SUBJECT: Principles of Science	**GRADE: 9**
Unit Title: Nature of Science	Time Frame: 3.5 weeks
UNIT OVERVIEW	
This unit will refresh students on the scientific method and lab safety, and introduce measurement conversions.	
LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
K2 Healthy Living, Wellness, and Self-Awareness S1 Collaboration and Teamwork S4 Critical thinking and Problem-solving	● K-12 Science and Engineering Practices: 1) Asking questions and defining problems. 2) Planning and carrying out investigations. 3) Analyzing and interpreting data. 4) Using mathematics and computational thinking. 5) Obtaining, evaluating, and communicating information.
COMPETENCIES	**LEARNING TARGETS**
I can effectively design, display, and explain the nature of science.	● I can ask questions and define problems. ○ I can solve problems using the scientific method, identify dependent and independent variables, controls, and experimental groups. ● I can plan and carry out investigations. ○ I can apply lab safety rules and procedures when performing labs in the classroom. ● I can analyze and interpret data by using mathematics and computational thinking. ○ I can measure and complete metric conversions correctly. ○ I understand SI units and am able to convert them using the factor label method. ○ I understand density and can calculate it. ● I can obtain, evaluate, and communicate information effectively. ○ I can read, interpret, and graph data.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Matter and Solutions	Time Frame: 5 weeks

UNIT OVERVIEW
This unit will cover the different types of matter, states, and types of changes that matter undergoes, both physical and chemical.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 Collaboration and Teamwork S4 Critical thinking and Problem-solving	3.2.9-12.B Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. 3.2.9-12. E Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. 3.2.9-12.G Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
COMPETENCIES	**LEARNING TARGETS**
I understand the properties of matter and changes in matter depending on the law of conservation of mass.	● I can plan and conduct an investigation to gather evidence to compare the structure for substance at the bulk scale to infer the strength of electrical forces between particles. (B) ○ I can classify matter as an element, compound, homogeneous mixture, or heterogeneous mixture. ○ I can distinguish and identify mixtures as solutions, suspensions, and colloids. ○ I can recognize the shape and volume difference among the three phases of matter. ○ I can list phase changes and give examples. ○ I understand the methods used to separate mixtures based on their properties. ○ I am able to distinguish physical and chemical changes in matter. ○ I am able to distinguish physical and chemical properties in matter.

	● I can apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction. (C) ○ I can distinguish the differences between unsaturated, saturated, and supersaturated substances. ○ I can recognize a solvent and a solute in a solution. ● I can use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. (D) ○ I understand and can explain the law of conservation of mass as it applies to changes in matter.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Atomic Structure and the Periodic Table	Time Frame: 5 weeks

UNIT OVERVIEW
This unit provides a more in-depth look at the periodic table. This unit will include calculating average atomic mass, isotopes, and subatomic particles.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
K4: Digital Literacy and Technological Proficiency S2 Communication and Empathy S3 Creativity and Innovation S4 Critical Thinking and Problem-solving	3.2.9-12.A. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy levels of atoms. 3.2.9-12.H Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

COMPETENCIES	LEARNING TARGETS
I can describe basic atomic structure and how that relates to the organization of the periodic table.	● I can use the periodic table as a model to predict the relative properties of elements based on the pattern of electrons in the outermost energy levels of atoms. (A) ○ I can identify common elements by their chemical symbol on the periodic table. ○ I am able to state how the periodic table and the atom have changed from the past to the present. ○ I am able to use current research and cite sources appropriately using MLA format. ● I can develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. (H) ○ I am able to create Bohr models for basic elements. ○ I am able to draw, calculate, and explain subatomic particles, atomic mass, and mass number. ○ I can calculate the average atomic mass of numerous isotopes.

	○ I can calculate the molar mass of elements, compounds, and molecules.

SUBJECT: Principles of Science	**GRADE: 9**
Unit Title: Periodic Table Trends	Time Frame: 1.5 weeks
UNIT OVERVIEW	
This unit will dive into the history of the periodic table, how it has developed into the modern periodic table, and the trends that appear on the table.	
LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S3 Creativity and Innovation S4 Critical thinking and Problem-solving D1 Adaptability and Flexibility	3.2.9-12.A. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy levels of atoms. 3.2.9-12.C Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
COMPETENCIES	**LEARNING TARGETS**
I can describe the periodic table properties and trends.	● I can use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy levels of atoms. (A) ○ I understand how the periodic table is organized based on valence electron number. ○ I can name and describe families on the periodic table based on their properties. ○ I am able to differentiate among metals, metalloids, and non-metals according to their properties and location. ● I can construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. (C) ○ I am able to describe the changes in atomic size across a period and down a group.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Chemical Bonds	Time Frame: 4 weeks
UNIT OVERVIEW	
This unit will highlight how compounds are created through different types of bonds and how to properly name compounds.	
LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S2 Communication and Empathy S4 Critical thinking and Problem-solving	3.2.9-12.B Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. 3.2.9-12.C Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table and knowledge of the patterns of chemical properties.
COMPETENCIES	**LEARNING TARGETS**
I can distinguish between types of chemical bonds.	● I can plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. (B) ○ I am able to describe and give examples of all types of bonds. ● I can construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of patterns of chemical properties. (C) ○ I can draw correct Lewis diagrams for any element, excluding transition metals and rare earth metals. ○ I can name chemical compounds from the formula for ionic and covalent compounds. ○ I can write the chemical formula from the names for ionic and covalent compounds.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Chemical Reactions	Time Frame: 4 weeks

UNIT OVERVIEW
In this unit, students will apply math concepts to balance chemical equations appropriately and learn about the different types of reactions that can occur.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
D1 Adaptability and Flexibility D4 Resilience and Grit S4 Critical thinking and Problem-solving	3.2.9-12.C Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron 3.2.9-12.D Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. 3.2.9-12.G Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
COMPETENCIES	**LEARNING TARGETS**
I can write balanced chemical reactions of various types.	● I can construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron. (C) ○ I can identify the parts of an equation, including the reactants and products ○ I can name and identify different types of chemical reactions (examples: synthesis, decomposition, single and double replacement, combustion). ● I can develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. (D) ○ I can distinguish the difference between endothermic and exothermic reactions. ● I can use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. (G)

	○ I can identify if a chemical reaction is balanced or unbalanced according to the law of conservation of matter. ○ I can add coefficients to a reaction to balance the chemical equation.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Motion and Force	Time Frame: 5 weeks

UNIT OVERVIEW

In this unit, students will review Newton's laws and introduce the mathematical calculations used with them. Different types of physics measurements and vectors will be used, such as distance, displacement, speed (average and instantaneous), momentum, and acceleration.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S3 Creativity and Innovation S4 Critical thinking and Problem-solving D3 Honesty, Integrity and Responsibility D4 Resilience and Grit	3.2.9-12. I analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. 3.2.9-12.J Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. 3.2.9-12.K Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. 3.2.9-12.L Use mathematical representations of Newton's Law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.

COMPETENCIES	LEARNING TARGETS
I am able to explain and calculate the motion of objects.	● I can analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. (I) ○ I can summarize the forces acting upon objects that are both in motion and stationary. ○ I can distinguish between displacement and distance and calculate both. ○ I can define and calculate speed, velocity, and acceleration. ● I can use mathematical representation to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. (J)

	○ I can calculate momentum given certain variables. ● I can apply scientific and engineering ideas to design, evaluate and refine a device that minimizes the force on a macroscopic object during a collision. (K) ○ I can explain what friction is and how it affects movement. ● I can use the mathematical representation of Newton's Law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects. (L) ○ I can distinguish and explain all three of Newton's laws of motion.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Energy	Time Frame: 3 weeks

UNIT OVERVIEW

In this unit, students will explore the different types of energy, how energy can be transformed, and how energy can be conserved.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 Collaboration and Teamwork S4 Critical thinking and Problem-solving	3.2.9-12.O Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flow in and out of the system are known. 3.2.9-12.P Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). 3.2.9-12.Q Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
COMPETENCIES	**LEARNING TARGETS**
I am able to define energy, identify energy sources, and explain how energy is conserved and converted.	● I can design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. (Q) ○ I can identify kinetic and potential energy and calculate for both. ● I can develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects). (P) ○ I can identify forms and give examples of energy transformations in a variety of situations. ● I can create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flow in and out of the system are known. (O) ○ I can explain how the law of conservation of energy applies to real-life situations.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Work and Machines	Time Frame: 4 weeks

UNIT OVERVIEW
This unit will explain what work is, how it is done, and how to make work easier.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 Collaboration and Teamwork S3 Creativity and Innovation	3.2.9-12.N Communicate scientific and technical information about why the molecular-level structure is important in the function of designed materials. 3.2.9-12.X Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

COMPETENCIES	LEARNING TARGETS
I am able to recognize work and various types of simple machines.	● I can communicate scientific and technical information about why the molecular-level structure is important in the function of designed materials. (N) ○ I can distinguish when work is being done. ○ I can identify and calculate mechanical advantage. ○ I can identify types of simple machines and compound machines. ○ I can calculate IMA and AMA of machines. ● I can communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. (X) ○ I can determine how technical information is being stored and transferred through wave behavior and interactions.

SUBJECT: Principles of Science	GRADE: 9
Unit Title: Waves and Sound	Time Frame: 2 weeks
UNIT OVERVIEW	
In this unit, students will explore how sound is generated and how it travels through different media.	
LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
D2 Continual learning and Growth Mindset	3.2.9-12.T. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling through various media. 3.2.9-12.V. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can either be described by a wave model or a particle model and that for some situations, one model is more useful than the other.
COMPETENCIES	**LEARNING TARGETS**
I can explain how waves, light, and sound behave and how they are affected by various objects.	● I can use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling through various media. (T) ○ I can define terms related to the characteristics of waves (wavelength, frequency, amplitude) ○ I can explain how waves are affected as they travel through different forms of matter. ○ I can explain the differences among light waves and sound waves. ● I can evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can either be described by a wave model or a particle model and that for some situations, one model is more useful than the other. (V) ○ I can summarize the characteristics of light waves. ○ I can describe the types of waves that make up the electromagnetic spectrum and list the characteristics and real-life uses of these waves. ○ I can explain how light interacts with matter using the terms transparent, translucent, and opaque.

	○ I can explain how light behaves by comparing and contrasting reflection and refraction. ○ I can explain how light behaves when it hits a lens, what a lens is, and how they are used in real life.