Curriculum Framework Science

School: The Delaware Met **Curricular Tool: DE Science Coalition** **Grade: 9** **Teacher: _____**

Standards Alignment	Unit Concept Big Ideas	Essential Questions Student Learning Targets	Assessments
Unit One: Energy **Timeline : 10 weeks**			
Standard One **The Nature and Application of Sciences and Technology** **Strand One** **Understandings and Abilities of Scientific Inquiry** **Substrand A**. Scientists conduct investigations for a variety of reasons including to explore new phenomena, to replicate other's results, to test how well a theory predicts, to develop new products, and to compare theories. **Substrand B**. : Science is distinguished from other ways of knowing by the use of empirical observations, experimental evidence, logical arguments and healthy skepticism. **Substrand C** Theories in science are well-established explanations of natural phenomena that are supported by many confirmed observations and verified hypotheses. The application of theories allows people to make reasonable predictions. Theories may be amended to become more complete with the introduction of new evidence. **Substrand D**. Investigating most real-world problems requires building upon previous scientific findings and cooperation among individuals with knowledge and expertise from a variety of scientific fields. The results of scientific studies are considered valid when subjected to critical review where contradictions are resolved and the explanation is confirmed. **Substrand E.** In communicating and defending the results of scientific inquiry, arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of	**Big Ideas** **Systems, Order, and Organization:** Energy takes many forms. These forms are grouped as kinetic energy and potential energy. **Evidence, Models, and Explanation:** Diagrams and equations are used to explain energy storage and transfer. Investigations supply evidence for explanations. **Constancy, Change, and Measurement:** Changes are caused by the transfer of energy. These transfers can be measured. Forces are responsible for these transfers. The total amount of energy cannot change. **Form and Function:** Energy stored in resources must be transferred into more useful forms before it	**Essential Questions:** What makes a question scientific? What constitutes evidence? When do you know you have enough evidence? Why is it necessary to justify and communicate an explanation? How do science and technology influence each other? How have past scientific contributions influenced current scientific understanding of the world? What do we mean in science when we hay that we stand on the shoulders of giants? Why do things have energy? How can energy be transferred from one material to another? What happens to a material	**Suggested Formative Assessments:** Students develop a crash barrier that will stop a car in the shortest distance without injuring a passenger. Students demonstrate their understanding of how wave energy can be used by designing inventions that transfer or transform energy to perform practical tasks. Students create a learning map that shows their understanding of the relationships among the forms of energy and the transfer and transformation of energy. Student journals Exit questions Lab reports Journals

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scientific knowledge. (American Association for the Advancement of Science, 2001) **Substrand F**. Knowledge and skill from sources other than science are essential to scientific inquiry. These include mathematics, reading, writing, and technology. **Strand Two** **Science, Technology and Society** **Substrand A**. The pursuit of science can generate the need for advanced technology. Advanced technology, in turn, can provide the opportunity to pursue new scientific knowledge. **Substrand B.** The social, economic, and political forces of a society have a significant influence on what science and technology programs are pursued, funded, and implemented. **Strand Three** **History and Context of Science** **Substrand A**. New disciplines of science emerge as older disciplines interface into an integrated study of the natural world. As the body of scientific knowledge grows, the boundaries between individual disciplines diminish. **Standard Three** **Energy and Its Effects** **Strand One** **Forms and Sources of Energy** **Substrand A**. Electromagnetic waves carry a single form of energy called electromagnetic (radiant) energy **Substrand B**. An object has kinetic energy because of its linear motion, rotational motion, or both. The kinetic energy of an object can be determined knowing its mass and speed. The object's geometry also needs to be known to determine its rotational kinetic energy. An object	can be helpful to us.	when energy is transferred to it? What happens to the energy in a system – where does this energy come from, how is it changed within the system, and where does it ultimately go? How does the flow of energy affect the materials in the system? What is a "responsible" use of energy? Are there alternative forms of energy that will serve our needs, or better ways of using traditional forms of energy?	Pre-learning concept checks **<u>Suggested Summative Assessments:</u>** Unit Summative Assessment is indicated to be in Pilot form. When the assessment is made available, it can be used for post summative assessment purposes.

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can have potential energy when under the influence of gravity, elastic forces or electric forces and its potential energy can be determined from its position **Substrand C.** Mechanical waves result from the organized vibrations of molecules in substances. Kinetic energy can be transferred very quickly over large distances by mechanical waves. **Substrand D**. Thermal (heat) energy is associated with the random kinetic energy of the molecules of a substance. **Substrand E**. Magnetic energy and electrical energy are different aspects of a single electromagnetic energy, which results from the motion of electrical charges. **Substrand F**. Chemical energy is derived from the making and breaking of chemical bonds. **Substrand G**. Nuclear energy is a form of potential energy that is released when a portion of the mass of the nucleus is converted to energy through nuclear fusion, nuclear fission, or radioactive decay. **Strand Two** **Forces and Transfer of Energy** **Substrand** B. Forces are mechanisms that can transfer energy from one object to another. A force acting on an object and moving it through a distance does work on that object and changes its kinetic energy, potential energy, or both. Power indicates the rate at which forces transfer energy to an object or away from it. **Substrand E**. Gravity is a universal force of attraction that each mass exerts on any other mass. The strength of the force depends on the masses of the objects and the distance between them. The force of gravity is generally not important unless at least one of the two masses involved is huge (a star, the Earth or another planet or a moon). **Substrand F** Electric forces between charged objects are attractive or repulsive. The electric forces between electrons and protons are			

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attractive, determine the structure of atoms, and are involved in all chemical reactions. The electromagnetic forces acting between atoms or molecules are much stronger than the gravitational forces between the same atoms or molecules and are responsible for many common forces such as friction, tensions and supporting forces **Substrand G.** Electromagnetic forces are responsible for the physical properties of materials (e.g., the boiling point of a liquid) and the mechanical properties of materials (e.g., surface tension). **Substrand I.** The nuclear forces that hold the nucleus of an atom together are much stronger than the repulsive electric forces acting between the protons that would make the nucleus fly apart, therefore, most atoms have stable nuclei. **Strand Three** **Energy Interacting with Materials; The Transformation and Conservation of Energy** **Substrand** A. Energy cannot be created nor destroyed. Energy can be transferred from one object to another and can be transformed from one form to another, but the total amount of energy never changes. Recognizing that energy is conserved, the processes of energy transformation and energy transfer can be used to understand the changes that take place in physical systems. **Substrand B**. Most of the changes that occur in the universe involve the transformation of energy from one form to another. Almost all of these energy transformations lead to the production of some heat energy, whether or not heat energy is the desired output of the transformation process. **Substrand C.** Waves (e.g., sound and seismic waves, waves in water, and electromagnetic waves) carry energy that can have important consequences when transferred to objects or substances. **Substrand D.** When waves interact with materials, the energy they transfer often leads to the formation of other forms of energy. These			

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interactions, which depend upon the nature of the material and the wavelength of the waves, can be used to create practical devices (e.g., sonar and ultra sound imaging, solar cells, remote control units, and communication devices). **Substrand E**. Through reflection and refraction, electromagnetic waves can be redirected to produce concentrated beams or images of their source. **Substrand F.** When radiant energy is absorbed or emitted by individual atoms or molecules, the changes in energy involve the jump of an electron from one distinct energy level to another.			
Unit Two: Living By Chemistry-Alchemy **Timeline: 10 weeks**			
Standard One **The Nature and Application of Sciences and Technology** **Strand One** **Understandings and Abilities of Scientific Inquiry** **Substrand A**. Understand that: Scientists conduct investigations for a variety of reasons including to explore new phenomena, to replicate other's results, to test how well a theory predicts, to develop new products, and to compare theories. Be able to: Identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation. **Substrand B.** Understand that: Science is distinguished from other ways of knowing by the use of empirical observations, experimental evidence, logical arguments and healthy skepticism. **Substrand C** Theories in science are well-established explanations of natural phenomena that are supported by many confirmed observations and verified hypotheses. The application of theories allows people to make reasonable predictions. Theories may be amended to become more complete with the introduction of new evidence.	**Big Ideas** Safety is paramount when dealing with chemicals in the laboratory. Matter can be characterized by its physical and chemical properties The language of chemistry is logical and necessary when sharing information relating to chemical activity or processes. The periodic table is a tool that is useful in understanding and/or predicting the behaviors and/or interactions of	**Essential Questions:** How does the structure of an atom determine its properties? How do multiple atoms combine to form larger compounds? How does the conservation of mass apply to the interaction of reactants and products in a chemical reaction? What is the common language used by chemists in communicating chemical information? **Learning Targets:**	**Suggested Formative Assessments:** Worksheets Student Journals Learning Logs Self Assessments Teacher made pre-unit assessment Vocabulary work Observation of student discussions Participation in oral discussions **Suggested Summative Assessments:**

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Substrand D. Understand that: Investigating most real-world problems requires building upon previous scientific findings and cooperation among individuals with knowledge and expertise from a variety of scientific fields. The results of scientific studies are considered valid when subjected to critical review where contradictions are resolved and the explanation is confirmed. **Substrand F.** Understand that: Knowledge and skill from sources other than science are essential to scientific inquiry. These include mathematics, reading, writing, and technology. **Strand Two** **Science, Technology and Society** **Substrand A**. The pursuit of science can generate the need for advanced technology. Advanced technology, in turn, can provide the opportunity to pursue new scientific knowledge. **Substrand B**. The social, economic, and political forces of a society have a significant influence on what science and technology programs are pursued, funded, and implemented. **Strand Three** **History and Context of Science** **Substrand A.** New disciplines of science emerge as older disciplines interface into an integrated study of the natural world. As the body of scientific knowledge grows, the boundaries between individual disciplines diminish. **Standard Two** **Materials and Their Properties** **Strand One** **Properties and Structures of Materials** **Substrand A**. All matter is composed of minute particles called atoms.	atoms and molecules. All atoms have a specific structure that is key to its interaction with other atoms. Some atoms contain more neutrons than others while maintaining a specific electron/proton balance. These atoms are called isotopes. Atoms have valence electrons that determine the types of bonds an atom can make with other atoms.	Demonstrate safe lab practice for all activities. Test solutions for electrical conductivity. Demonstrate the relationship between an atom's structure, chemical behavior, and its position in periodic table. Use models or drawings to illustrate how compounds are formed. Recognize that an atom with unequal numbers of positive and negative charges is an ion. Test various solids to determine which are good or poor conductors of electricity and relate this to the position of its constituent atoms on the periodic table. Demonstrate that ionic and molecular compounds are electrically neutral. Sketch and interpret graphs representing the melting, freezing, evaporation, and condensation of water.	Transfer tasks Performance Tasks Rubrics Teacher made post unit assessment Note: The assessment piece for this unit is not fully built out. When it is published, the assessment pieces as outlined by the coalition will be implemented for summative assessment purposes.

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Most of the mass of an atom is concentrated in the nucleus. In the nucleus, there are neutrons with no electrical charge and positively charged protons. Negatively charged electrons surround the nucleus and overall, the atom is electrically neutral. **Substrand C**. Isotopes of a given element differ in the number of neutrons in the nucleus. Their chemical properties remain essentially the same. **Substrand D**. The periodic table arranges the elements in order of atomic number (the number of protons). The elements are grouped according to similar chemical and physical properties. Properties vary in a regular pattern across the rows (periods) and down the columns (families or groups). As a result, an element's chemical and physical properties can be predicted knowing only its position on the periodic table. **Substrand E.** An atom's electron structure determines its physical and chemical properties. Metals have valence electrons that can be modeled as a sea of electrons where the valence electrons move freely and are not associated with individual atoms. These freely moving electrons explain the metallic properties such as conductivity, malleability, and ductility. **Substrand F**. Ionic compounds form when atoms transfer electrons. Covalent compounds form when atoms share electrons. Both types of interactions generally involve valence electrons and produce chemical bonds that determine the chemical property of the compound. **Substrand H**. A change of phase may occur when there is a change in the potential energy of the atoms or molecules of a substance. **Strand Three** **Conservation of Matter** **Substrand A**. The total mass of the system remains the same regardless of how atoms and molecules in a closed system interact with one another, or how they combine or break apart.		Balance a simple chemical equation. Conduct an investigation using the scientific method. Demonstrate how the properties of materials are used to the design manufactured goods.	

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Unit Three: Earth Systems[1] **Timeline: 10 weeks** Note: The template for this unit is not available on the Delaware Department of Education science page. However, the standards, ideas, and learning targets below suggest the content that could be included in an Earth Systems unit. When the Earth Systems unit is available through the Science Coalition membership, this section of the curriculum map will be revised to include those standards and concepts.			
Standard One **The Nature and Application of Sciences and Technology** **Strand One** **Understandings and Abilities of Scientific Inquiry** **Substrand B**. Understand that: Science is distinguished from other ways of knowing by the use of empirical observations, experimental evidence, logical arguments and healthy skepticism. Be able to: Design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. **Substrand C.** Understand that: Theories in science are well-established explanations of natural phenomena that are supported by many confirmed observations and verified hypotheses. The application of theories allows people to make reasonable predictions. Theories may be amended to become more complete with the introduction of new evidence. **Substrand E**. Understand that: In communicating and defending the results of scientific inquiry, arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge. (American Association for the Advancement of Science, 2001) **Strand Two** **Science, Technology and Society** **Substrand A**. The pursuit of science can generate the need for	**Big Ideas** **Earth System Science** analyses the dynamic interactions within and between the various subsystems: Geosphere, Biosphere (including humans), Hydrosphere and Atmosphere of System Earth, which resides within its suprasystem, the Solar System. Earth System Science emphasises how these interactions may bring about global environmental change, especially the sustainability of human life on planet Earth. A system may be considered as an arrangement of interdependent subsystems. The Geosphere is the	**Essential Questions:** How does understanding the properties of Earth materials and the physical laws that govern their behavior lead to prediction of Earth events? How do changes in one part of the Earth system affect other parts of the system? In what ways can Earth processes be explained as interactions among spheres? How does technology extend human senses and understanding?	**Suggested Formative Assessments:** Define Earth's subsystems Vocabulary work Observation of Student collaboration Investigation Journals Self assessment and reflection Teacher made pre-assessments Discussions/debates **Suggested Summative Assessments:** Teacher made post unit summative assessments Earth Science Research Project using multi-media technology

[1] Some of the content for this unit, to serve as a representative place holder prior to having access to the Science Coalition Unit is taken from **Project Atmosphere Australia Online** http://www.schools.ash.org.au/paa with permissions for use by non-profit educational agencies.

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advanced technology. Advanced technology, in turn, can provide the opportunity to pursue new scientific knowledge. **Standard Five** **Earth's Dynamic Systems** **Strand One** **Components of Earth** **Substrand A**. Minerals are the building blocks of rocks. Common rock-forming minerals found in Delaware (calcite, quartz, mica, feldspar, and hornblende) can be identified by their chemical and physical properties. **Substrand B**. Rocks can be classified as igneous, metamorphic and sedimentary based on the method of formation. The natural cycling of rocks includes the formation of new sediment though erosion and weathering and of new rock through heat and compaction of the sediment **Substrand C**. Earth's geosphere is composed of layers of rocks which have separated due to density and temperature differences and classified chemically into a crust (which includes continental and oceanic rock), a hot, convecting mantle, and a dense metallic core. **Stand Two** **Interactions Throughout Earth's Systems** **Substrand A**. Earth's four spheres interact as part of a dynamic system in which changes over time are the result of external and internal energy sources. **Substrand B.** Tectonic plates press against one another in some places (convergence), pull apart in other places (divergence), or slide past each other. These plate movements may result in the formation of mountain ranges, and can lead to earthquakes, volcanic eruptions, and tsunamis. The consequences of these events impact the surrounding atmosphere, geosphere, hydrosphere, and the life existing within them.	solid Earth that includes continental and oceanic crust as well as the various layers of the Earth's interior. Solid Earth is separated into four distinct layers: crust, mantle, outer core and inner core. The Biosphere is the life zone of the Earth and includes all living organisms, including humans. (The Anthrosphere), and all organic matter that has not yet decomposed. The Hydrosphere includes all 'water' (H2O) on Earth in the gaseous state (water vapour), in the liquid state (water) and in the frozen state (The Cryosphere). The Atmosphere is the gaseous envelope that surrounds the Earth and constitutes the transition between the surface of the Earth and the vacuum of space.		

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Substrand E. The atmosphere can be described as being in a state of dynamic equilibrium which is maintained in part by plate tectonic processes which recycle atmospheric gases trapped in the ground back into the atmosphere. **Strand Three** **Technology and Applications** **Substrand A.** Advances in science and technology (such as satellite imaging, Global Positioning Satellite (GPS), and Geographic Information Systems (GIS)) have improved our understanding of global and local changes that result from Earth system interactions, and our capacity to anticipate and mitigate natural hazards such as volcanoes and earthquakes.	Earth's systems can be broken down into individual components which have observable measurable properties. Earth's components form systems. These systems continually interact at different rates of time, affecting the Earth locally and globally. Technology enables us to better understand Earth's systems. It also allows us to analyze the impact of human activities on Earth's systems and the impact of Earth's systems on human activity.		