First State Military Academy

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December 14, 2012

Ms. Tonyea Mead
Education Associate for Science
Delaware Department of Education
John G. Townsend Building
401 Federal Street, Suite 2
Dover, DE 19901

Dear Ms. Mead:

The Founding Board of the First State Military Academy is submitting a charter school application to open a high school in the fall of 2014 in Clayton, DE. It is the intention of the Founding Board that the school will join the Science Coalition when it opens. The teachers will use the Science Coalition developed curriculum for grades 9-12, attend training, and fully implement science instruction as guided by the Science Coalition and Delaware Science Standards.

Sincerely,

C. Scott Kidner
Founding Board Chair
First State Military Academy

Delaware Science Coalition Memorandum of Agreement

The First State Military Academy agrees to abide by
(LEA Name)

the Delaware Science Coalition's bylaws and join the Delaware Science Coalition partnership. The Delaware Science Coalition program is sustained by local district/charter school fees in combination with state allocations. Professional development; materials acquisitions; distribution, collection and refurbishment of science curricular units; and any other associated costs are supported by these funding sources. The Coalition's bylaws and fee schedule for school year 2011-2012 are attached to this Memorandum of Agreement.

Signed:

Marian Wolak, Director **Curriculum, Instruction & Professional Development**	**Date**
Linda Rogers, Associate Secretary **Teaching & Learning Branch**	**Date**
Karen Field Rogers, Associate Secretary **Financial Reform & Resource Management**	**Date**
Lillian Lowery, Secretary **Delaware Department of Education**	**Date**
C. Scott Kidner, Board Chair	17 DEC 2012 **Date**

Curriculum Framework Science

School: First State Military Academy **Curricular Tool: DE Science Coalition** **Grade: 9** **Teacher: _____**

Standards Alignment	Unit Concept Big Ideas	Essential Questions 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	**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 can be helpful to us.	**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	**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 Pre-learning concept checks

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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) **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		material to another? What happens to a material 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?	**<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.

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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 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			

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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 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			

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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 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,	**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	**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	**Suggested Formative Assessments:** Worksheets Student Journals Learning Logs Self Assessments Teacher made pre-unit assessment Vocabulary work

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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**. 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.	is useful in understanding and/or predicting the behaviors and/or interactions of 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.	in a chemical reaction? What is the common language used by chemists in communicating chemical information? **Learning Targets:** 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.	Observation of student discussions Participation in oral discussions **Suggested Summative Assessments:** 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.

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
Standard Two **Materials and Their Properties** **Strand One** **Properties and Structures of Materials** **Substrand A**. All matter is composed of minute particles called atoms. 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		Demonstrate that ionic and molecular compounds are electrically neutral. Sketch and interpret graphs representing the melting, freezing, evaporation, and condensation of water. 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.	

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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.			
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	**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	**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?	**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

[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.

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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 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.	interdependent subsystems. The Geosphere is the 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. Earth's systems can be broken down into individual components which have observable measurable	How does technology extend human senses and understanding?	**Suggested Summative Assessments:** Teacher made post unit summative assessments Earth Science Research Project using multi-media technology

Standards Alignment	Unit Concept Big Ideas	Essential Questions Learning Targets	Assessments
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. **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.	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.		

Curriculum Framework Bio-Lit (Biology and ELA)

School: First State Military Academy **Curricular Tool: Science Coalition, *Science & Global Issues: Biology*, New Tech Network Echo** **Grade: 10** **Teacher: _____**

The content of this curriculum map will be taught in a daily block of 90 minutes. Students will have Biolit every day for 90 minutes.

Unit Concept Big Ideas	Essential Questions Student Learning Targets	Assessments
The full curriculum map for Biolit which articulates the integration of the Science and English Language Arts concepts, standards, big ideas, essential questions, learning targets, and assessments is found on of Attachment 4-A in the ELA/Integrated Curriculum Maps section. Unit One: Evolution – Maintaining Diversity Unit Two: Cell Biology Unit Three: Genetics – Feeding the World Unit Four: Ecology and Sustainability		

Curriculum Framework for Chemistry

School: __First State Military Academy__ Curricular Tool: _The Natural Approach to Chemistry/DE Science Coalition__ Grade: _11

Standards Alignment	Unit Concepts	Essential Questions	Assessments
Unit One: The Science of Chemistry **Timeline: 3 weeks**			
Standard One: Nature and Application of Science and Technology **Strand: 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. **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.** 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 D.** Understand that: Investigating most real-world problems requires building upon previous scientific	**Enduring Understanding:** Scientific inquiry involves asking scientifically-oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying the explanation. When materials interact within a closed system, the total mass of the system remains the same. <u>What Chemistry is About</u> Using clear standards of measurements, we can communicate more effectively in answering simple questions. Measurements that are not accurate could lead you to the wrong conclusion. If a measurement is not precise, you may not be able to tell the difference between agreement and disagreement. Science encompasses very large and very small objects. The scientific notation is a shorthand system to write very large and very small numbers. <u>Scientific Inquiry</u> The universe obeys a set of unwritten rules called natural laws. Science is about using the scientific method to discover what those natural laws are. <u>Matter and Energy</u> Whether matter is solid, liquid, or gas depends on how much internal thermal energy is associated	**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 does conservation of mass apply to the interaction of materials in a closed system? <u>Questions for Inquiry:</u> How did scientists "discover" the atom, when they couldn't see it? How do scientists know when they have the right explanation? How do we measure liquid quantities in chemistry? How can we measure very small quantities? How does scientific inquiry help scientists discover and text natural laws? How do we measure quantities of matter in chemistry? How do we compare quantities	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive

Standards Alignment	Unit Concepts	Essential Questions	Assessments
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.** 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) **Substrand F.** Understand that: Knowledge and skill from sources other than science are essential to scientific inquiry. These include mathematics, reading, writing, and technology. Be able to: Use mathematics, reading, writing and technology when conducting scientific inquiries. **Standard Two: Materials and Their Properties** **Strand: 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. **Standard Three: Energy and Its Effects**	with its constituent molecules and atoms. Energy is not created or destroyed but converted from one form to another.	of matter in different forms, such as liquids, solids, powders, solutions, and gasses? How do we translate between units? Be able to: Identify and form questions that generate a specific testable hypothesis that guide the design and breadth of the scientific investigation. Be able to: Design and conduct valid scientific investigations to control all but the testable variable in order to test a specific hypothesis. Be able to: Collect accurate and precise data through the selection and use of tools and technologies appropriate to the investigations. Display and organize data through the use of tables, diagrams, graphs, and other organizers that allow analysis and comparison with known information and allow for replication of Be able to: Construct logical scientific explanations and present arguments which defend proposed explanations through the use of closely examined evidence. Be able to: Communicate and defend the results of scientific investigations using logical arguments and connections with the known body of scientific	classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

Standards Alignment	Unit Concepts	Essential Questions	Assessments
Strand: Forms and Sources of Energy **Substrand D.** Thermal (heat) energy is associated with the random kinetic energy of the molecules of a substance.		information.	
Unit Two: Matter and Atoms **Timeline: 2 weeks**			

Standard Two: Materials and Their Properties
 	
Strand: Properties and Structure of Materials
 	
Substrand A. All matter is composed of minute particles called atoms. 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 B. Elements and compounds are pure substances. Elements cannot be decomposed into simpler materials by chemical reactions. Elements can react to form compounds. Elements and/or compounds may also be physically combined to form mixtures.
 	
Substrand C. Isotopes of a given element differ in the number of neutrons in the nucleus. Their chemical properties remain essentially the same.
 	
Strand: Mixtures and Solutions
	Enduring Understanding:
	The structures of materials determine their properties.
	
	<u>Matter and the Elements</u>
	Chemistry tells us how one kind of matter can be changed into a completely different kind of matter.
	
	Physical properties can be measured or seen through direct observations.
	
	Chemical properties are observed when a substance changes into a different substance.
	
	Matter can be mixtures or substances. The smallest unit of a pure substance is an element.
	
	Each element is a unique type of atom.
	
	The periodic table organizes elements according to how they combine with other elements (based on their chemical properties).
	<u>Molecules and Compounds</u>
	The properties of a compound depend more on the exact structure of the molecule than on the individual elements from which it is made.
	
	Compounds can be built using atoms and attending to the type of atom and the arrangement of atoms.
	
	Atoms with electric charge are known as ions.
		Essential Question:
		How do the properties and structures of materials determine their uses?
		
		How do the components determine the properties of mixtures**?**
		
		<u>Questions for Inquiry:</u>
		How do we explain the diversity of matter?
		
		What does "pure" mean?
		Is "pure" to a chemist the same as "pure" in every day conversation?
		
		What is a chemical formula and how is it used?
		
		How do we represent the number of each element in a chemical formula?
		
		Does the way a chemical formula is written give us information about the molecule?
		
		What does it mean to say a
			Assessment variables explored by the various tools are:
			• Communication skills, Understanding concepts,
			• Organizing scientific ideas, Designing scientific investigations,
			• Recording and organizing scientific data,
			• Analyzing scientific data, Recognizing and evaluating
			• Scientific evidence, understanding quantitative analysis.
			
			Specific Tools:
			1. Questions at the end of each chapter that include:
			  • conceptual questions
			  • multiple choice questions
			  • graphical analysis questions
			  • short answer questions
			  • quantitative problems
			2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation.
			3. Examples of average and exemplary student work and scoring examples.

Standards Alignment	Unit Concepts	Essential Questions	Assessments
Substrand A. Properties of solutions, such as pH, solubility, and electrical conductivity depend upon the concentration and interactions of the solute and solvents. **Substrand B**. A variety of methods can be used to separate mixtures into their component parts based upon the chemical and physical properties of the individual components.	<u>Mixtures and Solutions</u> Mixtures can be homogeneous or heterogeneous depending on whether or not the types of matter are distributed evenly the same throughout the sample. Solutions are made when solutes are dissolved into a solvent. Density can be an important clue in identifying a substance.	solution contains parts per million? How is parts per million measured? Do equal sizes contain equal amounts of matter? What determines how much matter there is per unit of volume?	4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out
Unit Three: Temperature, Energy, and Heat **Timeline: 2 weeks**			
Standard Two: Materials and Their Properties **Strand: Properties and Structure of Materials** **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. **Standard Three: Energy and Its Effects** **Strand: Form and Sources of Energy** **Substrand D**. Thermal (heat) energy is associated with the random kinetic energy of the molecules of a substance. **Strand: Energy Interaction with Materials** **Substrand A.** Energy cannot be created nor destroyed. Energy can be transferred from one object to another and can be	**Enduring Understanding:** Energy takes many forms. These forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and with energy fields (potential energy). <u>Temperature</u> Molecules are in constant, random motion. Random motion affects temperature while non-random motion does not affect temperature. Temperature is the measure of the average kinetic energy of atoms or molecules. <u>Heat and Thermal Energy</u> Energy (heat) spontaneously flows from higher temperature to lower temperature. The energy inside an isolated system is **constant**. The energy lost by a system **must** be gained by the surroundings or another system. <u>Phase Changes</u>	**Essential Question:** How do we know that things have energy? **<u>Questions for Inquiry:</u>** What is the difference between heat and temperature? Suppose an equal mass of sand and water are at the same temperature. Do they have the same amount of energy? How does specific heat affect temperature changes? Why does heat flow? How does heat flow? When does heat stop flowing? How can we move from solid to liquid, and from liquid to gas?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment

Standards Alignment	Unit Concepts	Essential Questions	Assessments
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.	Phase changes are physical changes. The loss or gain in thermal energy results in a phase change. Phase changing involves energy that is not available for changing temperature.	How much energy does it take to melt ice into liquid water? Where does the energy go during phase changes?	elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out
Unit Four: Physical and Chemical Change **Timeline: 2 weeks**			
Standard Two: Materials and Their Properties **Strand: Chemical Reactions** **Substrand A.** Chemical reactions result in new substances with properties that are different from those of the component parts (reactants). **Substrand D.** Energy is transformed in chemical reactions. Energy diagrams can illustrate this transformation. Exothermic reactions release energy. Endothermic reactions absorb energy.	**Enduring Understanding:** There are several ways in which elements and/or compounds react to form new substances and each reaction involves energy. <u>Understanding Chemical Changes</u> In a physical change the molecules are rearranged, intermolecular forces are broken, interatomic forces are not broken. In a chemical change the atoms are rearranged and interatomic forces are broken to create a new substance. This change is irreversible. Each type of atom allows only certain chemical bonds to be formed. This is due to the structure of the atom A chemical bond is formed by sharing or transferring electrons. Chemical bonds form because there is an advantage in energy.	**Essential Question:** What determines the type and extent of a chemical reaction? <u>Questions for Inquiry:</u> Can heat be taken or added without the temperature changing? What is the role of energy in phase changes? What are the signs or potential evidence that a chemical reaction has occurred? What happens during a chemical change? How do we describe chemical changes? What is the difference between	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions

Standards Alignment	Unit Concepts	Essential Questions	Assessments
	All chemical reactions involve three key components: reactants, products, energy. <u>Chemical Reactions</u> Chemical equations must be balanced so that mass is conserved An endothermic reaction requires an input of energy while an exothermic reaction releases energy. Energy can be neither created nor destroyed. <u>Chemical Reactions in a Lab</u> Many reactions, including those that sustain life, involve chemicals dissolved in water. A solution with water as the solvent is called an aqueous solution. Two types of chemical reactions take place in an aqueous environment: redox reactions (transfer of electrons) and acide-base reatctions (transfer of protons, H+ions).	acid–base reactions, oxidation–reduction reactions, and precipitate reactions?	• quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out
Unit Five: The Structure of the Atom **Timeline: 3 weeks**			
Standard Two: Materials and Their Properties **Strand: Properties and Structure of Materials** **Substrand B.** Elements and compounds are pure substances. Elements cannot be decomposed into simpler materials by chemical reactions. Elements can react to form compounds. Elements and/or compounds may also be physically	**Enduring Understanding:** The structures of materials determine their properties. <u>The Atom has Structure</u> Atoms are made from smaller particles. Each of the elements is a unique type of atom. You cannot divide something in half forever. The smallest piece of matter is called an atom. Atoms are made from smaller particles.	**Essential Question:** How do the properties and structures of materials determine their uses? <u>Questions for Inquiry:</u> If an atom is made of even smaller things, what is inside the atom itself? Why do some elements have more than one number above the	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence,

Standards Alignment	Unit Concepts	Essential Questions	Assessments
combined to form mixtures. **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. **Strand: Conservation of Matter** **Substrand B:** Radioactive isotopes are unstable and undergo spontaneous and predictable nuclear reactions emitting particles and/or radiation, and become new isotopes that can have very different properties. In these nuclear changes, the total of the mass and energy remains the same. **Standard Three: Energy and Its Effects** **Strand: Forces and the Transfer of Energy** **Substrand A:** Forces change the motion of objects. Newton's Laws can be used to predict these changes.	Dalton's Postulates: 1. All elements are made of tiny indivisible particles called atoms. 2. All atoms of the same element are the same, but different from atoms of every other element. 3. Chemical reactions rearrange atoms but do not create, destroy, or convert atoms from one element to another. 4. Compounds are made from combining atoms in simple whole number ratios. The size of the atom comes mostly from the space occupied by the electrons. The mass of the atom comes mostly from the nucleus. The number of protons is also called the atomic number for that element. Electrons are very light and fast. They are <u>not</u> organized along orbits around the nucleus. Except for mass, virtually every property of atoms is determined by electrons, including size and chemical bonding. Neutrons act as "glue." They hold protons together in the nucleus. The strong nuclear force attracts protons to protons, neutrons to neutrons, and protons to neutrons. Electrons repel each other, but don't "fall into" the nucleus because they are in constant motion. <u>The Quantum Atom</u> Elements in the same column have similar chemical properties.	symbol? What are the variations in this number called? What happens when you change the number of protons, electrons, or neutrons? How do we see color? How is color measured? How can a spectrophotometer be used to study light? How is color used to identify elements? What is the relationship between the atomic mass of an element and the number of spectral lines? Why is the periodic table shaped the way that it is? Why does the atom absorb only specific (discrete) energies?	understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

Standards Alignment	Unit Concepts	Essential Questions	Assessments
Substrand F. Electric forces between charged objects are attractive or repulsive. The electric forces between electrons and protons are 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 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.	Electrons are responsible for these chemical properties. Light waves come in bundles of light (photons), and an electron behaves as a wave. The higher the frequency of the way, the higher the energy. The wavelength of the electron must be a "multiple" of the "size" of the atom. Energy is quantized. Bohr Models: Only certain energy levels are allowed in each molecule. Different quantum states can have the same wavelength. Electrons are arranged in a pattern according to energy levels. - Lower energy levels are filled first - There can only be one electron per quantum state <u>Electron Configurations</u> Electron configurations determine the properties of atoms. Electrons settle into the lowest unfilled quantum states. <u>Light and Spectroscopy</u> Light is a form of electromagnetic energy that comes from electrons in atoms. The human eye can only detect a certain range of that energy: the visible spectrum. Visible light is only a small range in the electromagnetic spectrum. A wave moves forward one wavelength with each complete oscillation. Wavelength and frequency are related.		

Standards Alignment	Unit Concepts	Essential Questions	Assessments
	Each type of atom has a different electron structure. Each element has unique energy levels like a fingerprint.		
Unit Six: Elements and the Periodic Table **Timeline: 2 weeks**			

Standard One: Nature and Application of Science and Technology
 	
Strand: 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: Properties and Structure of Materials
 	
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
	Enduring Understanding:
	Understanding past processes and contributions is essential in building scientific knowledge.
	
	The structures of materials determine their properties.
	
	<u>The Periodic Table</u>
	The modern periodic table arranges elements in order of increasing atomic number, not atomic mass.
	
	Scientists have been adding elements to the periodic table, as more are discovered or created.
	
	Electron structure was discovered after the periodic table was developed, but orbitals also follow a pattern in the periodic table.
	
	The modern periodic table shows trends or repeating patterns in atomic radii, electronegativity and ionization energy
	
	<u>Properties of Groups of Elements</u>
	Elements that belong to the same period in the periodic table have similar chemical properties.
	
	This is because they have similar electron configurations, and electrons are responsible for bonding properties.
		Essential Questions:
		How have past scientific contributions influenced current scientific understanding of the world?
		
		What do we mean in science when we say that we stand on the shoulders of giants?
		How do the properties and structures of materials determine their uses?
		
		<u>Questions for Inquiry:</u>
		Are you made of star dust?
		
		What does "periodic" in "periodic table" mean?
		
		What are some characteristics of the elements?
		
		Why do elements in Group 1 have the tendency to form +1 ions?
		
		Why do elements in Group 2 have the tendency to form +2 ions?
		
		Why do elements in Group 17 have the tendency to form –1 ions?
			Assessment variables explored by the various tools are:
			• Communication skills, Understanding concepts,
			• Organizing scientific ideas, Designing scientific investigations,
			• Recording and organizing scientific data,
			• Analyzing scientific data, Recognizing and evaluating
			• Scientific evidence, understanding quantitative analysis.
			
			Specific Tools:
			1. Questions at the end of each chapter that include:
			  • conceptual questions
			  • multiple choice questions
			  • graphical analysis questions
			  • short answer questions
			  • quantitative problems
			2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation.
			3. Examples of average and exemplary student work and scoring examples.
			4. End of chapter test bank also provides a structured assessment tool which is based on extensive

Standards Alignment	Unit Concepts	Essential Questions	Assessments
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. **Standard Four: Earth and Space** **Strand: The Solar System** **Substrand** A. The motion and the basic elements (periodic table) that comprise our Solar System are consistent with the theory that the Solar System emerged from a large disk of gas and dust. **Strand:** Stars and Galaxies **Substrand E**. Most elements are formed as a result of natural astronomical processes, either in the Big Bang itself or in the natural evolution of stars.	<u>Valence</u> Elements that belong to the same group in the periodic table have the same number of valence electrons. Only valence electrons in the outer unfilled shells are involved in chemical bonding. The Lewis dot diagram is a way to show valence electrons for an atom.	Elements in group 18 are called "noble gases" because they do not chemically bond with any of the other elements. Why not? Is the periodic table just an organizational system? Can it be used as a tool? Given some blanks in the periodic table, can you figure out which element corresponds to which box? Why is the periodic table shaped the way that it is?	classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out
Unit Seven: Bonding **Timeline: 3 weeks**			
Standard 2: Materials and Their Properties **Strand: Properties and Structure of Materials** **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	**Enduring Understanding:** The structures of materials determine their properties. <u>What is a chemical bond?</u> The binding force between two atoms is an equilibrium of several forces. The electron cloud responds to changes in the electromagnetic environment. That distortion is called polarization. At a certain distance there is an equilibrium between attractive and repulsive forces.	**Essential Question:** How do the types of chemical bonding affect the way we can use a material? <u>Questions for Inquiry:</u> How do bonds form? How many valence electrons does a hydrogen atom have? How many valence electrons does an oxygen atom have?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis.

Standards Alignment	Unit Concepts	Essential Questions	Assessments
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 G:** A change in physical properties does not change the chemical composition of the substance. The physical properties of elements and compounds (such as melting and boiling points) reflect the nature of the interactions among their atoms, ions, or molecules and the electrical forces that exist between. **Standard Three: Energy and Its Effects** **Strand: Forms and Sources of Energy** **Substrand F.** Chemical energy is derived from the making and breaking of chemical bonds.	If the distance is close enough, an electron can be transferred or shared. A chemical bond forms. In a covalent bond Electrons are shared between the two nuclei. In an ionic bond one or more electrons are transferred to form ions. The positive and negative ions attract each other. Electronegativity is the relative affinity of an element for electrons from other atoms. Higher electronegativity means stronger attraction for electrons. The degree of electronegativity in the atom creates nonpolar covalent bonds, polar covalent bonds, and ionic bonds. Most molecules contain more than two atoms and more than one bond. Nonpolar bonds in a molecule make the molecule nonpolar. Polar bonds in a molecule make the molecule polar. <u>Valence Electrons and Bonding Patterns</u> The number of valence electrons affects bond number and ion charge. Valence electrons in combination with properties of ionization energy and electronegativity determine -specific ionic charge. -number of covalent bonds formed. Ionic substances typically form crystals.	How many electrons are available for bonding in hydrogen? What about in oxygen? How can you create two different molecules, each with that same chemical formula where each structure must use all available bonding sites on all atoms? Why isn't water a linear molecule? How can you identify planar, linear, tetrahedral and ring molecules?	**Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

Standards Alignment	Unit Concepts	Essential Questions	Assessments
	Electrons in covalent bonds are transferred so that each element has 8 valence electrons and has the same configuration as the closest noble gas. The light elements H, Li, Be, and B prefer to have 2 valence electrons. When forming ions, atoms gain or lose one or more electrons to reach the same electron configuration as the closest noble gas, with 8 valence electrons. <u>Molecular Geometry and Lewis Dot Structures</u> Lewis structures for individual atoms are like puzzle pieces. Put them together to form molecules. Use Lewis structures to predict the chemical formula, the bonding pattern, and the shape of the molecule. Sharing a pair of electrons is called a single bond. Carbon, nitrogen and oxygen commonly form double and triple bonds. The lone pairs of electrons are not involved in bonding, but affect the shape of the molecule. Similar charges repel each other. Identify regions of electron density to predict the molecular geometry. Two areas of electron density repel to form linear shapes. Three areas of electron density repel to form trigonal planar shapes. Different geometries formed by atoms with four regions of electron density: tetrahedral, trigonal		

Standards Alignment	Unit Concepts	Essential Questions	Assessments
	pyramidal, and bent.		
Unit Eight: Compounds and Molecules **Timeline: 4 weeks**			

Standard 2: Materials and Their Properties
 	
Strand: Properties and Structures of Materials
 	
Substrand A: All matter is composed of minute particles called atoms. 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 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 G. A change in physical properties does not change the chemical composition of the substance. The physical properties of elements and compounds (such as melting and boiling points) reflect the nature of the interactions among their atoms, ions, or molecules and the electrical forces that exist between.
 	
Substrand H. A change of phase may occur when there is a change in the
	Enduring Understanding:
	The structures of materials determine their properties.
	
	<u>Ionic Compounds</u>
	In any ionic crystal, the ratio of positive ions to negative ions must allow for all of the positive charge to cancel out all of the negative charge.
	
	The ionic structure leads to the following physical properties: Ionic substances are solid at room temperature; ionic substances have very high melting points; ionic substances are hard but brittle.
	
	When melted or dissolved, ions are free to move around, making it possible for an ionic solution to conduct electricity.
	
	<u>Molecular Compounds</u>
	Molecular compounds are held together by covalent bonds.
	
	Properties of molecular compounds vary widely by their:
	• Hardness, State of matter, Boiling points, Ability to conduct electricity.
	
	Properties of molecular substances depend on the structure of the individual molecule and the attractions between molecules.
	
	Molecules can be classified into different categories.
	
	Most small molecules (no more than a dozen
		Essential Question:
		How do the properties and structures of materials determine their uses?
		
		<u>Questions for Inquiry:</u>
		How are physical and chemical properties related to atom structures and chemical bonding?
		
		What are intermolar forces? Where do they come from? Do all molecules feel them?
		
		Can something that contains water still be dry?
		
		Given common chemicals, can you recognize some of the compounds? Can you figure out their chemical formulas? Do you know what these compounds look like?
		
		What is different about naming molecular and ionic compounds?
		
		What is the same about naming molecular and ionic compounds?
		
		What is the "common name" for dihydrogen monoxide?
		
		List the formulas for two more polyatomic ions.
			Assessment variables explored by the various tools are:
			• Communication skills, Understanding concepts,
			• Organizing scientific ideas, Designing scientific investigations,
			• Recording and organizing scientific data,
			• Analyzing scientific data, Recognizing and evaluating
			• Scientific evidence, understanding quantitative analysis.
			
			Specific Tools:
			1. Questions at the end of each chapter that include:
			  • conceptual questions
			  • multiple choice questions
			  • graphical analysis questions
			  • short answer questions
			  • quantitative problems
			2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation.
			3. Examples of average and exemplary student work and scoring examples.
			4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback.
			5. Other teacher-made formative

Standards Alignment	Unit Concepts	Essential Questions	Assessments
potential energy of the atoms or molecules of a substance. **Strand**: **Chemical Reactions** **Substrand F**. Certain small molecules (monomers) react with one another in repetitive fashion (polymerization) to form long chain macromolecules (polymers). The properties of the macromolecules depend on the properties of the molecules used in their formation and on the lengths and structure of the polymer chain. Polymers can be natural or synthetic.	atoms) are liquids or gases at room temperature. Some of the most important molecules related to our ecosystem are small molecules. Medium-sized molecules (no more than 100 atoms) tend to be liquids or soft solids at room temperature. They are often long-chain hydrocarbons or lipids. A polymer is a long chain molecule formed by connecting small repeating units with covalent bonds. A network is a type of large structure, usually made from hundreds to billions of atoms, in which each atom is covalently bonded to multiple neighboring atoms, forming a web of connections. Use the empirical formula to describe the simplest ratio of elements of that substance. Use the molecular formula to indicate the exact type and number of each atom in a single molecule of that substance. <u>Intermolecular Forces</u> Intermolecular attractions are also called van der Waals attractions Intermolecular attractions between polar molecules exist on a continuum and can be classified as strong or weak. Hydrogen bonding is strongest, followed by dipole-dipole bonding, and then London dispersion (which is between nonpolar molecules). Molecules that are polar will attract more strongly. Molecules with higher polarity will attract more strongly will have a higher boiling point.		assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

Standards Alignment	Unit Concepts	Essential Questions	Assessments
	Hydrogen bonding plays a crucial role in DNA and protein structures A temporary, very small polarity can be induced when nonpolar molecules are close enough. Molecules with a larger surface area will attract more strongly. Molecules that attract more strongly will have a higher boiling point. <u>Formula Masses</u> By measuring the amount of different elements in a particular substance, we can determine its formula and identify the specific substance. The name of the formula can be used to determine the ratios of elements in the formula. Then the periodic table can be used to get the molar mass (atomic mass) of each of the elements used. You can identify a compound using the percent mass of each element. The empirical formula is the one with the simplest ratio. The empirical formula can be the same as the molecular formula….but not always. The molecular mass will always be equal to, or a multiple of, the empirical formula mass.		
Unit Nine: Water and Solutions **Timeline: 3 weeks**			
Standard 2: Materials and Their Properties **Strand: Mixtures and Solutions**	**Enduring Understanding:** The properties of a mixture are based on the properties of its components.	**Essential Questions:** How can the properties of the components of a mixture be used to separate the mixture?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts,

Standards Alignment	Unit Concepts	Essential Questions	Assessments

Substrand A. Properties of solutions, such as pH, solubility, and electrical conductivity depend upon the concentration and interactions of the solute and solvents.
 	
Substrand B. A variety of methods can be used to separate mixtures into their component parts based upon the chemical and physical properties of the individual components.
	<u>Solutes, Solvents, and Water</u>
	A true solution is homogeneous on the molecular level.
	
	All solutions contain one solvent and at least one solute.
	There is a strong attraction among water molecules due to hydrogen bonding which leads to interesting properties.
	
	In ice, hydrogen bonds force water molecules to align in a crystal structure where molecules are farther apart than they are in a liquid. Surface tension can make a paper clip float on water.
	
	Water is often called the "universal solvent." It dissolves ionic compounds and dissolves many molecular compounds.
	
	Chemical reactions in solids do occur, but they are slow. In liquids chemical reactions occur easily. In gasses they occur quickly.
	
	Polar solvents dissolve polar solutes.
	Nonpolar solvents dissolve nonpolar solutes.
	
	<u>Concentration and Solubility</u>
	There are several ways to express concentration: concentration (g/L) or concentration (%), or concentration (M).
	
	Solubility is the amount of a solute that will dissolve in a particular solvent at a particular temperature and pressure.
	Temperature affects the solubility of solutes (how much) and the rate of solubility (how fast).
	Dissolving is a collision process. Slow (cold) molecules are not as effective as fast (hot) molecules.
		How do the components determine the properties of mixtures?
		
		<u>Questions for Inquiry:</u>
		Not everything dissolves in water. Why not?
		
		How do you measure the amount of sugar in a beverage when there is no balance, graduated cylinder or ruler to use?
		
		How can we quickly find the concentration of a solution?
		
		How can we express concentration quantitatively (with numbers)?
		
		How can we construct a calibration curve to help measure solutions of unknown concentration?
		
		How do we measure the energy of a chemical change?
		
		Is energy a product or a reactant?
		
		How much energy is involved?
			• Organizing scientific ideas, Designing scientific investigations,
			• Recording and organizing scientific data,
			• Analyzing scientific data, Recognizing and evaluating
			• Scientific evidence, understanding quantitative analysis.
			
			Specific Tools:
			1. Questions at the end of each chapter that include:
			  • conceptual questions
			  • multiple choice questions
			  • graphical analysis questions
			  • short answer questions
			  • quantitative problems
			2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation.
			3. Examples of average and exemplary student work and scoring examples.
			4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback.
			5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

Standards Alignment	Unit Concepts	Essential Questions	Assessments
	The rate of solubility increases with an increase in temperature and with an increase in surface area of the solute. Gases are soluble in liquids. At higher temperatures solid solutes (like salt and sugar) are more soluble gases are less soluble. <u>Properties of Solutions</u> In a solution, higher concentration generally means a faster reaction rate. In a solution, Higher temperature generally means a faster reaction rate. In an exothermic process, energy is released (negative number). In an endothermic process, energy is absorbed (positive number). The density of a solution increases as more solute is added. Colligative property is the physical property of a solution that depends only on the number of dissolved solute particles not on the type (or nature) of the particle itself.		
Unit Ten: Chemical Reactions **Timeline: 3 weeks**			
Standard 2: Materials and Their Properties **Strand: Chemical Reactions** **Substrand A.** Chemical reactions result in new substances with properties that are different from those of the component parts (reactants).	**Enduring Understanding:** There are several ways in which elements and/or compounds react to form new substances and each reaction involves energy. <u>Chemical Equations</u> Element symbols are the alphabet of chemistry. Compound formulas are the words of chemistry.	**Essential Question:** What determines the type and extent of a chemical reaction? <u>Inquiry Questions:</u> Which cup will best hold water? A cup of cardboard, a cup made of salt, or a cup made of glass. Why?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data,

Standards Alignment	Unit Concepts	Essential Questions	Assessments
Substrand B. There are different types of chemical reactions. Precipitation reactions produce insoluble substances (e.g., double replacement). The transfer of electrons between atoms is a reduction-oxidation (redox) reaction (e.g., single-replacement combustion, synthesis, decomposition). Some acid/base reactions involve the transfer of hydrogen ions. **Standard One: Nature and Application of Science and Technology** **Strand: 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.	Chemical equations are the sentences of chemistry. Law of Conservation of Mass: mass of the products = mass of reactants When balancing a chemical equation, only coefficients can be changed. Subscripts remain the same. <u>Methods for Balancing Chemical Equations</u> Strategy to balance a chemical equation: 1. Write down the unbalanced chemical equation. 2. Identify the element that occurs in only one compound on both sides, and balance it first. 3. Continue with the rest of the elements. If a free element is present, it is balanced last. 4. Check each element to make sure that the equation is balanced. 5. Make sure the coefficients are the smallest possible whole numbers. <u>Types of Chemical Reactions</u> There are four types of chemical reactions: 1. Synthesis (two compounds combine to make a third compound) / Decomposition (one compound breaks apart into two or more compounds or elements). 2. Single (Two compounds swap a single element or polyatomic ion 3.) / Double replacement (Two compounds exchange parts) 4. Precipitate reaction: An insoluble compound is formed 5. Polymerization reaction: A reaction that assembles a polymer through repeated additions of smaller molecular fragments (monomers)	Why are some compounds soluble in water and some not? How is the formation of a precipitate direct evidence that a chemical reaction has occurred? When does a chemical reaction occur? How do we know if a chemical reaction has occurred? How do you determine a quantity without measuring it directly?	• Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

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	Chemical Reactions and Energy A thermochemical equation is an equation that gives the chemical reaction and the energy information of the reaction. Knowing the enthalpies of formation of substances and the following equation, allow you to calculate unknown enthalpy values. Hess's law states that the overall enthalpy of a reaction (1) is the sum of the reaction enthalpies of the various steps into which a reaction can be divided (2).		
Unit Eleven: Stoichiometry **Timeline: 2 weeks**			
Standard Two: Materials and Their Properties **Strand: Chemical Reactions** **Substrand A.** Chemical reactions result in new substances with properties that are different from those of the component parts (reactants). **Substrand C.** The rate of a chemical reaction depends on the properties and concentration of the reactants, temperature, and the presence or absence of a catalyst. **Strand: 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.	**Enduring Understanding:** There are several ways in which elements and/or compounds react to form new substances and each reaction involves energy. Analyzing a Chemical Reaction • A chemical equation tells us: • What compounds are involved • How much of each is used • Mole ratios can be determined using coefficients in a balanced equation Percent Yield and Concentration The percent yield tells us how much product has actually obtained, compared to the theoretical value. The mass percent of a compound is the mass of the compound divided by the total mass of the solution times 100. Limiting Reactants When one reactant is completely used up, the whole reaction stops.	**Essential Question:** What determines the type and extent of a chemical reaction? Questions for Inquiry: How do you know how much of a chemical is necessary for a reaction to occur? In a given chemical reaction, how much product can we collect compared to the theoretical amount? How can you calculate the molar mass of the reactants and solid product? How can you calculate the number of moles of the reactants and solid product? How can you determine which reactant was limiting. Support	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3

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	The reactant that is completely used up first is the limiting reactant. If there is some reactant left over when the reaction stops, that reactant is the excess reactant. <u>Solving Stoichiometric Problems</u> Use what we've learned to answer these questions: • What is the limiting reactant? • What is the theoretical yield? • What is the percent yield? • How much excess reactant is left? • How much reactant is used if it's in a solution?	your answer with a calculation?	to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out
Unit Twelve: Reaction Rates and Equilibrium **Timeline: 2 weeks**			
Standard Two: Materials and Their Properties **Strand: Chemical reactions** **Substrand C**. The rate of a chemical reaction depends on the properties and concentration of the reactants, temperature, and the presence or absence of a catalyst. **Substrand E.** A catalyst lowers the activation energy of a chemical reaction. The catalyst remains unchanged and is not consumed in the overall reaction. Enzymes are protein molecules that catalyze chemical reactions in living systems.	**Enduring Understanding:** There are several ways in which elements and/or compounds react to form new substances and each reaction involves energy. <u>Reaction Rates</u> Collision Theory: Chemical reactions take place at the molecular level, where molecules of reactants are colliding with each other. Not all collisions are successful. Collision alone does not guarantee success. Factors that affect the reaction rate: • Concentration of reactants: The higher the concentration of reactants, the higher the rate • Temperature: The higher the temperature, the higher the rate • Surface area: The higher the surface area, the higher the rate • Catalysts <u>Chemical Equilibrium</u>	**Essential Question:** What determines the type and extent of a chemical reaction? <u>Questions for Inquiry:</u> What is the rate of a reaction and how is it measured? How does temperature affect the ability of living organisms to thrive and grow? Will varying the concentration of reactants affect the reaction rate? When a chemical equilibrium exists, can we predict which way a chemical reaction will proceed when there is a change in concentration of a reactant?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools**: 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions

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	Le Châtelier's principle helps to determine where the equilibrium lies when the system undergoes a change in: • Temperature • Concentration • Pressure or volume (for gaseous systems) The equilibrium constant helps to determine where the equilibrium lies: • Large K favors products • Small K favors reactants <u>Chemical Pathways</u> Reaction mechanisms are proposed based on experimental evidence. A series of elementary steps make up the overall reaction. The slowest elementary step is the rate determining step for the overall reaction <u>Catalysts</u> Catalysts are substances that lower the energy barrier. Catalysts are not consumed during the reaction and can be reused. Biological catalysts are called enzymes.	Can a change in the temperature of the surroundings cause one side of a chemical reaction to be favored? How does Le Châtelier's principle explain how the equilibrium of a system can change?	• quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out
Unit Thirteen: Acids and Bases **Timeline: 3 weeks**			
Standard Two: Materials and Their Properties **Strand: Chemical Reactions** **Substrand B:** There are different types of chemical reactions. Precipitation reactions produce insoluble substances (e.g., double replacement). The transfer of electrons between atoms is a reduction-	**Enduring Understanding:** There are several ways in which elements and/or compounds react to form new substances and each reaction involves energy. <u>The Chemical Nature of Acids and Bases</u> The whole subject of acids and bases has to do with the extraordinary chemical power of the H^+ ion, the "naked proton."	**Essential Question:** What determines the type and extent of a chemical reaction? <u>Questions for Inquiry:</u> What makes an acid and acid and a base a base? What does a pH measurement tell us?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data,

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oxidation (redox) reaction (e.g., single-replacement combustion, synthesis, decomposition). Some acid/base reactions involve the transfer of hydrogen ions. **Strand: Mixtures and Solutions** **Substrand A**. Properties of solutions, such as pH, solubility, and electrical conductivity depend upon the concentration and interactions of the solute and solvents.	Arrhenius theory: Acids are chemicals that create H^+ ions in aqueous solutions. Bases are checmicals that produce OH^- ions in aqueous solutions. Bronsted Lowry definition: Acids are chemicals that donate protons. Bases are chemicals that accept protons. A proton that is donated by one chemical (an acid) must be accepted by another chemical (a base). Acids and bases always act in pairs called conjugate acid-base pairs! <u>The pH Scale</u> pH doesn't just tell us if a solution is neutral, an acid or a base. It also tells us: the concentration of H^+ ions in the solution in moles/L which is expressed as a power of 10. You can't measure pH by just looking at a solution, or measuring its density or temperature, but you can measure pH indirectly by – • performing a chemical reaction with a solution of known pH • using a chemical that changes color at different pH values (pH indicators) • measuring the electrical properties of the solution <u>Acid-Base Equilibria</u> For dilute solutions there is an equilibrium between $[H^+]$ and $[OH^-]$. Use a RICE (Reaction, Initial, Change, Equilibrium) table to find the pH of a weak acid or a weak base. Once $[H^+]$ or $[OH^-]$ has been determined, the pH can be calculated.	How can the pH of a solution be calculated from concentration data? How can we determine the pH of a solution using the spectrophotometer? How can we use the technique of titration, to determine an unknown concentration by performing a chemical reaction with a solution of known concentration? What is the equivalence point why does it matter? How can phenolphthalein help us determine acids and bases? How do commercial antacids work? Are some antacids more effective than others? How much vitamin C is in fresh squeezed orange juice? Compared to orange juice, are vitamin C tablets a good source of vitamin C?	Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation. 3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out

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	Acid-Base Reactions Chemical reactions with acids and bases include corrosion, electrolysis, neutralization Neutralization includes: • Salts of weak acids • Salts of strong acids • Titration experiments • Buffers		
Unit Fourteen: Gases **Timeline: 2 weeks**			
Standard Two: Materials and Their Properties **Strand: Properties and Structures of Materials** **Substrand I.** Temperature, pressure, and volume are important properties of a gas. A change in two of these properties results in predictable changes in the third. **Standard Three: Energy and Its Effects** **Strand: The Forms and Sources of 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 have potential energy when under the influence of gravity, elastic forces or electric forces and its potential	**Enduring Understanding:** The structures of materials determine their properties. Pressure and Kinetic Theory Gases consist of widely separated atoms or molecules in constant, random motion. Gases have a unique set of physical properties explained by kinetic molecular theory. 1. Gases are translucent or transparent. 2. Gases have very low densities when compared to liquids or solids. 3. Gases are highly compressible compared to liquids and solids. 4. Gases can expand or contract to fill any container. The basis of kinetic molecular theory, which explains gas behavior because • No interaction between atoms or molecules, except during collisions. • Straight trajectory until a collision occurs. Pressure increases when: • the temperature (speed of molecules) increases.	**Essential Question:** Why are temperature, pressure and volume important properties of a gas? Questions for Inquiry: How can we determine the molar mass of a gas? Can we measure the volume of a gas using a graduated cylinder? Wouldn't the gas escape? Is an empty container really empty? If air is matter (just like a liquid or a solid) then shouldn't it have mass? How much mass? Liquids and solids have densities. What is the density of air?	**Assessment variables explored by the various tools are:** • Communication skills, Understanding concepts, • Organizing scientific ideas, Designing scientific investigations, • Recording and organizing scientific data, • Analyzing scientific data, Recognizing and evaluating • Scientific evidence, understanding quantitative analysis. **Specific Tools:** 1. Questions at the end of each chapter that include: • conceptual questions • multiple choice questions • graphical analysis questions • short answer questions • quantitative problems 2. Lab investigations have from 3 to 6 formative assessment elements built directly into the investigation.

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energy can be determined from its position. **Substrand** D. Thermal (heat) energy is associated with the random kinetic energy of the molecules of a substance.	• the density (number of molecules) increases. The energy of molecules only depends on temperature therefore, heavier molecules move slower. Diffusion is the slow spreading of one type of molecules within another type. <u>The Gas Laws</u> Because gases can expand and contract they behave differently from solid and liquids. Gas pressure is increased by more frequent and/or harder collisions. Gas pressure is affected by changing the 1. Density: More molecules means more impacts and a higher pressure. 2. Volume of the container: With less space to move around, there are more collisions and a higher pressure. 3. Temperature: With more kinetic energy, the molecules move faster. The collisions are harder and more frequent. Boyle's Law, and Charles's Law are combined to create the combined gas law. Avogardro's Law contributes with the combined gas law to create the ideal gas law. The ideal gas law is an approximation which is accurate for many gases over a wide range of conditions. The ideal gas law is not accurate at very high density or at very low temperature. <u>Stoichiometry and Gases</u> Steps for solving stoichiometry problems for gases and solids, solutions, and other gases.		3. Examples of average and exemplary student work and scoring examples. 4. End of chapter test bank also provides a structured assessment tool which is based on extensive classroom trials and teacher feedback. 5. Other teacher-made formative assessments – quizzes, quickwrites, observation, graphic organizers, tickets out