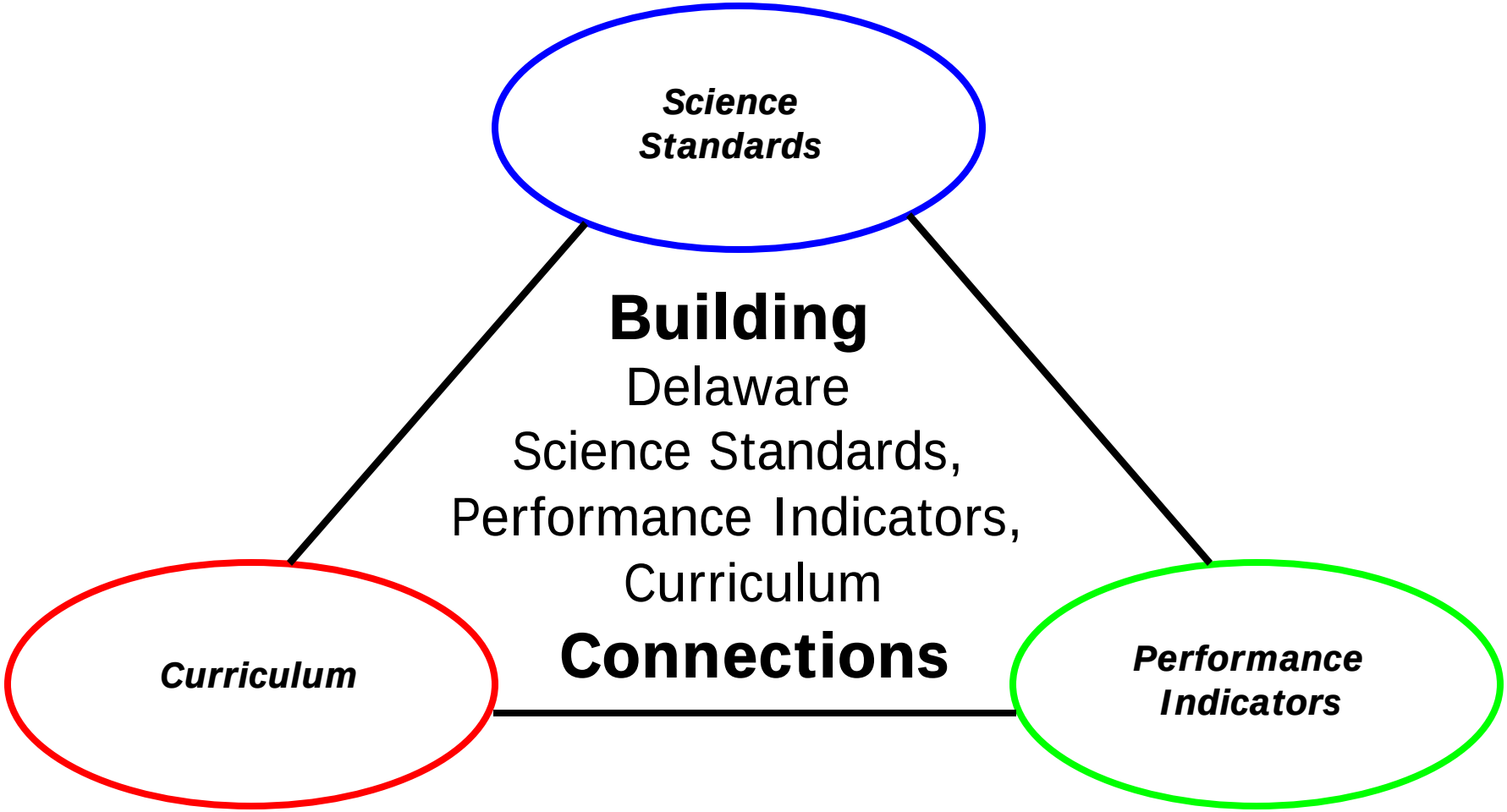

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9th Grade Science Standards and Performance Indicator Matrix

12/14/00

Standard #1 - Nature and Application of Science and Technology

Science Standard	Performance Indicator	Concept	Unit
Science as Inquiry 1.11 The identification and formulation of appropriate questions guide the design and breadth of a scientific investigation. Based on the type of question(s) proposed, investigations explore new phenomena, solve science and technology related problems, compare different theories, resolve conflicts concerning societal issues, determine reasons for discrepancies in previous experimental results, or test the practicality of a consumer product.	All	Nature of Science	Student Independent Investigation of Consumer Product Each Unit
1.12 Scientific investigations in many cases follow no fixed set of steps. However, there are certain features of a valid scientific investigation that are essential and result in evidence that can be used to construct explanations.	All	Scientific Investigation	Student Independent Investigation of Consumer Product Each Unit
1.13 Tools and technologies extend human capabilities to perform investigations in more detail and with greater accuracy and improved precision.	All	Technology	Computer Probe Technology Each Unit
1.14 The close examination of evidence is necessary to construct logical scientific explanations and present arguments which defend proposed explanations. Such critical analyses of supporting evidence are not only important to scientific investigations but help in judging the validity of claims made in advertisements or concluded from investigative reports.	All	Evidence	Student Independent Investigation of Consumer Product Each unit
1.15 Publication and presentation of scientific work with supporting evidence is part of the critique, review, and validation process conducted by the scientific community. The presentation of such work in accessible journals and reviews adds to the body of scientific knowledge and serves as background for subsequent	All	Communication	Student Independent Investigation of Consumer Product

investigations in similar areas.			Each Unit
Science, Technology, and Society 1.21 The practice of science and technology is not a linear process. In many cases, the desire of scientists to find what is real in nature creates opportunities for technology development. At the same time, technology provides scientists with tools and techniques that allow expansion of their capabilities and effectiveness.	All	Nature of Science Technology	Computer Probe Technology Each Unit
1.22 The social, economic, and political forces of a society have a significant influence on what science and technology programs are pursued, invested in, and used.	All	Science and Society	Periodic Table Atomic Theory Each Unit
History and Context of Science 1.31 Science is an international activity in which significant inventions and innovations have come from around the world. Even though scientists live and work in different cultures and come from different backgrounds, many of their activities are part of international collaborative efforts, and the knowledge created is shared in order to maximize the benefits to society.	All	Collaboration Contemporary and Historical Context of Science	Periodic Table Atomic Theory Each unit
1.32. Science is divided into many disciplines such as astrophysics, biochemistry, and geophysics. Each discipline is a field of endeavor in itself and requires specialized training. Many of the tools, techniques, methods, and much of the knowledge created in one discipline are shared across disciplines in order maximize the impact of the work.	All	Integration	Each Unit

Standard #2 - Materials and Their Properties

Science Standard	Performance Indicators	Concept	Unit
Properties and Structure of Matter 2.11 (3) All matter is composed of minute particles called atoms. Atoms are electrically neutral and consist of a nucleus of neutrons and positively charged protons surrounded by negatively charged electrons. Most of the mass of an atom is concentrated in the nucleus, whereas, most of the space is occupied by the electron cloud. The electron structure of the atom strongly influences its chemical behavior.	9.25 Use atomic models to explain that matter is composed of tiny particles called atoms that are unique to each element, and that atoms are composed of subatomic particles called protons, neutrons, and electrons. 9.26 Describe the relative charge, approximate mass, and location of protons, neutrons and electrons in an atom. 9.27 Construct or diagram simple atomic models of common elements from Groups I and II, Groups VI and VII, and the noble gases on the periodic table to identify patterns of electron configuration.	Atomic Theory	
2.12 (9) Elements are pure substances that are composed of identical atoms. Chemists and physicists have identified the elements, isolated them from their natural sources, synthesized them from other elements, and determined their properties. The periodic table arranges the elements in order of their atomic numbers (the numbers of proton in the nucleus). The elements are grouped according to similar chemical and physical properties (metals, non-metals, noble gases). The periodic table is used to predict the behavior of the elements and relates variations in their properties to the electron configuration of their atoms.	9.20 Explore the extent to which a variety of solid materials conduct electricity in order to rank the materials from good conductors to poor conductors. Based on the conductivity data, determine patterns of location on the periodic table for good conductors versus the poor conductors. 9.21 Explore the extent to which a variety of liquids (solutions) conduct electricity in order to rank the liquids from good conductors to poor conductors. Based on the conductivity data, determine patterns of location on the periodic table for the elements in the good conducting solutions versus the poor conducting solutions. 9.22 Investigate differences between the properties of metallic and nonmetallic elements and predict whether an element is a metal, a nonmetal or a semi-metal (metalloid or semi-conductor) due to its position on the periodic table. 9.23 Use the periodic table to indicate the physical state of an element under normal conditions of temperature and atmospheric pressure. 9.24 Identify a few of the most common elements in the earth's crust, oceans, and atmosphere and confirm their location on the periodic table (Example: Si, O, C, N, H, Al). 9.27 Construct or diagram simple atomic models of common elements from Groups I and II, Groups VI and VII, and the noble gases on the periodic table to identify patterns of electron configurations. 9.28 Explain how an atom's electron arrangement influences its ability to transfer or share electrons and determines its	Elements Periodic Table Properties	

	position on the periodic table. Recognize that an atom in which the positive and negative charges do not balance is an ion. 9.36 Classify a variety of common materials as an element, compound or mixture. 9.51 Identify some common rock forming minerals and the elements from which they are comprised. Examine the physical properties of the identified minerals to determine their rate of weathering and to match the properties with the appropriate mineral.		
2.13 (4) Substances are formed by atoms interacting with one another and transferring or sharing electrons. These interactions generally involve the electrons farthest from the nucleus, and result in the formation of chemical bonds and molecules, the building blocks of compounds.	9.28 Explain how an atom's electron arrangement influences its ability to transfer or share electrons and determines its position on the periodic table. Recognize that an atom in which the positive and negative charges do not balance is an ion. 9.29 Construct models or diagrams of common compounds and molecules (i.e. NaCl, SiO_2, O_2, H_2, CO_2) and distinguish between ionically and covalently bonded compounds. Based on the location of their component elements on the periodic table, explain the elements tendency to transfer or share electrons. 9.36 Classify a variety of common materials as an element, compound or mixture. 9.67 Observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Identify elements that comprise these compounds.	Bonding	
2.14 (11) The properties of compounds depend on the properties and interactions of their molecules. These molecular properties and interactions depend on the kinds of atoms in the molecule, molecular shape and motion, and the electrical forces that exist between molecules. An enormous variety of biological, chemical, and physical phenomena can be explained by these properties and interactions. Bonding diagrams and three-dimensional models can be used to represent and visualize atoms, molecules, and their interactions.	9.27 Construct or diagram simple atomic models of common elements from Groups I and II, Groups VI and VII, and the noble gases on the periodic table to identify patterns of electron configurations. 9.28 Explain how an atom's electron arrangement influences its ability to transfer or share electrons and determines its position on the periodic table. Recognize that an atom in which the positive and negative charges do not balance is an ion. 9.29 Construct models or diagrams of common compounds and molecules (i.e. NaCl, SiO_2, O_2, H_2, CO_2) and distinguish between ionically and covalently bonded compounds. Based on the location of their component elements on the periodic table, explain the elements tendency to transfer or share electrons	Atomic Models Molecular Models Water Properties Relation to Daily Life	

	9.30 Describe the physical state of a variety of materials and the relationship between the physical state and the amount of attraction between the particles (molecules) of the specific material. 9.34 Recognize that elements and compounds are homogeneous substances that have relatively constant properties. Mixtures are heterogeneous substances that are combined from two or more substances. 9.38 Construct a model or a diagram of the water molecule and use the model or diagram to explain waters' unique properties (e.g., polarity, hydrogen bonding, density, high boiling point, ionization, cohesion, and adhesion). Cite specific examples of how these properties are important in sustaining life on Earth. 9.39 Construct visual representations (or use computer simulations) to describe the spatial arrangement of water molecules in the three states of matter. 9.43 Design and conduct an investigation to verify that substances react more readily in solution than in solid form and relate this phenomena to living organisms requirement of water. 9.51 Identify some common rock forming minerals and the elements from which they are comprised. Examine the physical properties of the identified minerals to determine their rate of weathering and to match the properties with the appropriate mineral. 9.57 Use molecular models to explain why substances (such as nitrates) permeate and diffuse through soil so quickly and present serious problems for many Delaware watersheds. 9.67 Observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Identify elements that comprise these compounds.		
2.15 (4) Elements and compounds exist as solids, liquids, and gases. In solids, the atomic and molecular structure are orderly and nearly rigid and the vibration of atoms and molecules is constrained to a fixed site. In liquids, atoms and molecules move more freely and randomly, and this movement is insufficient to overcome the attractive forces that exist between the atoms and molecules. In gases, molecular motion is rapid and random and overcomes the attractive forces	9.31 Apply the kinetic molecular theory to explain that the energy associated with the motion of the particles is kinetic energy and that as the particles gain more kinetic energy, a change of state may occur. 9.39 Construct visual representations (or use computer simulations) to describe the spatial arrangement of water molecules in the three states of matter. 9.40 Conduct investigations to determine the effect of heat energy on the change of state of water molecules. Sketch	States of Matter	

that exist between molecules.	and interpret graphs representing the melting, freezing, evaporation and condensation of water. 9.57 Use molecular models to explain why substances (such as nitrates) permeate and diffuse through soil so quickly and present serious problems for many Delaware watersheds.		
Transformation and Conservation of Matter 2.21 (2) Chemical reactions which take places between the atoms and molecules of elements and compounds occur all around us, for example, combustion, rusting of iron, growing of plants, and cooking of foods. Complex chemical reactions take place constantly in every cell of the human body. A chemical equation represents, with symbols and formulas, the reactants and products in a chemical reaction.	9.32 Conduct and explain investigations to determine the difference between physical and chemical changes of a substance. Recognize that chemical changes involve a chemical reaction in which a new substance is produced. The new substance may be a solid, liquid, or gas. 9.69 Investigate the role digestion plays in breaking down food into compounds and molecules. Conduct tests to study the importance of mechanically breaking down food (chewing) and the effects of salivary amalase on starch. Explain the difference between the mechanical breakdown of food which involves a physical change, and the breakdown of large food molecules to small molecules (e.g. starch to glucose, lipids and glycerol to fatty acids, proteins to amino acids) which involves a chemical change.	Applications of Chemical Reactions in Daily Life	
2.22 Virtually all chemical reactions release or absorb energy. During chemical reaction, energy in the form of heat, light, or electricity is absorbed in the breaking of bonds or released when new bonds are formed. The rate of a chemical reaction depends on the properties and concentration of the reactants, temperature, and the presence or absence of a catalyst. A catalyst changes the rate of a chemical reaction by interacting with the reacting species but is not consumed in the overall reaction.		Exothermic and Endothermic Reactions Catalyst	Computer Probe Technology
2.23 (1) A large number of reactions, usually in solution, that are important in non-living systems, involve the transfer of either electrons (oxidation/reduction) or hydrogen ions (acid/base reactions).	9.43 Design and conduct an investigation to verify that substances react more readily in solution than in solid form and relate this phenomena to living organisms requirement of water.	Transfer of Electrons	
2.24 (4) Regardless of how atoms and molecules in a closed system interact with one another, or how they combine or break apart, the total weight of the system remains the same. (Benchmark for Scientific Literacy, 1993).	9.33 Conduct and explain the results of simple investigations to demonstrate that the total mass of substance is conserved during both physical and chemical changes. 9.58 Relate the Law of Conservation of Matter to physical and chemical weathering. Recognize that all of the atoms and ions that are products of weathering are equal to all the	Law of Conservation of Mass	

	atoms and ions of the original rock that weathered. 9.64 Recognize that once sediment is buried, additional deposits can accumulate turning the sediments into sedimentary rock. Relate the Law of Conservation of Matter to this phenomenon. 9.73 Analyze geochemical cycle diagrams and explain how matter is continually cycled between the living and nonliving environment. (Conservation of Matter).		
Mixtures and Solutions 2.31 (4) Mixtures have variable compositions and are either homogeneous or heterogeneous. A homogeneous mixture (solution) has the same properties throughout whereas a heterogeneous mixture consists of two or more phases that differ in properties. The formation of a mixture is a physical change; therefore, mixtures can be separated into their component parts without conducting a chemical reaction.	9.32 Conduct and explain investigations to determine the difference between physical and chemical changes of a substance. Recognize that chemical changes involve a chemical reaction in which a new substance is produced. The new substance may be a solid, liquid, or gas. 9.34 Recognize that elements and compounds are homogeneous substances that have relatively constant properties. Mixtures are heterogeneous substances that are combined from two or more substances. 9.35 Conduct experiments to separate mixtures into their component parts (distillation filtration). Explain how the properties of the component parts determine the physical separation techniques used. 9.36 Classify a variety of common materials as an element, compound or mixture.	Mixtures Physical Change Properties Separation	
2.32 (1) A variety of methods are used to prepare mixtures and to separate mixtures into their component parts. These methods such as blending, grinding, use of surfactants, distillation, floatation, and filtration are used throughout the scientific and industrial world.	9.35 Conduct experiments to separate mixtures into their component parts (distillation filtration). Explain how the properties of the component parts determine the physical separation techniques used.	Fractional Distillation Filtration Physical Separation Techniques	
2.33 (8) The properties of solutions depend upon the concentration, properties, and interactions of the solute and solvents.	9.21 Explore the extent to which a variety of liquids (solutions) conduct electricity in order to rank the liquids from good conductors to poor conductors. Based on the conductivity data, determine patterns of location on the periodic table for the elements in the good conducting solutions versus the poor conducting solutions. 9.41 Test water's ability to dissolve a large number of different substances. Use models of water molecules to explain what happens when a substance such as salt dissolves in water, and when a substance such as oil does not.	Properties of Solutions Interactions of Solutes and Solvents Concentration Application to Daily Life	

	9.42 Investigate factors that effect the solubility of common materials in water and construct solubility curves to compare the extent to which the materials dissolve. 9.43 Design and conduct an investigation to verify that substances react more readily in solution than in solid form and relate this phenomena to living organisms requirement for water. 9.44 Measure the hydrogen ion level of solution using pH paper or probe technology and describe how the pH scale indicates the degree of acidity of a solution. 9.47 Investigate the relative rate at which acidic solutions (most effective agents of chemical weathering) dissolve a variety of common rock material (e.g., limestone, marble). 9.49 Identify possible factors that could account for differences in the acidity levels of precipitation samples by testing the pH of local precipitation over time. 9.50 Differentiate between normal precipitation with a pH approximately 5.6 and precipitation that has become more acidic due to human influence. Explain why precipitation could accelerate the weathering processes on a variety of structures.		
Material Technology 2.41 (1) The properties of materials determine how they are used by society. New material discoveries are being used to improve the quality of life; however, their development often raises social, economic, and environmental issues.	9.37 Differentiate between physical and chemical properties of a variety of materials and explain how the properties determine the character and use of the materials.	Use of Materials Physical and Chemical Properties	
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Standard #3 - Energy and Its Effects

Forms/Sources of Energy 3.15 Chemical energy is derived from the gain or loss of electrons between atoms during the making and breaking of chemical bonds. The energy released or absorbed in a chemical reaction can be predicted and measured. The rate of many chemical reactions can be increased by raising the temperature or by adding catalysts in order to reduce the activation energy.		Energy Rate of Reaction Catalysts Activation Energy	
Force and Motion 3.21 (7) A force acting on an object and moving it through a distance does work on that object and changes it's kinetic energy (energy of motion), potential energy (energy of position), or both. The ratio of output work to input energy is the efficiency of the machine or process and is always less than 100%. Power is the rate at which the work is done.	9.09 Use data obtained from force and motion investigations to calculate the work done (W=Fd) to move an object horizontally. Recognize that when work is done on an object (in a frictionless environment) it gains mechanical energy and that the mechanical energy of moving objects is defined as kinetic energy. 9.10 Us appropriate instrumentation to collect data in order to calculate the work done to lift an object to the top of an inclined plane. Recognized that when work is done on an object, it gains mechanical energy and that the mechanical energy stored by an elevated object is defined as potential energy. 9.11 Determine how changing the angle of inclination of an inclined plane effects the final speed of a moving object. 9.12 Use data obtained from inclined plane investigations to calculate potential energy (PE=mgh) and kinetic energy ($KE=1/2mv^2$) at various positions on the plane. 9.13 Recognize that an object's potential energy at the top of an inclined plane is transformed into kinetic energy as the object moves down the incline plane. 9.14 Recognize that the potential energy at the top of the inclined lane is equal to the object's kinetic energy at the bottom of the inclined plane plus energy transformed into heat energy by frictional forces. 9.16 Use data from frictional force investigations to calculate the amount of mechanical energy transformed into heat energy by frictional forces (e.g., KE_{smooth}-$KE_{rough\ surface}$ = Energy transformed into heat energy by frictional forces).	Potential Energy Kinetic Energy Efficiency Power Work	Force, Motion, and Mechanical Energy

3.22 (6) Displacement, velocity, acceleration, and time are used to describe the motion or changes in motion of an object.	9.01 Sketch graphs (distance vs. time) to represent the motion of an object at constant speed and then at constantly changing speeds as displayed by motion detectors, strobe photography, ticker tape timing, stopwatches, etc. 9.02 Calculate the average speed (v=d/t) for an object in motion using data acquired by probe technology or other means (stopwatches, strobe photography, etc.). 9.03 Interpret a distance vs. time graph of an object moving at a constant speed and calculate its average speed (i.e. finding the slope of the line). 9.04 Analyze a series of graphs to identify those graphs that represent objects moving at constant speed versus those moving at constantly changing speeds, as detected by motion detectors, strobe photography, ticker tape timing, stopwatches, etc. 9.11 Determine how changing the angle of inclination of an inclined plane effects the final speed of a moving object. 9.62 Design and conduct investigations (e.g., changing the slope of a stream table or increasing the volume of water) to determine the relationship between erosion and the speed of moving water. Relate the results of the investigation to results obtained from previous force and motion investigations.	Speed Accerleration	Force, Motion, and Mechanical Energy
3.23 (6) Objects can have linear motion, rotational motion, or both. Newton's Laws can be used to predict changes in linear motion and/or rotational motion. Momentum allows objects to remain in motion after the applied force is removed. The Law of Conservation of Momentum can be used to predict the outcomes of a collision between moving objects.	9.05 Conduct investigations to identify forces (e.g., friction, tension, gravity, etc.) acting on the object of investigation when forces are either balanced or unbalanced. 9.06 Observe and describe (in qualitative terms) the motion of an object when forces acting upon that object are balanced or unbalanced. 9.07 Calculate the net force on an object in motion by measuring the object's mass and its acceleration using F-ma. 9.08 Design and conduct a series of investigations to determine how changing an object's mass and forces acting on that object (tension, friction, etc.) affect its motion. 9.15 Design and conduct investigations to determine how frictional forces related to varying surface conditions affect the motion of an object. 9.62 Design and conduct investigations (e.g., changing the slope of a stream table or increasing the volume of water) to determine the relationship between erosion and the speed of moving water. Relate the results of the investigation to results obtained from previous force and motion	Newton's Laws Momentum	Force, Motion, and Mechanical Energy

	investigations.		
Transformation and Conservation of Energy 3.31 (6) Energy can be transformed from one form into another, but the total energy is constant in a closed system. The amount of energy involved in any process, and the rate at which it is generated or consumed can be discussed qualitatively and measured. Some heat is released or absorbed in most energy transformations.	9.14 Recognize that the potential energy at the top of the inclined plane is equal to the object's kiinetic energy at the bottom of the inclined plane plus energy transformed into heat energy by frictional forces. 9.16 Use data from frictional force investigations to calculate the amount of mechanical energy transformed into heat energy by frictional forces (e.g., KE_{smooth}-$KE_{rough\ surface}$ = Energy transformed into heat energy by frictional forces). 9.17 Construct a transfer of energy diagram to illustrate that the total energy remains constant in motion, force, and energy investigations. 9.18 Explore other forms of energy that can be transformed from mechanical energy, such as the mechanical energy in a hand-cranked generator→electrical energy→heat and light energy. 9.19 Explain using multiple examples, that any energy transfer or transformation results in some loss of energy in the form of heat which may spread by radiation, conduction or convection. 9.40 Conduct investigations to determine the effect of heat energy on the change of state of water molecules. Sketch and interpret graphs representing the melting, freezing, evaporation and condensation of water.	Law of Conservation of Energy Heat Energy Friction Energy Transfer	Force, Motion, and Mechanical Energy

Standard #5 - Earth's Dynamic Systems			
Components of Earth 5.11 (14) Long term exposure of rocks to different environments results in weathering and decomposition and the production of soils and sediments. Differences in the geographical origin of rock materials lead to variations in the physical properties and chemical composition of soil.	9.24 Identify a few of the most common elements in the earth's crust, oceans, and atmosphere and confirm their location on the periodic table. (Example: Si, O, C, N, Al). 9.45 Differentiate between mechanical and chemical weathering and identify several examples of each. Recognize that mechanical weathering results in physical change that does not alter the chemical composition of rock, and that chemical weathering results in chemical change where rocks decompose and new chemical substances or compounds are formed. 9.46 Identify climatic variables (e.g. precipitation and temperature), and explain how these variables affect the rate of mechanical and chemical weathering and influence the formation of geologic land features. 9.47 Investigate the relative rate at which acidic solutions (most effective agents of chemical weathering) dissolve a variety of common rock material (e.g., limestone, marble). 9.48 Determine the effects and relative rate of physical and chemical weathering on local area structures composed of earth (e.g., buildings, sidewalks, and tombstones) and relate the results to previous weathering investigations. Explain how the properties and composition of earth materials affect the degree of weathering observed. 9.52 Examine a variety of rocks to determine the major rock type (igneous, metamorphic, sedimentary) and to explain how the processes by which the rocks form influence their rate of weathering. 9.53 Examine local soil samples to identify their living and nonliving components and the type of parent materials from which the samples could come. 9.54 Determine properties of local soil samples, such	Physical and Chemical Changes Application to Daily Life Rate of Change	

	as pH and permeability. Investigate how these properties affect local vegetation, crops, and land use decisions. 9.55 Examine Delaware soil profiles to identify distinct layers and to compare and contrast composition and properties of different soil horizons. 9.58 Relate the Law of Conservation of Matter to physical and chemical weathering. Recognize that all of the atoms and ions that are products of weathering are equal to all the atoms and ions of the original rock that weathered. 9.61 Use stream tables to study the effects of water as an agent of erosion that is driven by gravity and that produces distinctive land forms. 9.63 Determine using stream tables how streams and rivers transport sediments (products of weathering such as sand, silt, and mud) and where the sediments are usually deposited. 9.64 Recognize that once sediment is buried, additional deposits can accumulate turning the sediments into sedimentary rock. Relate the Law of Conservation of Matter to this phenomenon. 9.65 Investigate the rate at which soils are eroding in Delaware. Explain why soils take such a long time to form and identify practices that can minimize the consequences of erosion.		
5.12 (5) A mixture of gases, water vapor, and solid particles comprise the Earth's atmosphere. Variations in atmospheric composition caused by either natural or human activities influence life on Earth.	9.24 Identify a few of the most common elements in the earth's crust, oceans, and atmosphere and confirm their location on the periodic table. Example: Si, O, C, N, H, Al). 9.47 Investigate the relative rate at which acidic solutions (most effective agents of chemical weathering) dissolve a variety of common rock material (e.g., limestone, marble). 9.48 Determine the effects and relative rate of physical	Variations in Earth's Atmosphere Elements Physical Properties	

	and chemical weathering on local area structures composed of earth materials (e.g., buildings, sidewalks, and tombstones) and relate the results to previous weathering investigations. Explain how the properties and composition of earth materials affect the degree of weathering observed. 9.49 Identify possible factors that could account for differences in the acidity levels of precipitation samples by testing the pH of local precipitation over time. 9.50 Differentiate between normal precipitation with a pH approximately 5.6 and precipitation that has become more acidic due to human influence. Explain why precipitation could accelerate the weathering processes on a variety of structures.	Chemical Properties Precipitation	
5.13 (4) Sub-surface water is a limited resource and must be judiciously managed. The rate of movement of sub-surface water is controlled by differences in elevation and the porosity and permeability of the rock and soil through which it moves.	9.54 Determine properties of local soil samples, such as pH and permeability. Investigate how these properties affect local vegetation, crops, and land use decisions. 9.56 Explore the rate at which water permeates through local soil samples. Use simple molecular models to explain why certain soil samples (clay) retain water longer than other soil samples. 9.60 Identify environments (reservoirs) in which water is stored and recognize that even though water flows from one reservoir to another, there is not a net gain or loss of water on Earth. 9.62 Design and conduct investigations (e.g., changing the slope of a stream table or increasing the volume of water) to determine the relationship between erosion and the speed of moving water. Relate the results of the investigation to results obtained from previous force and motion investigations.	Water as a Limited Resource	

Interactions Among Earth's Systems 5.23 (3) Physical features of Earth result from a balance of processes that elevate and wear down land surfaces and move materials from higher to lower elevations.	9.61 Use stream tables to study the effects of water as an agent of erosion that is driven by gravity and that produces distinctive land forms. 9.62 Design and conduct investigations (e.g., changing the slope of a stream table or increasing the volume of water) to determine the relationship between erosion and the speed of moving water. Relate the results of the investigation to results obtained from previous force and motion investigations. 9.63 Determine using stream tables how streams and rivers transport sediments (products of weathering such as sand, silt, and mud) and where the sediments are usually deposited.	Erosion Force and Motion as Related to Water and Sediments	
5.24 (2) Radiation from the Sun drives the circulation of air and water around the Earth leading to a variety of weather phenomena and regional climates.	9.59 Explain the hydrologic cycle and recognize that the movement of water is driven in part by solar energy. 9.60 Identify environments (reservoirs) in which water is stored and recognize that even though water flows from one reservoir to another, there is not a net gain or loss of water on Earth.	Hydrologic Cycle Solar Radiation Water	
Technology and Applications 5.31 (2) The understanding of global and local changes that result from the interactions of ocean systems has increased substantially as a result of continuous advances in science and technology.	9.59 Explain the hydrologic cycle and recognize that the movement of water is driven in part by solar energy. 9.60 Identify environments (reservoirs) in which water is stored and recognize that even though water flows from one reservoir to another, there is not a net gain or loss of water on Earth.	Technology	

Standard #6 - Life Processes

Science Standard	Performance Indicator	Concept	Unit
Structure/Function Relationship 6.13 (2) The cell membrane defines the boundary of the cell and regulates the passage of materials into and out of the cell. Transport mechanisms across the membrane are dependent on membrane structure and concentration gradients.	9.70 Construct models (dialysis tubing) of the small intestine to identify which compounds or molecules are able to move through a semi-permeable membrane. Relate how the size of molecules determines their ability to be absorbed directly into the blood stream from the small intestine and broken down into simple sugars. 9.71 Speculate as to how molecules in the previous investigations move through a membrane. Describe the movement of molecules from an area of higher concentration to an area of lover concentration (diffusion).	Molecular Size Cell Membrane Diffusion	
Matter and Energy Transformation 6.21 (4) Cells carry out a variety of chemical transformations which allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones. Most of these transformations are made possible by protein catalysts called enzymes.	9.66 Conduct tests for specific compounds and use the tests to determine which compounds are found in ordinary foods. 9.67 Observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Identify elements that comprise these compounds. 9.69 Investigate the role digestion plays in breaking down food into compounds and molecules. Conduct tests to study the importance of mechanically breaking down food (chewing) and the effect of salivary amalase on starch. Explain the difference between the mechanical breakdown of food which involves a physical change, and the breakdown of large food molecules to small molecules (e.g., starch to glucose, lipids and glycerol to fatty acids, proteins to amino acids) which involves a chemical change. 9.72 Trace the pathway of food from the mouth through the digestive system. Recognize that once specific food molecules enter the bloodstream, they serve as building blocks for the synthesis of body structures (i.e., “you are what you eat”).	Digestion Conversion of Energy Breakdown of Molecules Building Larger Molecules Enzymes	
6.22 (2) Plant cells contain plastids which convert light energy into chemical energy through the process of photosynthesis. This chemical energy is used by the plants to convert carbon dioxide and water into high	9.67 Observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Identify elements that comprise these compounds. 9.68 Recognize that during photosynthesis, plants use solar energy and elements from the atmosphere and the soil to	Photosynthesis	

energy food molecules such as lipids and carbohydrates. Photosynthesis adds oxygen to the atmosphere and removes CO_2.	make specific compounds. Recognize that these compounds are used by living things as sources of matter and energy.		
6.23 (1) All organisms including plants, use the process of cellular respiration to transform high energy food molecules produces during photosynthesis into energy. The energy produces is stored in the phosphate linkages of ATP and is used by organisms to conduct their life processes. Cellular respiration may require oxygen and adds carbon dioxide to the atmosphere.	9.68 Recognize that during photosynthesis, plants use solar energy and elements from the atmosphere and the soil to make specific compounds. Recognize that these compounds are used by living things as sources of matter and energy.	Cellular Respiration	
6.24 (1) Photosynthesis and cellular respiration are complimentary processes to the flow of energy and the cycling of matter in ecosystems.	9.68 Recognize that during photosynthesis, plants use solar energy and elements from the atmosphere and the soil to make specific compounds. Recognize that these compounds are used by living things as sources of matter and energy.	Photosynthesis Cellular Respiration	

Standard #8 - Ecology

Science Standard	Performance Indicator	Concept	Unit
Flow of Matter and Energy in Ecosystems 8.12 (4) The law of conservation of matter applies to ecosystems. Matter needed to sustain life in ecosystems is continually recycled (e.g., carbon cycle, water cycle, nitrogen cycle, mineral cycles) among organisms and between organisms and the environment.	9.59 Explain the hydrologic cycle and recognize that the movement of water is driven in part by solar energy. 9.60 Identify environments (reservoirs) in which water is stored and recognize that even though water flows from one reservoir to another, there is not a net gain or loss of water on Earth. 9.73 Analyze geochemical cycle diagrams and explain how matter is continually cycled between the living and nonliving environment. (Conservation of Matter). 9.74 Construct a diagram or other visual aid to show a logical set of events that could explain how atoms such as carbon, hydrogen, oxygen, and nitrogen, which are basic components of human bodies, could have come from another organism or from a rock.	Conservation of Matter in Ecosystems Recycling of Matter	
8.13 (1) The law of conservation of energy applies to ecosystems. All energy is conserved as it passes from the Sun through an ecosystem. During energy transformations some energy is converted to biologically unusable waste heat which is eventually lost and replenished by a continual input of solar energy.	9.59 Explain the hydrologic cycle and recognize that the movement of water is driven in part by solar energy.		
Changes in Ecosystems 8.21 (1) Earth's ecosystems are interconnected by biological, chemical, and physical processes. Changes in one ecosystem may have local or global consequences.	9.75 Explain how human activities impact geochemical cycles (e.g., the carbon cycle affects global warming or the nitrogen cycle contaminates groundwater), and identify measures that are being taken to minimize adverse environmental consequences associated with such human activity.	Interconnected ecosystems	
8.22 (1) Ecosystems are reasonably stable over long periods of time and tend to have cyclic fluctuations around a point of equilibrium. An ecosystem can react to stabilize conditions (e.g., pH, nutrient reduction, temperature, disease) and	9.75 Explain how human activities impact geochemical cycles (e.g., the carbon cycle affects global warming or the nitrogen cycle contaminates groundwater), and identify measures that are being taken to minimize adverse environmental consequences associated with such human activity.	Stabilizing Ecosystems Causes of Changes in Ecosystems	

restore itself to its original state. Ecosystems undergo major changes as a result of such factors as climatic change, introduction of new species, and habitat destruction.			
8.23 (1) Ecosystems have a carrying capacity for each species. Overpopulation can lead to depletion of resources and elimination species.	9.75 Explain how human activities impact geochemical cycles (e.g., the carbon cycle affects global warming or the nitrogen cycle contaminates groundwater), and identify measures that are being taken to minimize adverse environmental consequences associated with such human activity.	Carrying Capacity Overpopulation	
Interaction of Humans Within Ecosystems 8.31 (2) All organisms are dependent upon the Earth's finite supply of material resources to sustain life. Human decision concerning the use of resources alters the stability and the biodiversity of ecosystems and adversely affect the natural recycling processes which maintain the quality of air, water, and land.	9.57 Use molecular models to explain why substances (such as nitrates) permeate and diffuse through soil so quickly and present serious problems for many Delaware watersheds. 9.75 Explain how human activities impact geochemical cycles (e.g., the carbon cycle affects global warming or the nitrogen cycle contaminates groundwater), and identify measures that are being taken to minimize adverse environmental consequences associated with such human activity.	Effect of Human Activities on Earth's Finite Resources	
8.32 (1) The availability of and access to natural resources shape the economic policies of society and form a basis for international trade agreements. Unequal distribution of resources and increased demand for natural resources require global cooperation and long-term planning to satisfy the resource needs of successive generations.	9.75 Explain how human activities impact geochemical cycles (e.g., the carbon cycle affects global warming or the nitrogen cycle contaminates groundwater), and identify measures that are being taken to minimize adverse environmental consequences associated with such human activity.	Economics and the Environment	
Technology and Its Influence on the Environment 8.41 (3) Continuous growth in human population and depletion of land suitable for farming require farmers to rely on modern agricultural technologies to meet demands for increased crop yields. The use of these technologies, however, involves economic	9.57 Use molecular models to explain why substances (such as nitrates) permeate and diffuse through soil so quickly and present serious problems for many Delaware watersheds. 9.65 Investigate the rate at which soils are eroding in Delaware. Explain why soils take such a long time to form and identify practices that can minimize the consequences of erosion. 9.75 Explain how human activities impact geochemical	Population and the Environment Consequences of Erosion Human Impact on the	

and environmental tradeoffs.	cycles (e.g., the carbon cycle affects global warming or the nitrogen cycle contaminates groundwater), and identify measures that are being taken to minimize adverse environmental consequences associated with such human activity.	Environment	