



Center for Science and the Schools

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Pennsylvania Academic Standards for Science and Technology - PSU Version

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3.1. Unifying Themes			
3.1.4. GRADE 4	3.1.7. GRADE 7	3.1.10. GRADE 10	3.1.12. GRADE 12
<p><i>Pennsylvania’s public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i></p>			
<p>A. Know that natural and human-made objects are made up of parts.</p> <ul style="list-style-type: none"> • Identify and describe what parts make up a system. • Identify system parts that are natural and human-made (e.g., ball point pen, simple electrical circuits, plant anatomy). • Describe the purpose of analyzing systems. • Know that technologies include physical technology systems (e.g., construction, manufacturing, transportation), informational systems and biochemical-related systems. 	<p>A. Explain the parts of a simple system and their relationship to each other.</p> <ul style="list-style-type: none"> • Describe a system as a group of related parts that work together to achieve a desired result (e.g., digestive system). • Explain the importance of order in a system. • Distinguish between system inputs, system processes and system outputs. • Distinguish between open loop and closed loop systems. • Apply systems analysis to solve problems. <p>Links: Solar Racing (e21) Solar Cooking (e21) Flywheels (GREATT)</p>	<p>A. Discriminate among the concepts of systems, subsystems, feedback and control in solving technological problems.</p> <ul style="list-style-type: none"> • Identify the function of subsystems within a system (e.g., role of thermostat in an engine, pressure switch). • Describe interrelationships among inputs, processes, outputs, feedback and control in specific systems. • Explain the concept of system redesign and apply it to improve technological systems. • Apply the universal systems model to illustrate specific solutions and troubleshoot specific problems. • Analyze and describe the effectiveness of systems to solve specific problems. <p>Links: Maximum Power Point (e21) Photovoltaics & Fuel Cells (e21) Air Bags (GREATT) Solar Power (GREATT) Fuel Cells (GREATT) Hybrid Electric Vehicles (GREATT)</p>	<p>A. Apply concepts of systems, subsystems, feedback and control to solve complex technological problems.</p> <ul style="list-style-type: none"> • Apply knowledge of control systems concept by designing and modeling control systems that solve specific problems. • Apply systems analysis to predict results. • Analyze and describe the function, interaction and relationship among subsystems and the system itself. • Compare and contrast several systems that could be applied to solve a single problem. • Evaluate the causes of a system’s inefficiency.

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<p>B. Know models as useful simplifications of objects or processes.</p> <ul style="list-style-type: none"> • Identify different types of models. • Identify and apply models as tools for prediction and insight. • Apply appropriate simple modeling tools and techniques. • Identify theories that serve as models (e.g., molecules). 	<p>B. Describe the use of models as an application of scientific or technological concepts.</p> <ul style="list-style-type: none"> • Identify and describe different types of models and their functions. • Apply models to predict specific results and observations (e.g., population growth, effects of infectious organisms). • Explain systems by outlining a system’s relevant parts and its purpose and/or designing a model that illustrates its function. <p>Links: Accidental Discoveries (Swift)</p>	<p>B. Describe concepts of models as a way to predict and understand science and technology.</p> <ul style="list-style-type: none"> • Distinguish between different types of models and modeling techniques and apply them in specific applications (e.g., kinetic gas theory, DNA). • Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability). • Apply mathematical models to science and technology. <p>Links: Combustion and Emissions (GREATT) Modeling Metals with Marbles (GREATT) Hybrid Electric Vehicles (GREATT)</p>	<p>B. Apply concepts of models as a method to predict and understand science and technology.</p> <ul style="list-style-type: none"> • Evaluate technological processes by collecting data and applying mathematical models (e.g., process control). • Apply knowledge of complex physical models to interpret data and apply mathematical models. • Appraise the importance of computer models in interpreting science and technological systems.
<p>C. Illustrate patterns that regularly occur and reoccur in nature.</p> <ul style="list-style-type: none"> • Identify observable patterns (e.g., growth patterns in plants, crystal shapes in minerals, climate, structural patterns in bird feathers). • Use knowledge of natural patterns to predict next occurrences (e.g., seasons, leaf patterns, lunar phases). 	<p>C. Identify patterns as repeated processes or recurring elements in science and technology.</p> <ul style="list-style-type: none"> • Identify different forms of patterns and use them to group and classify specific objects. • Identify repeating structure patterns. • Identify and describe patterns that occur in physical systems (e.g., construction, manufacturing, transportation), informational systems and biochemical-related systems. 	<p>C. Apply patterns as repeated processes or recurring elements in science and technology.</p> <ul style="list-style-type: none"> • Examine and describe recurring patterns that form the basis of biological classification, chemical periodicity, geological order and astronomical order. • Examine and describe stationary physical patterns. • Examine and describe physical patterns in motion. 	<p>C. Assess and apply patterns in science and technology.</p> <ul style="list-style-type: none"> • Assess and apply recurring patterns in natural and technological systems. • Compare and contrast structure and function relationships as they relate to patterns. • Assess patterns in nature using mathematical formulas.

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<p>D. Know that scale is an important attribute of natural and human made objects, events and phenomena.</p> <ul style="list-style-type: none"> Identify the use of scale as it relates to the measurement of distance, volume and mass. Describe scale as a ratio (e.g., map scales). Explain the importance of scale in producing models and apply it to a model. 	<p>D. Explain scale as a way of relating concepts and ideas to one another by some measure.</p> <ul style="list-style-type: none"> Apply various applications of size and dimensions of scale to scientific, mathematical, and technological applications. Describe scale as a form of ratio and apply to a life situation. 	<p>D. Apply scale as a way of relating concepts and ideas to one another by some measure.</p> <ul style="list-style-type: none"> Apply dimensional analysis and scale as a ratio. Convert one scale to another. <p>Magnetism and Motors (GREATT) Properties Of Metals (GREATT) Fuel Cells (GREATT)</p>	<p>D. Analyze scale as a way of relating concepts and ideas to one another by some measure.</p> <ul style="list-style-type: none"> Compare and contrast various forms of dimensional analysis. Assess the use of several units of measurement to the same problem. Analyze and apply appropriate measurement scales when collecting data.
<p>E. Recognize change in natural and physical systems.</p> <ul style="list-style-type: none"> Recognize change as fundamental to science and technology concepts. Examine and explain change by using time and measurement. Describe relative motion. Describe the change to objects caused by heat, cold, light or chemicals. <p>Milk Carton Cars (GREATT)</p>	<p>E. Identify change as a variable in describing natural and physical systems.</p> <ul style="list-style-type: none"> Describe fundamental science and technology concepts that could solve practical problems. Explain how ratio is used to describe change. Describe the effect of making a change in one part of a system on the system as a whole. 	<p>E. Describe patterns of change in nature, physical and man made systems.</p> <ul style="list-style-type: none"> Describe how science and tech concepts are used to solve practical problems (e.g., momentum, gravity, tectonics, cell theory, evolutionary theory, atomic theory, theory of relativity, germ theory, heliocentrism, gas laws). Recognize that stable systems often involve underlying dynamic changes (e.g., a chemical reaction at equilibrium has molecules reforming continuously). Describe the effects of error in measurements. Describe changes to matter caused by heat, cold, light or chemicals using a rate function. <p>Air Bags (GREATT) Memory Metals (GREATT) Theories (Swift)</p>	<p>E. Evaluate change in nature, physical systems and man made systems.</p> <ul style="list-style-type: none"> Evaluate fundamental science and tech concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe). Analyze how models, systems and technologies change over time (e.g., germ theory, theory of evolution, solar system, cause of fire). Explain how correlation does not necessarily imply causation. Evaluate the patterns of change within a technology (e.g., changes in engineering in the automotive industry). <p>Fuel Cells (GREATT)</p>

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3.2. Inquiry and Design			
3.2.4. GRADE 4	3.2.7. GRADE 7	3.2.10. GRADE 10	3.2.12. GRADE 12
<i>Pennsylvania’s public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i>			
<p>A. Identify and use the nature of scientific and technological knowledge.</p> <ul style="list-style-type: none"> • Distinguish between a scientific fact and a belief. • Provide clear explanations that account for observations and results. • Relate how new information can change existing perceptions. 	<p>A. Explain and apply scientific and technological knowledge.</p> <ul style="list-style-type: none"> • Distinguish between a scientific theory and a belief. • Answer “What if” questions based on observation, inference or prior knowledge or experience. • Explain how skepticism about an accepted scientific explanation led to a new understanding. • Explain how new information may change existing theories and practice. <p>Ethanol (GREATT) Flywheels (GREATT) Accidental Discoveries (Swift)</p>	<p>A. Apply knowledge and understanding about the nature of scientific and technological knowledge.</p> <ul style="list-style-type: none"> • Compare and contrast scientific theories and beliefs. • Know that science uses both direct and indirect observation means to study the world and the universe. • Integrate new information into existing theories and explain implied results. 	<p>A. Evaluate the nature of scientific and technological knowledge.</p> <ul style="list-style-type: none"> • Know and use the ongoing scientific processes to continually improve and better understand how things work. • Critically evaluate the status of existing theories (e.g., germ theory of disease, wave theory of light, classification of subatomic particles, theory of evolution, epidemiology of aids).
<p>B. Describe objects in the world using the five senses.</p> <ul style="list-style-type: none"> • Recognize observational descriptors from each of the five senses (e.g., see-blue, feel-rough). • Use observations to develop a descriptive vocabulary. 	<p>B. Apply process knowledge to make and interpret observations.</p> <ul style="list-style-type: none"> • Measure materials using a variety of scales. • Describe relationships by making inferences and predictions. • Communicate, use space / time relationships, define operationally, raise questions, formulate hypotheses, test and experiment, 	<p>B. Apply process knowledge and organize scientific and technological phenomena in varied ways.</p> <ul style="list-style-type: none"> • Describe materials using precise quantitative and qualitative skills based on observations. • Develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing 	<p>B. Evaluate experimental information for appropriateness and adherence to relevant science processes.</p> <ul style="list-style-type: none"> • Evaluate experimental data correctly within experimental limits. • Judge that conclusions are consistent and logical with experimental conditions. • Interpret results of experimental

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	<ul style="list-style-type: none"> • Design controlled experiments, recognize variables, and manipulate variables. • Interpret data, formulate models, design models, and produce solutions. <p> The Biomass Balancing Act (e21) As the Rotor Turns: Wind Power (e21) Ethanol (GREATT) Earth, The Universe, and Culture (Swift) Theories (Swift) Creativity in Science (Swift) </p>	<p>variables, manipulating variables, interpreting data, and producing solutions.</p> <ul style="list-style-type: none"> • Use process skills to make inferences and predictions using collected information and to communicate, using space / time relationships, defining operationally. <p> Running on Renewables (e21) Maximum Power Point (e21) Photovoltaics & Fuel Cells (e21) Air Bags (GREATT) Combustion and Emissions (GREATT) Ethanol (GREATT) Magnetism and Motors (GREATT) Memory Metals (GREATT) Properties Of Metals (GREATT) Fuel Cells (GREATT) </p>	<p>research to predict new information or improve a solution.</p> <p>Combustion and Emissions (GREATT)</p>
<p>C. Recognize and use the elements of scientific inquiry to solve problems.</p> <ul style="list-style-type: none"> • Generate questions about objects, organisms and/or events that can be answered through scientific investigations. • Design an investigation. • Conduct an experiment. • State a conclusion that is consistent with the information. <p>Milk Carton Cars (GREATT)</p>	<p>C. Identify and use the elements of scientific inquiry to solve problems.</p> <ul style="list-style-type: none"> • Generate questions about objects, organisms and/or events that can be answered through scientific investigations. • Evaluate the appropriateness of questions. • Design an investigation with limited variables to investigate a question. • Conduct a two-part experiment. • Judge the significance of experimental information in answering the question. • Communicate appropriate conclusions from the experiment. <p>The Biomass Balancing Act (e21)</p>	<p>C. Apply the elements of scientific inquiry to solve problems.</p> <ul style="list-style-type: none"> • Generate questions about objects, organisms and/or events that can be answered through scientific investigations. • Evaluate the appropriateness of questions. • Design an investigation with adequate control and limited variables to investigate a question. • Conduct a multiple step experiment. • Organize experimental information using a variety of analytic methods. • Judge the significance of experimental information in answering the question. 	<p>C. Apply the elements of scientific inquiry to solve multi-step problems.</p> <ul style="list-style-type: none"> • Generate questions about objects, organisms and/or events that can be answered through scientific investigations. • Evaluate the appropriateness of questions. • Design an investigation with adequate control and limited variables to investigate a question. • Organize experimental information using analytic and descriptive techniques. • Evaluate the significance of experimental information in answering the question.

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	<p>Solar Racing (e21) Solar Cooking (e21)</p>	<ul style="list-style-type: none"> Suggest additional steps that might be done experimentally. <p>Running on Renewables (e21) Maximum Power Point (e21) Siting Wind Power (e21) Air Bags (GREATT) Solar Power (GREATT)</p>	<ul style="list-style-type: none"> Project additional questions from a research study that could be studied. <p>Fuel Cells (GREATT)</p>
<p>D. Recognize and use the technological design process to solve problems.</p> <ul style="list-style-type: none"> Recognize and explain basic problems. Identify possible solutions and their course of action. Try a solution. Describe the solution, identify its impacts and modify if necessary. Show the steps taken and the results. 	<p>D. Know and use the technological design process to solve problems.</p> <ul style="list-style-type: none"> Define different types of problems. Define all aspects of the problem, necessary information and questions that must be answered. Propose the best solution. Design and propose alternative methods to achieve solutions. Apply a solution. Explain the results, present improvements, identify and infer the impacts of the solution. <p>As the Rotor Turns: Wind Power (e21) Solar Racing (e21) Solar Cooking (e21)</p>	<p>D. Identify and apply the technological design process to solve problems.</p> <ul style="list-style-type: none"> Examine the problem, rank all necessary information and all questions that must be answered. Propose and analyze a solution. Implement the solution. Evaluate the solution, test, redesign and improve as necessary. Communicate the process and evaluate and present the impacts of the solution. <p>Running on Renewables (e21) Solar Power (GREATT)</p>	<p>D. Analyze and use the technological design process to solve problems.</p> <ul style="list-style-type: none"> Assess all aspects of the problem, prioritize the necessary information and formulate questions that must be answered. Propose, develop and appraise the best solution and develop alternative solutions. Implement and assess the solution. Evaluate and assess the solution, redesign and improve as necessary. Communicate and assess the process and evaluate and present the impacts of the solution. <p>Fuel Cells (GREATT) Hybrid Electric Vehicles (GREATT)</p>

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3.3. Biological Sciences			
3.3.4. GRADE 4	3.3.7. GRADE 7	3.3.10. GRADE 10	3.3.12. GRADE 12
<p><i>Pennsylvania’s public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i></p>			
<p>A. Know the similarities and differences of living things.</p> <ul style="list-style-type: none"> • Identify life processes of living things (e.g., growth, digestion, react to environment). • Know that some organisms have similar external characteristics (e.g., anatomical characteristics; appendages, type of covering, body segments) and that similarities and differences are related to environmental habitat. • Describe basic needs of plants and animals. 	<p>A. Describe the similarities and differences that characterize diverse living things.</p> <ul style="list-style-type: none"> • Describe how the structures of living things help them function in unique ways. • Explain how to use a dichotomous key to identify plants and animals. • Account for adaptations among organisms that live in a particular environment. 	<p>A. Explain the structural and functional similarities and differences found among living things.</p> <ul style="list-style-type: none"> • Identify and characterize major life forms according to their placement in existing classification groups. • Explain the relationship between structure and function at the molecular and cellular levels. • Describe organizing schemes of classification keys. • Identify and characterize major life forms by kingdom, phyla, class and order. 	<p>A. Explain the relationship between structure and function at all levels of organization.</p> <ul style="list-style-type: none"> • Identify and explain interactions among organisms (e.g., mutually beneficial, harmful relationships). • Explain and analyze the relationship between structure and function at the molecular, cellular and organ-system level. • Describe and explain structural and functional relationships in each of the five (or six) kingdoms. • Explain significant biological diversity found in each of the biomes.

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<p>B. Know that living things are made up of parts that have specific functions.</p> <ul style="list-style-type: none"> Identify examples of unicellular and multicellular organisms. Determine how different parts of a living thing work together to make the organism function. 	<p>B. Describe the cell as the basic structural and functional unit of living things.</p> <ul style="list-style-type: none"> Identify the levels of organization from cell to organism. Compare life processes at the organism level with life processes at the cell level. Explain that cells and organisms have particular structures that underlie their functions. Describe and distinguish among cell cycles, reproductive cycles and life cycles. Explain disease effects on structures or functions of an organism. 	<p>B. Describe and explain the chemical and structural basis of living organisms.</p> <ul style="list-style-type: none"> Describe the relationship between the structure of organic molecules and the function they serve in living organisms. Identify the specialized structures and regions of the cell and the functions of each. Explain how cells store and use information to guide their functions. Explain cell functions and processes in terms of chemical reactions and energy changes. 	<p>B. Analyze the chemical and structural basis of living organisms.</p> <ul style="list-style-type: none"> Identify and describe factors affecting metabolic function (e.g., temperature, acidity, hormones). Evaluate metabolic activities using experimental knowledge of enzymes. Evaluate relationships between structure and functions of different anatomical parts given their structure. Describe potential impact of genome research on the biochemistry and physiology of life.
<p>C. Know that characteristics are inherited and, thus, offspring closely resemble their parents.</p> <ul style="list-style-type: none"> Identify characteristics for animal and plant survival in different climates. identify physical characteristics that appear in both parents and offspring and differ between families, strains or species. 	<p>C. Know that every organism has a set of genetic instructions that determines its inherited traits.</p> <ul style="list-style-type: none"> Identify and explain inheritable characteristics. Identify that the gene is the basic unit of inheritance. Identify basic patterns of inheritance (e.g., dominance, recessive, co-dominance). Describe how traits are inherited. Distinguish how different living things reproduce (e.g., vegetative budding, sexual). recognize that mutations can alter a gene. Describe how selective breeding, natural selection and genetic technologies can change genetic makeup of organisms. 	<p>C. Describe how genetic information is inherited and expressed.</p> <ul style="list-style-type: none"> Compare and contrast the function of mitosis and meiosis. Describe mutations' effects on a trait's expression. Distinguish different reproductive patterns in living things (e.g., budding, spores, fission). Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria). Explain the relationship among DNA, genes and chromosomes. Explain different types of inheritance (e.g., multiple allele, sex-influenced traits). Describe the role of DNA in protein synthesis as it relates to gene expression. 	<p>C. Explain gene inheritance and expression at the molecular level.</p> <ul style="list-style-type: none"> Analyze gene expression at the molecular level. Describe the roles of nucleic acids in cellular reproduction and protein synthesis. Describe genetic engineering techniques, applications and impacts. Explain birth defects from the standpoint of embryological development and/or changes in genetic makeup.

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<p>D. Identify changes in living things over time.</p> <ul style="list-style-type: none"> Compare extinct life forms with living organisms. 	<p>D. Explain basic concepts of natural selection.</p> <ul style="list-style-type: none"> Identify adaptations that allow organisms to survive in their environment. Describe how an environmental change can affect the survival of organisms and entire species. know that differences in individuals of the same species may give some advantage in surviving and reproducing. recognize that populations of organisms can increase rapidly. Describe the role that fossils play in studying the past. Explain how biologic extinction is a natural process. 	<p>D. Explain the mechanisms of the theory of evolution.</p> <ul style="list-style-type: none"> analyze data from fossil records, similarities in anatomy and physiology, embryological studies and DNA studies that are relevant to the theory of evolution. Explain the role of mutations and gene recombination in changing a population of organisms. Compare modern day descendants of extinct species and propose possible scientific accounts for their present appearance. describe the factors (e.g., isolation, differential reproduction) affecting gene frequency in a population over time and their consequences. describe and differentiate between the roles of natural selection and genetic drift. Describe changes that illustrate major events in the earth's development based on a time line. explain why natural selection can act only on inherited traits. Apply the concept of natural selection to illustrate and account for a species' survival, extinction or change over time. 	<p>D. Analyze the theory of evolution.</p> <ul style="list-style-type: none"> Examine human history by describing the progression from early hominids to modern humans. apply the concept of natural selection as a central concept in illustrating evolution theory.
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Note: Ecosystem Standards can be found in the Environment and Ecology Standards Category 4.6.

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3.4. Physical Science, Chemistry and Physics			
3.4.4. GRADE 4	3.4.7. GRADE 7	3.4.10. GRADE 10	3.4.12. GRADE 12
<i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i>			
<p>A. Recognize basic concepts about the structure and properties of matter.</p> <ul style="list-style-type: none"> • Describe properties of matter (e.g., hardness, reactions to simple chemical tests). • Know that combining two or more substances can make new materials with different properties. • Know different material characteristics (e.g., texture, state of matter, solubility). 	<p>A. Describe concepts about the structure and properties of matter.</p> <ul style="list-style-type: none"> • Identify elements as basic building blocks of matter that cannot be broken down chemically. • Distinguish compounds from mixtures. • Describe and conduct experiments that identify chemical and physical properties. • Describe reactants and products of simple chemical reactions. <p>Combustion and Emissions (GREATT) Ethanol (GREATT)</p>	<p>A. Explain concepts about the structure and properties of matter.</p> <ul style="list-style-type: none"> • Know that atoms are composed of even smaller subatomic structures. • Explain the repeating pattern of chemical properties using patterns of atomic structure in the periodic table. • Predict the behavior of gases through the use of Boyle's, Charles' or the ideal gas law, in everyday situations. • Describe phases of matter according to Kinetic Molecular Theory. • Explain the formation of compounds and their properties using bonding theories (ionic and covalent). • Recognize formulas for simple inorganic compounds. • Describe chemical reactions using conservation of mass and energy. • Apply knowledge of mixtures to appropriate separation techniques. • Understand that carbon can form several types of compounds. <p>Food or Fuel (e21) Air Bags (GREATT) Combustion and Emissions (GREATT) Ethanol (GREATT) Modeling Metals with Marbles (GREATT)</p>	<p>A. Apply concepts about the structure and properties of matter.</p> <ul style="list-style-type: none"> • Apply rules of systematic nomenclature and formula writing. • Classify and describe in equations types of chemical and nuclear reactions. • Explain how isotopes can be used to estimate the age of materials. • Explain how the forces that bind solids, liquids, and gases affect their properties. • Characterize and identify important classes of compounds. • Apply conservation of energy to fields as diverse as mechanics, nuclear particles, and studies of the origin of the universe. • Estimate the age of materials that contain radioactive isotopes. • Quantify the properties of matter (e.g., density, solubility coefficients) by applying mathematical formulas. <p>Food or Fuel (e21) Photovoltaics & Fuel Cells (e21) Combustion and Emissions (GREATT) Modeling Metals with Marbles (GREATT) Fuel Cells (GREATT)</p>

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<p>B. Know basic energy types, sources and conversions.</p> <ul style="list-style-type: none"> Identify energy forms and examples (e.g., sunlight, heat, stored, motion). Know the concept of the flow of energy by measuring flow through an object or system. Describe static electricity in terms of attraction, repulsion and sparks. Apply knowledge of the basic electrical circuits to design and construction simple direct current circuits. Classify materials as conductors and nonconductors. Know and demonstrate the basic properties of heat by producing it in a variety of ways. Know the characteristics of light (e.g., reflection, refraction, absorption) and use them to produce heat, color or a virtual image. <p>Milk Carton Cars (GREATT)</p>	<p>B. Relate energy sources and transfers to heat and temperature.</p> <ul style="list-style-type: none"> Identify and describe sound changes in moving objects. Know that the sun is a major source of energy that emits wavelengths of visible light, infrared and ultraviolet radiation. Explain the conversion of one form of energy to another by applying knowledge of each form of energy. Explain the parts and functions in an electrical circuit. <p>Thinking About Energy (e21) The Biomass Balancing Act (e21) As the Rotor Turns: Wind Power (e21) Solar Racing (e21) Solar Cooking (e21)</p>	<p>Memory Metals (GREATT)</p> <p>B. Analyze energy sources and transfers of heat.</p> <ul style="list-style-type: none"> Determine the efficiency of chemical systems by applying mathematical formulas. Use knowledge of chemical reactions to generate an electrical current. Evaluate energy changes in chemical reactions. Use knowledge of conservation of energy and momentum to explain common phenomena (e.g., refrigeration system, rocket propulsion). Explain resistance, current and electro-motive force (Ohm's Law). <p>Thinking About Energy (e21) Running on Renewables (e21) Maximum Power Point (e21) Siting Wind Power (e21) Air Bags (GREATT) Solar Power (GREATT) Hybrid Electric Vehicles (GREATT)</p>	<p>B. Apply and analyze energy sources and conversions and their relationship to heat and temperature.</p> <ul style="list-style-type: none"> Determine the heat involved in illustrative chemical reactions. Evaluate mathematical formulas that calculate the efficiency of specific chemical and mechanical systems. Use knowledge of oxidation and reduction to balance complex reactions Apply appropriate thermodynamic concepts (e.g., conservation, entropy) to solve problems relating to energy and heat. <p>Thinking About Energy (e21) Photovoltaics & Fuel Cells (e21) Fuel Cells (GREATT)</p>
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<p>C. Observe and describe different types of force and motion.</p> <ul style="list-style-type: none"> • Identify characteristics of sound (pitch, loudness and echoes) • Recognize forces that attract or repel other objects and demonstrate them. • Describe various types of motions. • Compare the relative movement of objects and describe types of motion that are evident. • Describe the position of an object by locating it relative to another object or the background (e.g., geographic direction, left, up). <p>Milk Carton Cars (GREATT)</p>	<p>C. Identify and explain the principles of force and motion.</p> <ul style="list-style-type: none"> • Describe the motion of an object based on its position, direction and speed. • Classify fluid power systems according to fluid used or mode of power transmission (e.g., air, oil). • Explain various motions using models. • Explain how convex and concave mirrors and lens change light images. • Explain how sound and light travel in waves of differing speeds, sizes and frequencies. <p>Solar Racing (e21) Flywheels (GREATT)</p>	<p>C. Distinguish among the principles of force and motion.</p> <ul style="list-style-type: none"> • Identify the relationship of electricity and magnetism as two aspects of a single electromagnetic force. • Identify elements of simple machines in compound machines. • Explain fluid power systems through the design and construction of appropriate models. • Describe sound effects (e.g., Doppler effect, amplitude, frequency, reflection, refraction, absorption, sonar, seismic). • Describe light effects (e.g., Doppler effect, dispersion, absorption, emission spectra, polarization, interference). • Describe and measure the motion of sound, light and other objects. • Know Newton’s laws of motion (including inertia, action and reaction) and gravity and apply them to solve problems related to forces and mass. • Determine the efficiency of mechanical systems by applying mathematical formulas. <p>Magnetism and Motors (GREATT) Properties Of Metals (GREATT)</p>	<p>C. Apply the principles of motion and force.</p> <ul style="list-style-type: none"> • Evaluate wave properties of frequency, wavelength and speed as applied to sound and light through different media. • Propose and produce modifications to specific mechanical power systems that will improve their efficiency. • Analyze the principles of translational motion, velocity and acceleration as they relate to free fall and projectile motion. • Analyze the principles of rotational motion to solve problems relating to angular momentum, and torque. • Interpret a model that illustrates circular motion and acceleration. • Describe inertia, motion, equilibrium, and action/reaction concepts through words, models and mathematical symbols.
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<p>D. Describe the composition and structure of the universe and the earth's place in it.</p> <ul style="list-style-type: none"> • Recognize earth's place in the solar system. • Explain and illustrate the causes of seasonal changes. • Identify planets in our solar system and their general characteristics. • Describe the solar system motions and use them to explain time (e.g., days, seasons), major lunar phases and eclipses. 	<p>D. Describe essential ideas about the composition and structure of the universe and the earth's place in it.</p> <ul style="list-style-type: none"> • Compare various planets' characteristics. • Describe basic star types and identify the sun as a star type. • Describe and differentiate comets, asteroids and meteors. • Identify gravity as the force that keeps planets in orbit around the sun and governs the rest of the movement of the solar system and the universe. • Illustrate how the positions of stars and constellations change in relation to the Earth during an evening and from month to month. • Identify equipment and instruments that explore the universe. • Identify the accomplishments and contributions provided by selected past and present scientists in the field of astronomy. • Identify and articulate space program efforts to investigate possibilities of living in space and on other planets. 	<p>D. Explain essential ideas about the composition and structure of the universe.</p> <ul style="list-style-type: none"> • Compare the basic structures of the universe (e.g., galaxy types, nova, black holes, neutron stars). • Describe the structure and life cycle of star, using the Hertzsprung-Russell diagram. • Describe the nuclear processes involved in energy production in a star. • Explain the "red-shift" and Hubble's use of it to determine stellar distance and movement. • Compare absolute versus apparent star magnitude and their relation to stellar distance. • Explain the impact of the Copernican and Newtonian thinking on man's view of the universe. • Identify and analyze the findings of several space instruments in regard to the extent and composition of the solar system and universe. 	<p>D. Analyze the essential ideas about the composition and structure of the universe.</p> <ul style="list-style-type: none"> • Analyze the Big Bang Theory's use of gravitation and nuclear reaction to explain a possible origin of the universe. • Compare the use of visual, radio and x-ray telescopes to collect data regarding the structure and evolution of the universe. • Correlate the use of the special theory of relativity and the life of a star.
<p><i>Refer to Technology Standard Category 3.6 for applied uses of these concepts and principles.</i></p>			

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3.5. Earth Sciences			
3.5.4. GRADE 4	3.5.7. GRADE 7	3.5.10. GRADE 10	3.5.12. GRADE 12
<i>Pennsylvania’s public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i>			
<p>A. Know basic landforms and earth history.</p> <ul style="list-style-type: none"> • Describe earth processes (e.g., rusting, weathering, erosion) that have affected selected physical features in students’ neighborhoods. • Identify various earth structures (e.g., mountains, faults, drainage basins) through the use of models. • Identify the composition of soil as weathered rock and decomposed organic remains. • Describe fossils and the type of environment they lived in (e.g., tropical, aquatic, desert). 	<p>A. Describe earth features and processes.</p> <ul style="list-style-type: none"> • Describe major layers of the earth. • Describe the processes involved in the creation of geologic features (e.g., folding, faulting, volcanism, sedimentation) and that these processes seen today (e.g., erosion, weathering crustal plate movement) are similar to those in the past. • Describe the processes that formed Pennsylvania geologic structures and resources including mountains, glacial formations, water gaps and ridges. • Explain how the rock cycle affected rock formations in the state of Pennsylvania. • Distinguish between examples of rapid surface changes (e.g., landslides, earthquakes) and slow surface changes (e.g., weathering). • Identify living plants and animals that are similar to fossil forms. 	<p>A. Relate earth features and processes that change the earth.</p> <ul style="list-style-type: none"> • Illustrate and explain plate tectonics as the mechanism of continental movement and sea floor changes. • Compare examples of change to the earth’s surface over time as they related to continental movement and ocean basin formation (e.g., Delaware, Susquehanna, Ohio Rivers system formations, dynamics). • Interpret topographic maps to identify and describe significant geologic history/structures in Pennsylvania. • Evaluate and interpret geologic history using geologic maps. • Explain several methods of dating earth materials and structures. • Correlate rock units with general geologic time periods in the history of the earth. • Describe and identify major types of rocks and minerals. 	<p>A. Analyze and evaluate earth features and processes that change the earth.</p> <ul style="list-style-type: none"> • Apply knowledge of geophysical processes to explain the formation and degradation of earth structures (e.g., mineral deposition, cave formations, soil composition). • Interpret geological evidence supporting evolution. • Apply knowledge of radioactive decay to assess the age of various earth features and objects.

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<p>B. Know types and uses of earth materials.</p> <ul style="list-style-type: none"> Identify uses of various earth materials (e.g., buildings, highways, fuels, growing plants). Identify and sort earth materials according to a classification key (e.g., soil/rock type). 	<p>B. Recognize earth resources and how they affect everyday life.</p> <ul style="list-style-type: none"> Identify and locate earth resources (e.g., rock types, oil, gas, coal deposits) in Pennsylvania. Explain the processes involved in the formation of oil and coal in Pennsylvania. Explain the value and uses of different earth resources (e.g., selected minerals, ores, fuel sources, agricultural uses). Compare the locations of human settlements as related to available resources. <p>Thinking About Energy (e21) The Biomass Balancing Act (e21) As the Rotor Turns: Wind Power (e21) Solar Cooking (e21)</p>	<p>B. Explain sources and uses of earth resources.</p> <ul style="list-style-type: none"> Compare the locations of strategic minerals and earth resources in the world with their geologic history using maps and GIS. Demonstrate the effects of sedimentation and erosion before and after a conservation plan is implemented. Evaluate the impact of geologic activities/hazards (e.g., earthquakes, sinkholes, landslides). Evaluate land use (e.g., agricultural, recreational, residential, commercial) in Pennsylvania based upon soil characteristics. <p>Thinking About Energy (e21)</p>	<p>B. Analyze the availability, location and extraction of earth resources.</p> <ul style="list-style-type: none"> Describe how the location of earth's major resources has affected a country's strategic decisions. Compare locations of earth features and country boundaries. Analyze the impact of resources (e.g., coal deposits, rivers) on the life of Pennsylvania's settlements and cities. <p>Thinking About Energy (e21)</p>
<p>C. Know basic weather elements.</p> <ul style="list-style-type: none"> Identify cloud types. Identify weather patterns from data charts (including temperature, wind direction and speed, precipitation) and graphs of the data. Explain how the different seasons effect plants, animals, food availability and daily human life. 	<p>C. Describe basic elements of meteorology.</p> <ul style="list-style-type: none"> Explain weather forecasts by interpreting weather data and symbols. Explain the oceans' impact on local weather and the climate of a region. Identify how cloud types, wind directions and barometric pressure changes are associated with weather patterns in different regions. Explain and illustrate the processes of cloud formation and precipitation. Describe and illustrate the major layers of the earth's atmosphere. Identify different air masses and global wind patterns and how they relate to the weather patterns in 	<p>C. Interpret meteorological data.</p> <ul style="list-style-type: none"> Analyze information from meteorological instruments and online sources to predict weather patterns. Describe weather and climate patterns on global levels. Evaluate specific adaptations plants and animals have made that enable them to survive in different climates. 	<p>C. Analyze atmospheric energy transfers.</p> <ul style="list-style-type: none"> Describe how weather and climate involve the transfer of energy in and out of the atmosphere. Explain how unequal heating of the air, ocean and land produces wind and ocean currents. Analyze the energy transformations that occur during the greenhouse effect and predict the long-term effects of increased pollutant levels in the atmosphere. Analyze the mechanisms that drive a weather phenomena (e.g., El Nino, hurricane, tornado) using the correlation of three methods of heat energy transfer.

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	different regions of the U.S.		Siting Wind Power (e21) Combustion and Emissions (GREATT)
<p>D. Recognize the earth’s different water resources.</p> <ul style="list-style-type: none"> • Know that approximately three-fourths of the earth is covered by water. • identify and describe types of fresh and salt-water bodies. • Identify examples of water in the form of solid, liquid and gas on or near the surface of the earth. • Explain and illustrate evaporation and condensation. • Recognize other resources available from water (e.g., energy, transportation, minerals, food). 	<p>D. Explain the behavior and impact of the earth’s water systems.</p> <ul style="list-style-type: none"> • Explain the water cycle using the processes of evaporation and condensation. • Describe factors that affect evaporation and condensation. • Distinguish salt from fresh water (e.g., density, electrical conduction). • Compare the effect of water type (e.g., polluted, fresh, salt water) and the life contained in them. • Identify ocean and shoreline features, (e.g., bays, inlets, spit, tidal marshes). 	<p>D. Assess the value of water as a resource.</p> <ul style="list-style-type: none"> • Compare specific sources of potable water (e.g., wells, public systems, rivers) used by people in Pennsylvania. • Identify the components of a municipal/agricultural water supply system and a wastewater treatment system. • Relate aquatic life to water conditions (e.g., turbidity, temperature, salinity, dissolved oxygen, nitrogen levels, pressure). • Compare commercially important aquatic species in or near Pennsylvania. • Identify economic resources found in marine areas. • Assess the natural and man-made factors that affect the availability of clean water (e.g., rock and mineral deposits, man-made pollution). 	<p>D. Analyze the principles and history of hydrology.</p> <ul style="list-style-type: none"> • Analyze the operation and effectiveness of a water purification and desalination system. • Evaluate the pros and cons of surface water appropriation for commercial and electrical use. • Analyze the historical development of water use in Pennsylvania (e.g., recovery of Lake Erie). • Compare the marine life and type of water found in the intertidal, neritic and bathyal zones.
<p><i>Refer to Environment and Ecology Standards Categories 4.1, 4.3, 4.8 for standards that deal with environmental impact of Earth structures and forces.</i></p>			

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3.6. Technology Education			
3.6.4. GRADE 4	3.6.7. GRADE 7	3.6.10. GRADE 10	3.6.12. GRADE 12
<i>Pennsylvania’s public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i>			
<p>A. Know that biotechnologies relate to propagating, growing, maintaining, adapting, treating and converting.</p> <ul style="list-style-type: none"> • Identify agricultural and industrial production processes that involve plants and animals. • Identify waste management treatment processes. • Describe how knowledge of the human body influences or impacts ergonomic design. • Describe how biotechnology has impacted various aspects of daily life (e.g., health care, agriculture, waste treatment). 	<p>A. Explain biotechnologies that relate to related technologies of propagating, growing, maintaining, adapting, treating and converting.</p> <ul style="list-style-type: none"> • Identify the environmental, societal and economic impacts that waste has in the environment. • Identify and explain the impact that a specific medical advancement has had on society. • Explain the factors that were taken into consideration when a specific object was designed. • Define and describe how fuels and energy can be generated through the process of biomass conversion. • Identify and group basic plant and animal production processes. • Explain the impact that agricultural science has had on biotechnology. <p>The Biomass Balancing Act (e21) Ethanol (GREATT)</p>	<p>A. Apply biotechnologies that relate to propagating, growing, maintaining, adapting, treating and converting.</p> <ul style="list-style-type: none"> • Apply knowledge of plant and animal production processes in designing an improvement to existing processes. • Apply knowledge of biomedical technology applications in designing a solution to a simple medical problem (e.g., wheel chair design, artificial arteries). • Apply knowledge of how biomedical technology affects waste products in designing a solution that will result in reduced waste. • Apply ergonomic engineering factors when devising a solution to a specific problem. • Describe various methods of biochemical conversion. • Describe specific examples that reflect the impact that agricultural science has had on biotechnology. <p>Food or Fuel (e21)</p>	<p>A. Analyze biotechnologies that relate to propagating, growing, maintaining, adapting, treating and converting.</p> <ul style="list-style-type: none"> • Analyze and solve a complex production process problem using biotechnologies (e.g., hydroponics, fish farming, crop propagation). • Analyze examples where engineering has impacted society in protection, health, or physical enhancement. • Evaluate the cause and effect and environmental, economic and societal impacts that result from biomass conversion. • Evaluate and apply biotechnical processes to complex plant and animal production methods. • Apply knowledge of biochemical-related technologies to handle effect waste treatment. • Apply knowledge of agricultural science to solve or improve a biochemical related problem. <p>Food or Fuel (e21) Combustion and Emissions (GREATT)</p>

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<p>B. Know that information technologies involve encoding, transmitting, receiving, storing, retrieving and decoding.</p> <ul style="list-style-type: none"> • Identify electronic communication methods that exist in the community (e.g., digital cameras, telephone, internet, television, fiber optics). • Identify graphic reproduction methods. • Describe appropriate image generating techniques (e.g., photography, video). • Demonstrate the ability to communicate an idea by applying basic sketching and drawing techniques. 	<p>B. Explain information technologies of encoding, transmitting, receiving, storing, retrieving and decoding.</p> <ul style="list-style-type: none"> • Demonstrate the effectiveness of image generating technique to communicate a story (e.g., photography, video). • Analyze and evaluate the effectiveness of a graphic object designed and produced to communicate a thought or concept. • Apply basic technical drawing techniques to communicate an idea or solution to a problem. • Apply the appropriate method of communications technology to communicate a thought. 	<p>B. Apply knowledge of information technologies of encoding, transmitting, receiving, storing, retrieving and decoding.</p> <ul style="list-style-type: none"> • Describe the proper use of graphic and electronic communication systems. • Apply a variety of advanced mechanical and electronic drafting methods to communicate a solution to a specific problem. • Apply and analyze advanced communication techniques to produce an image that effectively conveys a message (e.g., desktop publishing, audio and/or video production). • Illustrate an understanding of a computer network system by modeling, constructing or assembling its components. 	<p>B. Analyze knowledge of information technologies of processes encoding, transmitting, receiving, storing, retrieving and decoding.</p> <ul style="list-style-type: none"> • Apply and analyze advanced information techniques to produce a complex image that effectively conveys a message (e.g., desktop publishing, audio and/or video production). • Analyze and evaluate a message designed and produced using still, motion and animated communication techniques. • Describe the operation of fiber optic, microwave and satellite informational systems. • Apply graphic and electronic information to solve real world problems (e.g., data analysis, forecasting, interpolation).
<p>C. Know physical technologies of structural design, analysis and engineering, finance, production, marketing, research and design.</p> <ul style="list-style-type: none"> • Identify and group a variety of construction tasks. • Identify the major construction systems present in a specific local building. • Identify specific construction systems that depend on each other in order to complete a project. • Know skills used in construction. • Identify examples of manufactured 	<p>C. Explain physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design.</p> <ul style="list-style-type: none"> • Use knowledge of material effectiveness to solve specific construction problems (e.g., steel vs. wood bridges). • Differentiate among the different types of construction applications (e.g., microwave tower, power plants, aircrafts). • Explain basic material processes that manufactured objects undergo 	<p>C. Apply physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design to real world problems.</p> <ul style="list-style-type: none"> • Describe and classify common construction by their characteristics and composition. • Compare and contrast specific construction systems that depend on each other in order to complete a project. • Evaluate material failure common to specific applications. 	<p>C. Analyze physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design to real world problems.</p> <ul style="list-style-type: none"> • Apply knowledge of construction technology by designing, planning and applying all the necessary resources to successfully solve a construction problem. • Compare resource options in solving a specific manufacturing problem.

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<p>goods present in the home and school.</p> <ul style="list-style-type: none"> • Identify basic resources needed to produce a manufactured item. • Identify basic component operations in a specific manufacturing enterprise (e.g., cutting, shaping, attaching). • Identify waste and pollution resulting from a manufacturing enterprise. • Explain and demonstrate the concept of manufacturing (e.g., assemble a set of papers or ball point pens sequentially, mass produce an object). • Identify transportation technologies of propelling, structuring, suspending, guiding, controlling and supporting. • Identify and experiment with simple machines used in transportation systems. • Explain how improved transportation systems have changed society. <p>Milk Carton Cars (GREATT)</p>	<p>during production. (e.g., separating, forming, combining).</p> <ul style="list-style-type: none"> • Evaluate a construction activity by specifying task analyses and necessary resources. • Explain the relationships among the basic resources needed in the production process for a specific manufactured object. • Explain the difference between design engineering and production engineering processes. • Analyze manufacturing steps that affect waste and pollutants. • Explain transportation technologies of propelling, structuring, suspending, guiding, controlling and supporting. • Identify and explain the workings of several mechanical power systems. • Model and explain examples of vehicular propulsion, control, guidance, structure and suspension systems. • Explain the limitations of land, marine, air and space transportation systems. <p>As the Rotor Turns: Wind Power (e21) Solar Cooking (e21)</p>	<ul style="list-style-type: none"> • Demonstrate knowledge of various construction systems by building or interpreting models. • Select and apply the necessary resources to successfully conduct a manufacturing enterprise. • Apply concepts of design engineering and production engineering in the organization and application of a manufacturing activity. • Apply the concepts of manufacturing by redesigning an enterprise to improve productivity or reduce or eliminate waste and/or pollution. • Evaluate the interrelationship of various transportation systems in the community. • Analyze the impacts that transportation systems have on a community. <p>Combustion and Emissions (GREATT) Memory Metals (GREATT) Hybrid Electric Vehicles (GREATT)</p>	<ul style="list-style-type: none"> • Analyze and apply complex skills needed to process materials in complex manufacturing enterprises. • Apply advanced information collection and communication techniques to successfully convey solutions to specific construction problems. • Assess the importance of capital on specific construction applications. • Analyze the positive and negative qualities of several different types of materials as they would relate to specific construction applications. • Analyze transportation technologies of propelling, structuring, suspending, guiding, controlling and supporting. • Analyze the concepts of vehicular propulsion, guidance, control, suspension and structural systems while designing and producing specific complex transportation systems.
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3.7. Technological Devices			
3.7.4. GRADE 4	3.7.7. GRADE 7	3.7.10. GRADE 10	3.7.12. GRADE 12
<p><i>Pennsylvania's public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i></p>			
<p>A. Explore the use of basic tools, simple materials and techniques to safely solve problems.</p> <ul style="list-style-type: none"> • Describe the scientific principles on which various tools are based. • Group tools and machines by their function. • Select and safely apply appropriate tools and materials to solve simple problems. 	<p>A. Describe the safe and appropriate use of tools, materials and techniques to answer questions and solve problems.</p> <ul style="list-style-type: none"> • Identify uses of tools, machines, materials, information, people, money, energy and time that meet specific design criteria. • Describe safe procedures for using tools and materials. • Assess materials for appropriateness of use. <p>Flywheels (GREATT)</p>	<p>A. Identify and safely use a variety of tools, basic machines, materials and techniques to solve problems and answer questions.</p> <ul style="list-style-type: none"> • Select and safely apply appropriate tools, materials and processes necessary to solve complex problems. • Apply advanced tool and equipment manipulation techniques to solve problems. 	<p>A. Apply advanced tools, materials and techniques to answer complex questions.</p> <ul style="list-style-type: none"> • Demonstrate the safe use of complex tools and machines within their specifications. • Select and safely apply appropriate tools, materials and processes necessary to solve complex problems that could result in more than one solution. • Evaluate and use technological resources to solve complex multi-step problems.
<p>B. Select appropriate instruments to study materials.</p> <ul style="list-style-type: none"> • Develop simple skills to measure, record, cut and fasten. • Explain appropriate instrument selection for specific tasks. <p>Milk Carton Cars (GREATT)</p>	<p>B. Use appropriate instruments and apparatus to study materials.</p> <ul style="list-style-type: none"> • Select appropriate instruments to measure the size, weight, shape and temperature of living and non-living objects. • Apply knowledge of different measurement systems to measure and record objects' properties. 	<p>B. Apply appropriate instruments and apparatus to examine a variety of objects and processes.</p> <ul style="list-style-type: none"> • Describe and use appropriate instruments to gather and analyze data. • Compare and contrast different scientific measurement systems; select the best measurement system for a specific situation. • Explain the need to estimate measurements within error of 	<p>B. Evaluate appropriate instruments and apparatus to accurately measure materials and processes.</p> <ul style="list-style-type: none"> • Apply and evaluate the use of appropriate instruments to accurately measure scientific and technologic phenomena within the error limits of the equipment. • Evaluate the appropriate use of different measurement scales (macro and micro). • Evaluate the utility and advantages

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		<p>various instruments.</p> <ul style="list-style-type: none"> • Apply accurate measurement knowledge to solve everyday problems. • Describe and demonstrate the operation and use of advanced instrumentation in evaluating material and chemical properties (e.g., scanning electron microscope, nuclear magnetic resonance machines). 	<p>of a variety of absolute and relative measurement scales for their appropriate application.</p>
<p><i>Computer literacy, including the use of hardware and software in standard statements C, D, and E, should be integrated across all content areas.</i></p>			
<p>C. Identify basic computer operations and concepts.</p> <ul style="list-style-type: none"> • Identify the major parts necessary for a computer to input and output data. • Explain and demonstrate the basic use of input and output devices (e.g., keyboard, monitor, printer, mouse). • Explain and demonstrate the use of external and internal storage devices (e.g., disk drive, CD drive). 	<p>C. Explain and demonstrate basic computer operations and concepts.</p> <ul style="list-style-type: none"> • Know specialized computer applications used in the community. • Describe the function of advanced input and output devices (e.g., scanners, video images, plotters, projectors) and demonstrate their use. • Demonstrate age appropriate keyboarding skills and techniques. 	<p>C. Apply basic computer operations and concepts.</p> <ul style="list-style-type: none"> • Identify solutions to basic hardware and software problems. • Apply knowledge of advanced input devices. • Apply knowledge of hardware setup. • Describe the process for basic software installation and demonstrate it. • Analyze and solve basic operating systems problems. • Apply touch keyboarding skills and techniques at expectable speed and accuracy. • Demonstrate the ability to perform basic software installation. <p>Running on Renewables (e21)</p>	<p>C. Evaluate computer operations and concepts as to their effectiveness to solve specific problems.</p> <ul style="list-style-type: none"> • Describe and demonstrate atypical software installation. • Analyze and solve hardware and advanced software problems. • Assess and apply multiple input and output devices to solve specific problems.
<p>D. Use basic computer software.</p> <ul style="list-style-type: none"> • Apply operating system skills to 	<p>D. Apply computer software to solve specific problems.</p>	<p>D. Utilize computer software to solve specific problems.</p>	<p>D. Evaluate the effectiveness of computer</p>

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<p>perform basic computer tasks.</p> <ul style="list-style-type: none"> • Apply basic word processing skills. • Identify and use simple graphic and presentation graphic materials generated by the computer. • Apply specific instructional software. 	<ul style="list-style-type: none"> • Identify software designed to meet specific needs (e.g., Computer Aided Drafting, design software, tutorial, financial, presentation software). • Identify and solve basic software problems relevant to specific software applications. • Identify basic multimedia applications. • Demonstrate a basic knowledge of desktop publishing applications. • Apply intermediate skills in utilizing word processing, database and spreadsheet software. • Apply basic graphic manipulation techniques. 	<ul style="list-style-type: none"> • Identify legal restrictions in the use of software and the output of data. • Apply advanced graphic manipulation and desktop publishing techniques. • Apply basic multimedia applications. • Apply advanced word processing, database and spreadsheet skills. • Describe and demonstrate how two or more software applications can be used to produce an output. • Select and apply software designed to meet specific needs. <p>Running on Renewables (e21)</p>	<p>software to solve specific problems.</p> <ul style="list-style-type: none"> • Evaluate the effectiveness of software to produce an output and demonstrate the process. • Design and apply advanced multimedia techniques. • Analyze, select and apply the appropriate software to solve complex problems. • Evaluate the effectiveness of the computer as a presentation tool. • Analyze the legal responsibilities of computer users.
<p>E. Identify basic computer communications systems.</p> <ul style="list-style-type: none"> • Apply a web browser. • Apply basic electronic mail functions. • Use on-line searches to answer age appropriate questions. 	<p>E. Explain basic computer communications systems.</p> <ul style="list-style-type: none"> • Describe the organization and functions of the basic parts that make up the World Wide Web. • Apply advanced electronic mail functions. • Apply basic on-line research techniques to solve a specific problem. 	<p>E. Apply basic computer communications systems.</p> <ul style="list-style-type: none"> • Identify and explain various types of on-line services. • Identify and explain the function of the parts of a basic network. • Describe and apply the components of a web page and their function. • Explain and demonstrate file transfer within and out side of a computer network. • Identify, describe and complete advanced on-line research. 	<p>E. Assess the effectiveness of computer communications systems.</p> <ul style="list-style-type: none"> • Assess the effectiveness of a computer based communications system. • Transfer files among different computer platforms. • Analyze the effectiveness of on-line information resources to meet the needs for collaboration, research, publications, communications and productivity. • Apply knowledge of protocol standards to solve connectivity problems.

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3.8. Science, Technology and Human Endeavors			
3.8.4. GRADE 4	3.8.7. GRADE 7	3.8.10. GRADE 10	3.8.12. GRADE 12
<p><i>Pennsylvania’s public schools shall teach, challenge and support every student to realize his or her maximum potential and to acquire the knowledge and skills needed to . . .</i></p>			
<p>A. Know that people select, create and use science and technology and that they are limited by social and physical restraints.</p> <ul style="list-style-type: none"> • Identify and describe positive and negative impacts that influence or result from new tools and techniques. • Identify how physical technology (e.g., construction, manufacturing, transportation), informational technology and biotechnology are used to meet human needs. • Describe how scientific discoveries and technological advancements are related. • Identify interrelationships among technology, people and their world. • Apply the technological design process to solve a simple problem. 	<p>A. Explain how sciences and technologies are limited in their effects and influences on society.</p> <ul style="list-style-type: none"> • Identify and describe the unavoidable constraints of technological design. • Identify changes in society as a result of a technological development. • Identify and explain improvements in transportation, health, sanitation and communications as a result of advancements in science and technology and how they effect our lives. 	<p>A. Analyze the relationship between societal demands and scientific and technological enterprises.</p> <ul style="list-style-type: none"> • Identify past and current tradeoffs between increased production, environmental harm and social values (e.g., increased energy needs, power plants, automobiles). • Compare technologies that are applied and accepted differently in various cultures (e.g., factory farming, nuclear power). • Describe and evaluate social change as a result of technological developments. • Assess the social impacts of a specific international environmental problem by designing a solution that applies the appropriate technologies and resources. <p>Siting Wind Power (e21) Air Bags (GREATT) Combustion and Emissions (GREATT)</p>	<p>A. Synthesize and evaluate the interactions and constraints of science and technology on society.</p> <ul style="list-style-type: none"> • Compare and contrast how scientific and technological knowledge is both shared and protected. • Evaluate technological developments that have changed the way humans do work and discuss their impacts (e.g., genetically engineered crops). • Evaluate socially proposed limitations of scientific research and technological application. <p>Food or Fuel (e21) Photovoltaics & Fuel Cells (e21) Combustion and Emissions (GREATT) Fuel Cells (GREATT) Hybrid Electric Vehicles (GREATT)</p>

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<p>B. Know how human ingenuity and technological resources satisfy specific human needs and improve the quality of life.</p> <ul style="list-style-type: none">• Identify and distinguish between human needs and improving the quality of life.• Identify and distinguish between natural and human-made resources.• Describe a technological invention and the resources that were used to develop it.	<p>B. Explain how human ingenuity and technological resources satisfy specific human needs and improve the quality of life.</p> <ul style="list-style-type: none">• Identify interrelationships between systems and resources.• Identify and describe the resources necessary to solve a selected problem in a community and improve the quality of life.• Identify and explain specific examples of how agricultural science has met human needs and has improved the quality of life.	<p>B. Analyze how human ingenuity and technological resources satisfy specific human needs and improve the quality of life.</p> <ul style="list-style-type: none">• Identify several problems and opportunities that exist in your community, apply various problem-solving methods to design and evaluate possible solutions.• Analyze a recently invented item, describing the human need that prompted its invention and the current and potential social impacts of the specific invention.• Apply knowledge of oceanography, meteorology, geology and human anatomy to explain important considerations that need to be made for construction of homes, buildings and businesses in the United States.• Assess the impacts that agricultural science has had on meeting human needs and improving the quality of life. <p>Siting Wind Power (e21) Memory Metals (GREATT)</p>	<p>B. Apply the use of ingenuity and technological resources to solve specific societal needs and improve the quality of life.</p> <ul style="list-style-type: none">• Apply appropriate tools, materials and processes to solve complex problems.• Use knowledge of human abilities to design or modify technologies that extend and enhance human abilities.• Apply appropriate tools, materials and processes to physical, informational or biotechnological systems to identify and recommend solutions to international problems.• apply knowledge of agricultural science to develop a solution that will improve on a human need or want.
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<p>C. Know the pros and cons of possible solutions to scientific and technological problems in society.</p> <ul style="list-style-type: none"> • Compare the positive and negative expected and unexpected impacts of technological change. • Identify and discuss examples of technological change in the community that have both positive and negative impacts. 	<p>C. Identify the pros and cons of applying technological and scientific solutions to address problems and the effect upon society.</p> <ul style="list-style-type: none"> • Describe the positive and negative expected and unexpected effects of specific technological developments. • Describe ways technology extends and enhances human abilities. <p>As the Rotor Turns: Wind Power (e21) Solar Racing (e21) Solar Cooking (e21) Flywheels (GREATT)</p>	<p>C. Evaluate possibilities consequences and impacts of scientific and technological solutions.</p> <ul style="list-style-type: none"> • Relate scientific and technological advancements in terms of cause and effect. • Describe and evaluate the impacts that financial considerations have had on specific scientific and technological applications. • Compare and contrast potential solutions to technological, social, economic and environmental problems. • Analyze the impacts on society of accepting or rejecting scientific and technological advances. <p>Maximum Power Point (e21) Photovoltaics & Fuel Cells (e21) Combustion and Emissions (GREATT) Solar Power (GREATT) Fuel Cells (GREATT) Hybrid Electric Vehicles (GREATT)</p>	<p>C. Evaluate the consequences and impacts of scientific and technological solutions.</p> <ul style="list-style-type: none"> • Propose solutions to specific scientific and technological applications, identifying possible financial considerations. • Analyze scientific and technological solutions through the use of risk/benefit analysis. • Analyze and communicate the positive or negative impacts that a recent technological invention had on society. • Evaluate and describe potential impacts from emerging technologies and the consequences of not keeping abreast of technological advancements (e.g., assessment alternatives, risks, benefits, costs, economic impacts, constraints). <p>Combustion and Emissions (GREATT)</p>
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