorem. Solve real-world and mathematical problems involving volume of cylinders, cones and spheres. 8SP Investigate patterns of association in bivariate data. **CCR Reading Standards** 1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. 2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. 3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9–10 texts and topics*. 5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*). 6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. 7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 8. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **CCR Writing Standards** 1. Write arguments focused on *discipline-specific content*. 2. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. 6. Conduct short as well as more sustained research projects to answer a question (including a self-

	phenomena or design solutions to describe explanations and create computational models or simulations. (reteach) •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. (reteach) •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. (reteach) •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems (reteach) •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. (reteach) •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. (reteach) •Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. (reteach) •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a	generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 7. Draw evidence from informational texts to support analysis, reflection, and research.

	scientific question or solve a problem.	
Content Objectives	• Describe the different forms of energy and give examples of each. • Apply the law of conservation of energy to explain how energy transfers from one form to another. • Compare and contrast kinetic and potential energy and calculate each. • Prove that the mechanical energy of a system is always constant at any given point on a track. • Define work both in terms of force-distance and energy. • Identify whether work is being done in different situations. • Calculate the work done for situations involving force and distance. • Explain the relationship between work and power. • Describe and calculate power in physical systems. • Describe how a machine in terms of input and output. • Define simple machines and give examples. • Design and build a simple machine. • Calculate the efficiency (mechanical advantage) of a simple machine given input and output work. • Calculate the linear momentum of a moving object given the mass and velocity. • Solve a one-dimensional elastic collision problem using momentum conservation. • Predict and analyze qualitatively the outcome of collision between two systems of different masses. • Verify the law of conservation of momentum during collisions of two systems (marbles) of different masses. • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. Present findings of an investigation to whole class or small groups using appropriate vocabulary • Describe the phases of matter and phase change at the molecular level. • Explain evaporation, condensation, cooling, and warming in terms of average molecular kinetic energy. • Compare and contrast the concepts of heat, temperature, and thermal energy at the microscopic and macroscopic levels. • Describe the behavior of molecules at absolute zero. • Investigate how specific heat affects rise in temperature in different substances. • Apply the heat equation to solve problems involving phase change and temperature change.	

	• Explain how heat flows in physical systems in terms of conduction, convection, and radiation. • Apply the concepts of thermal insulators and conductors to practical systems and real-life examples. • Describe free and forced convection and recognize these processes in real-life applications. • Calculate the heat transfer in watts for conduction, convection, and radiation in simple systems. • Explain how the three heat-transfer processes are applied to evaluating the energy efficiency of a house or building. • Verify thermal equilibrium experimentally using equal and unequal masses of different objects. • Describe the cause and some consequences of thermal expansion in solids, liquids, and gases. • Apply the gas laws to solve simple problems involving pressure, temperature, mass, and volume. • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. • Present findings of an investigation to whole class or small groups using appropriate vocabulary.
Assessments/ Products	**Investigations:** 10.1-10.2-10.3 Machines, Work, Energy conservation 11.1-11.2 Efficiency, Power 12.1-12.2 Momentum, Collisions 25.1-25.2-25.3 Matter, atoms, heat, temperature, thermal energy 26.1-26.2-26.3 Conduction, convection, radiation 27.1-27.2-27.3 Properties of solids, liquids, and gases **Reading Connections:** Hydroelectric Power pp196-197, Energy from Tides pp 2116-217, Jet Engines pp 235-236 The Refrigerator pp516-517, Energy Efficient Buildings pp534-535, Deep Water Submarine pp 560-561 **End of chapter review concepts and vocabulary, problem solving, apply your knowledge, research and write,** 198-200, 218-220, 237-240, 518-520, 536-538, 562-564

Formative assessment:

ExamView CD Chapters 10-11-12 25-26-27

Student self-assess

'Did I Sheet'

Notebooks:

- **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize).
- **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations.
- **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim.
- **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?

Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Physics MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Physics MCAS question generator.

Embedded throughout by use of focus/probing questions:

- How do simple machines work?
- Is free energy possible? Why or why not?
- What is the difference between an ideal machine and real machine?
- Why do we still use horsepower to describe the power of a machine?
- How do solar cells generate electricity?
- How can you predict the motion of billiard balls using the law of conservation of momentum?
- Are cars that crumple during collision safer than cars that rebound?
- Why is it more comfortable to exercise on a day when the humidity is low?

	• How many atoms make up the thickness of an aluminum sheet? • Is it possible to melt a rock? • Why does it take more energy to heat water than it does to heat aluminum or steel? • In which system are molecules moving faster: a cold cup of tea or hot cup of tea? • Why does an ice cube melt at room temperature? • What happens at the molecular level when a hot fluid is mixed with a cold fluid? • Which object emits more thermal radiation: a lamp turned on or a rock at room temperature? • Why does heating the air inside a balloon cause it to float in the air? • Why is the filling of the apple pie hotter than the crust? • Why does hot fudge pour faster when it is heated? • Where in a building is insulation required most: ceiling, walls, or floor? • Why do you feel warmer in a black T-shirt than a white one? • Do Christmas tree lights generate enough heat to cause fire?
Texts, Materials, and Resources	**Textbook:** Foundations of Physics **Materials and Resources:** Teacher's CD Ancillaries, Skill and Practice Worksheets Simulations – Energy Skate Park (phet.colorado.edu) Mythbusters – Free Energy (www.discoveryeducation.com) Video – Greatest Inventions with Bill Nye: Energy Crush-Test Dummies: Collision Warning (www.discoveryeducation.com) Science of sports – work, momentum, collisions (www.nbclearn.com/nfl) Simulation- Phases of Matter (phet.colorado.edu) Video – Greatest Inventions with Bill Nye: The Science of Materials www.discoveryeducation.com Mythbusters – Christmas-tree fire, how to make a fire sandwich? (www.discoveryeducation.com
	Term 3 (January-April)
Essential Questions	*How do we know that waves carry energy?* *Is radiation good or bad and why?* *How can physical matter impact the behavior of light?*
Standards	4.1 Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize

	examples of simple harmonic motion. 4.2 Distinguish between mechanical and electromagnetic waves. 4.3 Distinguish between the two types of mechanical waves, transverse and longitudinal. 4.4 Describe qualitatively the basic principles of reflection and refraction of waves. 4.5 Recognize that mechanical waves generally move faster through a solid than through a liquid and faster through a liquid than through a gas. 4.6 Describe the apparent change in frequency of waves due to the motion of a source or a receiver (the Doppler effect). 6.1 Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum. 6.2 Describe the electromagnetic spectrum in terms of frequency and wavelength, and identify the locations of radio waves, microwaves, infrared radiation, visible light (red, orange, yellow, green, blue, indigo, and violet), ultraviolet rays, x-rays, and gamma rays on the spectrum.	
Concepts and Skills/ Practices	**Waves** Use of scientific tools, pendulum, physics stand, steel balls, timer, photogates. Steel bolt, rubber bands, wood block, wiggler, wave generator, flat tray, slinky, sound and wave module, spring scale, tuning fork, wine glass, speakers. **Use of scientific tools** Light and optics kit, index card, laser, red, blue, green LEDs, lens, diffraction grating glasses, mirror, prism, diffraction grating glasses, spectrometer, slinky, polarizing filter **Practices** •Ask questions that arise from careful observations of phenomena. •Use and develop multiple types of models to represent and support explanations of phenomena and solve problems. •Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly. •Conduct an investigation individually and	SIS1. Make observations, raise questions, and formulate hypotheses SIS2. Design and conduct scientific investigations SiS3. Analyze and interpret results of scientific investigations SIS4. Communicate and apply the results of scientific investigation **Mathematics Framework** 8NS Know that there are numbers that are not rational, and approximate them by rational numbers 8EE Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations. Analyze and solve liner equations and pairs of simultaneous liner equations. 8F Define, evaluate, and compare functions. Use functions to model relationships between quantities. 8G. understand and apply the Pythagorean Theorem. Solve real-world and mathematical problems involving volume of cylinders, cones and spheres. 8SP Investigate parents of association in bivariate data **CCR Reading Standards** 1. Cite specific textual evidence to support analysis of science and technical texts, attention to the precise details of explanations or descriptions. 2. Determine the central ideas or conclusions of a text; trace the text's explanation of depiction of a complex process, phenomenon. Or concept; provide an accurate summary of the text. 3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. 4. Determine the meaning of symbols, key terms, and other domain specific words and phrases as they are used in specific scientific or technical context relevant to grades 9-10 texts and topics. 5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g. force, friction, reaction forces. Energy). 6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussion an experiment in a text, defining the question the author seeks to address. 7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a

	collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data •Select appropriate tools to collect, record, analyze, and evaluate data. •Manipulate dependent and independent variables and collect data about a proposed process or system. •Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. •Compare and contrast various types of data sets to examine consistency of measurements and observations. •Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. •Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems •Design, evaluate, and refine a solution to a complex	table or chart) and translate information expressed visually or mathematically (e.g., in an equations) into words. 8. Read and comprehend science/technical text's in the grades 9-10 text complexity band independently and proficiently. **CCR Writing Standards** 1. Write arguments focused on *discipline-specific content*. 2. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. 6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 7. Draw evidence from informational texts to support analysis, reflection, and research.

	real-world problem, based on scientific knowledge, student-generated sources of evidence. •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms. •Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem. Electromagnetic radiation	
Content Objectives	• Recognize real-life examples of waves. • Identify the characteristics of harmonic motion. • Find period, frequency, and amplitude from a graph of harmonic motion. • Sketch a wave pattern to demonstrate changes in frequency/period or wavelength. • Describe the meaning of natural frequency and the concept of resonance. • Differentiate between transverse and longitudinal waves. • Identify mechanical and electromagnetic waves and give examples of each. • Estimate and measure the wavelength, frequency, period and amplitude of a wave or pendulum. • Calculate the period, frequency, and/or speed of a wave. • Sketch and describe how to create plane and circular waves. • Explain how the speed of a mechanical wave changes in different mediums (solid, liquids, and gases). • Describe how sound is created and recorded. • Relate pitch, loudness, and speed of sound to properties of waves. • Explain the Doppler Effect and connect it to real-life examples. • Describe the functions of convex and concave lenses, a prism, and a flat mirror. • Describe how light rays form an image. • Construct ray diagrams for a lens and a mirror showing the object and image.	

	• Verify the law of reflection experimentally using a plane mirror. • Investigate how light bends when it passes from one transparent medium to another (refraction). • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. • Present findings of an investigation to whole class or small groups using appropriate vocabulary. • Define electromagnetic waves and recognize the change in their speed in different mediums. • Identify electromagnetic waves and their uses in everyday life. • Distinguish between mechanical and electromagnetic waves. • Explain how the electromagnetic spectrum is classified. • Arrange electromagnetic waves in increasing order of frequency. • Explain how we perceive color in terms of the three primary colors. • Investigate the additive process of primary colors (red, blue, green). • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. • Present findings of an investigation to whole class or small groups using appropriate vocabulary.
Assessments/ Products	**Investigations** 13.1-13.2-13.3 Harmonic motion, oscillations, resonance 14.1-14.2-14.3 Waves, interaction, natural frequency 15.1-15.2-15.3 Sound, perception and music 16.1-16.2 Light, color, vision 17.1-17.2-17.3 Reflection, refraction, mirrors, lenses, images, optical systems 18.1-18.2 electromagnetic spectrum, interference, diffraction, polarization

Reading Connections:
Quartz Crystals pp 257-258, Microwave Ovens 280-281, Sound from a Guitar 303-304 Color Printing pp325-326, The Telescope pp 349-350, Hologrpahy pp 372-373

End of chapter review concepts and vocabulary, problem solving, apply your knowledge, research and write:
258-260, 282-284, 305-308, 327-328, 351-355, 374-376

Formative assessment: ExamView CD Chapters 13-14-15 16-17-18

Student self-assess
'Did I Sheet'

Notebooks:

- **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize).
- **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations.
- **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim.
- **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?

Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Physics MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Physics MCAS question generator.

Embedded throughout by use of focus/probing questions:

- How is dribbling a basketball similar to waves?
- What kinds of systems oscillate?
- How can you make a singing glass?
- What is the difference between AM and FM radio broadcastings?
- How do noise canceling headsets operate?

	• Why does sound travel faster in liquids than in gases? • Why does the pitch a person's voice change after inhaling helium? • Can the rhythmic march of soldiers break a bridge? • Was it possible that the Greek scientist Archimedes was able to set an invading Roman boat to fire by using just mirrors and the sun? • How do fiber optic cables use the laws of reflection and refraction? • Why is refraction important for eyeglasses? • Why does a pencil appear broken if part of it is dipped in a glass of water? • How can you make a glass sing? • Why does a note played on a violin sound different from the same note played on a guitar? • Why do some animals hear sounds we don't? • How is it possible to make an object disappear? • Why do we see lightning before we hear thunder? • How do our eyes see color? • Why is it hard to distinguish between different colors in a dimly lit room? • Are there colors we do not see? • If humans only have three kinds of color photoreceptors, how can we see many different colors? • Why is it a good idea to wear white on a hot sunny day? • Why is the sky blue? • Why are sunsets red? • How can infrared cameras 'see' (detect) a person in the dark?
Texts, Materials, and Resources	**Textbook:** Foundations of Physics **Materials and Resources:** Teacher's CD Ancillaries, Skill and Practice Worksheets Mythbusters – Breakstep bridge, Archimedes' Myth Daily planet- Sweet and sonic (www.discoveryeducation.com) Simulation – Radio Waves and Electromagnetic Fields phet.colorado.edu
	Term 4 (April-June)
Essential Questions	*How does the connection between electricity and magnetism allow for the technology we use?*

<table>
<tr><td>Standards</td><td colspan="2">5.1 Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.
5.2 Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm’s law).
5.3 Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.
5.4 Describe conceptually the attractive or repulsive forces between objects relative to their charges and the distance between them (Coulomb’s law).
5.5 Explain how electric current is a flow of charge caused by a potential difference (voltage), and how power is equal to current multiplied by voltage.
5.6 Recognize that moving electric charges produce magnetic forces and moving magnets produce electric forces. Recognize that the interplay of electric and magnetic forces is the basis for electric motors, generators, and other technologies.</td></tr>
<tr><td>Concepts and Skills</td><td>Electromagnetism

Electric circuit kit, D cell battery, wire, switch, bulb, socket, multimeter, resistors, electroscope, Van de Graff generator, glass and plastic rods, wool, satin, balloons, light string, electronic scale, meter stick, RC pack, magnets, compass, nail, sandpaper, magnetic wire, electric motor kit, generator coil, timer, photogate

Practices

•Ask questions that arise from careful observations of phenomena.
•Use and develop multiple types of models to represent and support explanations of phenomena and solve problems.
•Design an investigation individually and collaboratively and test designs to support explanations for phenomena, or test solutions to problems and refine the design accordingly.
•Conduct an investigation individually and collaboratively, taking accurate data to produce reliable measurements and consider limitations on the precision of the data
•Select appropriate tools to collect, record, analyze, and evaluate data.
•Manipulate dependent and independent variables and collect data about a proposed process or system.</td><td>SIS1. Make observations, raise questions, and formulate hypotheses.
SIS2. Design and conduct scientific investigations.
SIS3. Analyze and interpret results of scientific investigations.
SIS4. Communicate and apply the results of scientific investigations.

Mathematics Framework
8NS Know that there are numbers that are not rational, and approximate them by rational numbers.
8EE Work with radicals and integer exponents. Understand the connections between proportional relationships, lines, and linear equations. Analyze and solve linear equations and pairs of simultaneous linear equations.
8F Define, evaluate, and compare functions. Use functions to model relationships between quantities.
8G Understand and apply the Pythagorean Theorem. Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.
8SP Investigate patterns of association in bivariate data.

CCR Reading Standards

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a</td></tr>
</table>

	•Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to analyze data. •Compare and contrast various types of data sets to examine consistency of measurements and observations. •Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. •Use mathematical or algorithmic representations of phenomena or design solutions to describe explanations and create computational models or simulations. •Apply techniques of algebra and functions to represent and solve scientific and engineering problems. •Make quantitative and qualitative claims regarding the relationship between dependent and independent variables. •Engage in arguments using scientific and empirical evidence from investigations. •Engage in argument to critique solutions proposed by peers by citing relevant evidence •Redefine argument based on evidence from multiple sources (peers, text, etc.) •Accountable talk strategies; turn-and-talk; think-write-pair-share •Apply scientific knowledge, reasoning, and empirical evidence from investigations to support claims, explain phenomena, and solve problems •Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence. •Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions of a text; summarize complex concepts, or processes by paraphrasing them in simpler but still accurate terms.	table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. 8. Read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **CCR Writing Standards** 1. Write arguments focused on *discipline-specific content*. 2. Write informative/explanatory texts, including scientific procedures/ experiments, or technical processes. 3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. 4. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. 6. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 7. Draw evidence from informational texts to support analysis, reflection, and research.

	•Synthesize, communicate, and evaluate the validity and reliability of claims, methods, and designs that appear in scientific and technical texts or media reports, verifying the data when possible. •Produce scientific and/or technical writing and/or oral presentations that communicate scientific ideas and/or design and performance of a process •Compare, integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) in order to address a scientific question or solve a problem.	
Content Objectives	• Compare and contrast insulators and conductors in terms of flow of electric charge. • Distinguish between open and closed circuits. • Use electrical symbols to draw circuit diagrams. • Explain the relationship between current, voltage, and resistance. • Apply Ohm's Law to calculate the current, voltage or resistance. • Describe the differences between AC and DC electricity. • Describe the function of common circuit components. • Design and build simple circuits. • Measure current, voltage, and resistance in a circuit using a multimeter. • Recognize and sketch examples of series and parallel circuits. • Calculate the total resistance in series and parallel circuits. • Solve problems involving series and parallel circuits using Kirchhoff's law and Ohm's law. • Identify a short circuit and describe its hazards. • Analyze and calculate the electric forces between two electric charges held at a distance. • Draw the electric forces between like and unlike charges. • Identify the factors that affect electric force. • Explain the causes of static electricity and give real-life examples. • Describe the forces between two permanent magnets. • Sketch the magnetic field of a single permanent magnet. • Predict the direction of the force on a magnet placed in a given magnetic field. • Describe how compasses work. • Predict the direction of the force on a moving charge or current-carrying wire in a magnetic field by using the right-hand rule. • Explain the relationship between electric current and magnetism. • Describe and construct a simple electromagnet. • Explain and apply Faraday's law of induction.	

	• Describe three ways to increase the current from an electric generator. • Pose questions and form hypotheses based on personal observations, experiments, and previous knowledge. • Identify independent and dependent variables. • Write procedures that clearly describe how to set up materials for conducting an experiment. • Record measurements and collect data accurately and consistently. • Properly use instruments, equipment, and materials. • Use mathematical operations, charts, and graphs to analyze and interpret data results. • Analyze the reliability of data collected in an investigation. • Develop a conclusion to an investigation that supports or refutes the stated hypothesis. • Present findings of an investigation to whole class or small groups using appropriate vocabulary.
Assessments/ Products	**Investigations** 19.1-19.2-19.3 electric circuits, current, voltage, resistance, Ohm's law 20.1-20.2-20.3 Series and parallel, power, AC/DC 21.1-21.2-21.3 Charge, Coulomb's law, capacitors 22.1-22.2-22.3 Magnets, magnetic materials, magnetic field of Earth 23.1-23.2-23.3 Current, magnetism, electromagnet, motor, induction, generator **Reading Connections:** Hybrid Gas-Electric Cars pp 392-393, Wiring in Homes and Buildings pp 413-414, How Televisions Work pp 434-435, Magnetic Resonance Imaging pp 451-452, Magnetic Levitation Trains pp 472-473, Electronic Addition of Numbers pp 492-493 **End of chapter review concepts and vocabulary, problem solving, apply your knowledge, research and write:** 394-396, 415-416, 436-438, 453-454, 474-476 **Formative assessment:** ExamView CD Chapters 19-20-21-22-23 **Student self-assess** 'Did I Sheet' **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-

development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations.

- **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim.
- **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others?

Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Physics MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Physics MCAS question generator.

Embedded throughout by use of focus/probing questions:

- Why are electrical wires covered with a layer of plastic?
- How does a potentiometer act as a dimmer switch?
- What are the most commonly used batteries in today's laptops and what are the characteristics of each?
- Why does a voltmeter show a zero reading when both its terminals are touched to the same pole of the battery?
- Why are short circuits dangerous?
- How can you prevent short circuits in your house?
- Why do a string of tree lights stop working when one bulb burns off?
- How does electricity reach our houses?
- Why do electrical systems in your houses use parallel wiring?
- How can you tell how much electrical energy an appliance consumes?
- What is the difference between DC and AC?
- What's the role of fused and circuit breakers?
- How does a Van de Graff generator raise the hair of a person touching it?
- How does lightning occur?
- How can you stay safe during a lightning storm?
- How does a compass work?
- What causes the Earth's magnetism?
- How can a magnet lift a car?
- How can you build an electromagnet?
- How can you increase the strength of electromagnets?
- How can you reverse the poles of an electromagnet?
- How does MRI scan work?

	• What are the pros and cons of MRI scan, CAT scan and X-ray? • Why do electric motors have magnets inside them? • What is the role of transformers on a power line? • Why does a compass change direction when it is placed near a current-carrying wire? • How can you explain the fact that computers are getting smaller but increasing speed and memory?
Texts, Materials, and Resources	**Textbook:** Foundations of Physics **Materials and Resources:** Teacher's CD Ancillaries, Skill and Practice Worksheets Mythbusters – Electric cars, safety in thunderstorms, greatest discoveries with Bill Nye: electromagnetism (www.discoveryeducation.com) Simulation – Ohm's law, circuit construction kit, balloon and static electricity, magnet and compass, generators (phet.colorado.edu)