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SUBJECT: Principles of Chemistry	**GRADE: 10-11**
Unit Title: Lab Safety and Equipment	2-3 weeks

UNIT OVERVIEW

This unit will cover basic equipment that would be used in a chemistry lab and in what situations each piece of lab equipment would be used. Students will learn how to safely conduct themselves so that they can keep themselves and their peers free of danger while still having a full lab experience.

LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S4C – Critical Thinking & Problem Solving K2 - Healthy Living, Wellness, and Self-Awareness	Flinn Scientific Safety Recommendations
COMPETENCIES	**LEARNING TARGETS**
I can work in a lab and use appropriate equipment safely	● I know the general safety tips and procedures for everyday lab work. ● I can point out unsafe lab procedures and hazards when they are present. ● I can identify everyday lab equipment by name. ● I know how to safely and carefully handle everyday lab equipment. ● I am aware of the risks and potential dangers of working in a Chemistry Lab.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Measurement and Conversions	2-3 weeks

UNIT OVERVIEW

This unit explores the process of measurement and the relationship between accuracy and precision. Students will demonstrate their understanding of converting measurement units within the metric and standard systems. Dimensional measurements will be applied throughout the calculation of density, and lab results will be evaluated through the analysis of percent error.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 - Collaboration and Teamwork S4 - Critical Thinking and Problem Solving D2 - Continual Learning and Growth Mindset	PA Standards from 2008 3.1.12.C 3.1.12.D 3.2.12.A 3.7.12.A 3.7.12.B
COMPETENCIES	**LEARNING TARGETS**
I understand the meaning of units, know how to convert and assess their accuracy and precision.	● I understand the difference between Accuracy and Precision, and can evaluate data in terms of both. ● I can convert between different metric units by knowing what their prefixes mean. ● I can convert most units to other units by using the Factor Label Method. ● I can calculate the percentage error for a measured number if I am given what the real measurement should be. ● I can calculate Density, and can apply density to predict what an item is or whether it will float on a substance. ● I can measure correctly and understand how to determine the number of significant figures in a measurement.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Matter and Energy	2-3 weeks

UNIT OVERVIEW

This unit studies the various forms that matter can take at the macroscopic level, and how that can be explained at the atomic level. Students will learn about the differences between pure substances and mixtures, and be able to further describe elements, compounds, homogeneous mixtures, and heterogeneous mixtures. Examples and sorting activities will be used to help students understand how to classify various forms of matter. Using observations, students will be able to describe various properties of matter as either physical or chemical properties, and further be able to describe changes in matter as physical or chemical changes.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 - Collaboration and Teamwork S3 - Creativity and Innovation 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 them.

COMPETENCIES	LEARNING TARGETS
I can make informed predictions about changes in matter, including Physical and Chemical Changes.	● I can classify an object as either an Element, Compound, Homogeneous Mixture, or Heterogeneous Mixture by knowing the properties of each of these categories. ● If I am given a property of a substance, I can identify it as a Physical or a Chemical Property ● I can distinguish the three main states of matter from each other. ● I know what changes in state are called and can describe what is happening to particles of that substance as it changes. ● After observing a change in matter, I can use the signs of Chemical Changes to determine whether the change was Chemical or Physical.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Atomic Structure	2-3 weeks

UNIT OVERVIEW

This unit explores the historical evolution of the structure of the atom as scientists used new information to reevaluate understandings. Students will be able to describe a modern understanding of the structure of the atom including the numbers of subatomic particles in various atoms and their relative locations. Using vocabulary words like element, isotope, and ion, students should be able to compare and contrast various effects of subatomic particles on atom identity.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
K4 - Digital Literacy and Technological Proficiency S2 - Communication and Empathy 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.

COMPETENCIES	LEARNING TARGETS
I can describe atomic structure using subatomic particles and their relationship to forming isotopes and ions.	● I can identify scientists and explain models historically associated with the development of the current atomic theory. ● I can determine the number of protons, neutrons, and electrons in an atom by using the periodic table. ● I can calculate average atomic mass. ● I can determine the charge of an ion by identifying the ratio of electrons to protons. ● I can identify the different isotopes of an element by knowing the mass number.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Electromagnetic Spectrum	2-3 weeks

UNIT OVERVIEW

This unit will examine the various types of the electromagnetic spectrum. Students will be able to show how each wavelength, frequency, and energy of light are all related. Students will be able to describe why various types of light are produced at the atomic level, and how each could then affect everyday objects that utilize the electromagnetic spectrum.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S4 - Critical Thinking and Problem Solving	3.2.9-12.T. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves in various media. 3.2.9-12.U. Evaluate questions about the advantages of using digital transmission and storage information. 3.2.9-12.V. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described by either a wave model or particle model and that for some situations, one model is more useful than the other. 3.2.9-12.W. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. 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 can describe the characteristics of the electromagnetic spectrum and the relationships of light to wavelength, frequency and energy.	● I can classify types of electromagnetic radiation as radio, microwave, infrared, visible, ultraviolet, x- ray or gamma rays. ● I can calculate wavelength or frequency of an electromagnetic wave. ● I can describe the behavior of light as both a wave and a particle. ● I can determine the relationship between light frequency and energy using Planck's constant in calculations. ● I can explain how light is produced at the subatomic level. ● I can explain how atomic emission and absorption spectra are used to identify elements. ● I can explain how wave behavior plays a role in information processing.

SUBJECT: Principles of Chemistry	**GRADE: 10-11**
Unit Title: Electronic Structure	2-3 weeks
UNIT OVERVIEW	
This unit compares the different ways to express an atoms electron structure. Students will use the periodic table to help construct Bohr models, which they will use to explain preferences of elements to form ions. Lewis dot structures will be used to explain behavior of elements when forming compound. Comparisons will be made to the modern quantum mechanical model of the atom, and students will examine how electrons are arranged according to this model.	
LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S3 - Creativity and Innovation S4 - Critical Thinking and Problem Solving	3.2.9-12. A. Us the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy levels.
COMPETENCIES	**LEARNING TARGETS**
I can describe the electrons of neutral atoms and ions	● I can explain the importance of valence electrons. ● I can draw Lewis Dot structures. ● I can demonstrate the location of an atom's electrons by writing the electron configuration. ● I can determine the locations and spin of electrons using orbital notation.

SUBJECT: Principles of Chemistry	**GRADE: 10-11**
Unit Title: The Periodic Table	2-3 weeks

UNIT OVERVIEW
This unit explores the formulation and usefulness of the modern periodic table and explain why elements are organized into groups and periods. Using placement on the periodic table, students will be able to describe and compare elements' ionization energy, electron affinity, electronegativity, and atomic radius.

LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S1 - Collaboration and Teamwork S4 - Critical Thinking and Problem Solving D2 - Continual Learning and Growth Mindset	3.2.9-12. A. Us the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy levels.

COMPETENCIES	**LEARNING TARGETS**
I can identify general trends of the periodic table and use them to infer properties of elements.	● I can identify scientists and explain models historically associated with the development of the periodic table. ● I can locate and describe families/groups of the periodic table. ● I can describe differences between the properties of metals, metalloids, and nonmetals. ● I can use Periodic Law to describe trends of atomic radius, electronegativity, electron affinity, and ionization energy.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Chemical Formulas	2-3 weeks

UNIT OVERVIEW

This unit will explore the formation of chemical compounds with a focus on the difference between molecular and ionic compounds. Students will name compounds and be able to write chemical formulas. Students will use these skills when evaluating products created in labs, in addition to using these fundamental skills in developing chemical equations in the following unit.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 - Communication and Empathy	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 periodic table, and knowledge of the patterns of chemical properties.

COMPETENCIES	LEARNING TARGETS
I can write the formula and name both molecular and ionic compounds.	● I can identify and explain the difference between a molecular and ionic compound. ● I can write the formula and name of a simple ionic compound. ● I can write the formula and name of an ionic compound including a polyatomic ion. ● I can write the formula and name of an ionic compound including a transition metal. ● I can write the formula and name for a molecular compound. ● I can write the formula and name of an acid.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Molecular Structure	2-3 weeks

UNIT OVERVIEW

The structure of chemical compounds can affect their relative properties and behavior. This unit focuses molecular structure by using key characteristics like elemental electronegativity, polarity, and bonding behavior. Valence Shell Electron Pair Repulsion (VSEPR) is introduced as a key theory to producing representative molecular shapes.

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 them. 3.2.9-12.N - Communicate scientific technical information about why the molecular-level structure is important in the functioning of designing materials. 3.2.9-12.S. - Develop and use a model of two objects interacting through electric or magnetic field to illustrate the forces between objects and the changes in energy of objects due to the interaction.
COMPETENCIES	**LEARNING TARGETS**
I can properly identify the properties of a molecule from the shape, polarity, and bond type.	● I can use electronegativity to determine the polarity of a molecule. ● I can use Coulomb's law to explain the strength of ionic bond and lattice energy. ● I can use Lewis Dot structures to determine bonding in compounds. ● I can draw Lewis structures to represent bonding in molecules. ● I can use VSEPR Theory to determine molecular structure. ● I can determine the strength of intermolecular interactions between molecules.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Chemical Equations	2-3 weeks

UNIT OVERVIEW

In this unit, students will initially work to be able to identify the different types of chemical reactions. Through lab experiments, students will work on skills that develop their ability to predict the products of chemical reactions based on the initial reactants present. Six different types of reactions will be identified and evaluated in total.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 - Collaboration and Teamwork S3 - Creativity and Innovation 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 states of atoms, trends in periodic table, and knowledge of the patterns of chemical properties. 3.2.9-12.D. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends on changes in total bond energy. 3.2.9-12.E. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of 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 considered during a chemical reaction.
COMPETENCIES	**LEARNING TARGETS**
I can balance and predict products of chemical equations.	● I can balance chemical equations. ● I can identify and describe synthesis, decomposition, single replacement, double displacement, combustion, and acid-base reactions. ● I can predict the product(s) of a synthesis, decomposition, single replacement, double displacement, combustion, and acid-base reactions. ● I can predict if a single replacement reaction will happen based on the activity series. ● I can predict if a double displacement reaction will happen based on the activity series.

SUBJECT: Principles of Chemistry	**GRADE: 10-11**
Unit Title: Moles and Mole Conversions	2-3 weeks

UNIT OVERVIEW

The Moles Unit will concentrate on mastering the forward and back conversion of atoms, molecular mass and gas volume by liters. Students will be able to determine the difference between empirical and molecular formulas by undergoing calculations of percent composition. Finally, an essential portion of the Mole Unit supports students in mastering the concept of molarity as a concept of quantifying the concentration of solutions.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S3 - Creativity and Innovation S4 - Critical Thinking and Problem Solving	3.2.9-12.G. – Use mathematical representations to support the claim that atoms, and therefore mass, are considered during a chemical reaction.
COMPETENCIES	**LEARNING TARGETS**
I understand the relationship between moles and other properties of elements/compounds.	● I can use moles to determine the number of atoms or molecules. ● I can convert mass to moles and moles to mass. ● I can convert volume to moles and moles to volume. ● I can complete a 2 Step Mole Problem. ● I can calculate percent composition. ● I can differentiate between empirical and molecular formulas.

SUBJECT: Principles of Chemistry	**GRADE: 10-11**
Unit Title: Stoichiometry	2-3 weeks

UNIT OVERVIEW

Stoichiometry the relationship between the relative quantities of substances taking part in a reaction or forming a compound. It is a term derived from the Greek word “stoich” which means “element.” This unit is a culmination of the Chemical Formulas, Chemical Equations, and Moles units as students synthesize their experience to effectively predict product quantities based on reagents. Students will also be able to solve basic stoichiometry problems like finding the limiting reagent in a chemical reaction..

LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S1 - Collaboration and Teamwork S4 - Critical Thinking and Problem Solving	3.2.9-12.G. – Using mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
COMPETENCIES	**LEARNING TARGETS**
I can use Stoichiometry to determine the limiting reactant, theoretical yield, and quantity of starting material.	● I can define stoichiometry. ● I can determine the limiting reactant and percent yield of a reaction. ● I can use stoichiometry to determine amount of starting material needed to produce a given amount of product. ● I can use stoichiometry with gases.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Gas Laws	2-3 weeks

UNIT OVERVIEW

This unit of study explores the relationship between the volume, temperature, and pressure of gases. Students will explore various gas laws such as Boyle's, Charles Gas Law, etc. Students will also be able to apply their skills with the Mole concept to solve gas law problems with unknown variables.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S1 - Collaboration and Teamwork S3 - Creativity and Innovation S4 - Critical Thinking and Problem Solving	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.
COMPETENCIES	**LEARNING TARGETS**
I can calculate pressure, volume, moles, and temperature of a gas using the gas law equations.	● I can solve for pressure or volume using Boyle's Law. ● I can solve for either volume or temperature using Charles' Law. ● I can solve for pressure or temperature using Gay-Lussac's Law. ● I can solve for either pressure, temperature, or volume using the Combined gas law. ● I can solve for either moles, pressure, temperature, or volume using the Ideal gas law.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Thermochemistry	2-3 weeks

UNIT OVERVIEW	
This unit will examine how temperature will affect particles at the atomic level and how this translates to the state of matter at the macroscopic level. Students will be able to describe what it means when a substance changes in kinetic energy or potential energy and locate these points on a heating curve graph.	
LRG SKILLS AND DISPOSITIONS	**PA STANDARDS**
S4 - Critical Thinking and Problem Solving	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.O. Create a computational model to calculate in a system when the change in energy other component(s) and energy flows in and out of the system are known. 3.2.9-12. R. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
COMPETENCIES	**LEARNING TARGETS**
I can describe the flow of energy in changes of matter, including Chemical Reactions, Dissolving Substances, and Heating/Cooling Curves.	● I can describe the difference between Heat and Temperature. ● I can calculate for specific heat and apply it calorimetry problems. ● When given a section of a Heating/Cooling Curve, I can describe what is happening to the particles at that point, as well as what state(s) those particles are in at that section. ● I can describe the direction of heat flow in both exothermic and endothermic chemical reactions. ● I understand activation energy and bond energy and can apply it to an exothermic and endothermic chemical reactions.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Solutions	2-3 weeks

UNIT OVERVIEW

The Solutions Unit will focus on the properties of solutions and calculations involving solution concentrations. Saturated, supersaturated, and unsaturated solutions will be covered, while Molarity calculations involving stoichiometry will be performed. Students will perform how to make a solution using a volumetric glassware. Basic kinetic theory will be introduced to describe collisions of reactions and reaction rate.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S3 - Creativity and Innovation S4 - Critical Thinking and Problem Solving	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.

COMPETENCIES	LEARNING TARGETS
I understand what a solution is and how to make a solution of a known concentration.	● I can calculate Molarity. ● I can determine if a substance is soluble in another substance based on the polarity of a substance. ● I can determine if a substance is soluble in water based off basic solubility rules. ● I can differentiate between a saturated, supersaturated, and unsaturated solution. ● I can describe how to make a supersaturated solution. ● I can calculate and experimentally make a solution of a specific concentration ● I can perform stoichiometry calculations using molarity. ● I can understand reaction rate. ● I can explain the effects of collision, temperature, and solubility on reaction rate.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Equilibrium	2-3 weeks

UNIT OVERVIEW
The Equilibrium unit will introduce the idea of reversible reactions. The concept of Le'Chatlier's principles as well as a basic understanding of the equilibrium constant will be introduced to determine the direction favored in a reversible reaction.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S4 - Critical Thinking and Problem Solving	3.2.9-12.F. – Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

COMPETENCIES	LEARNING TARGETS
I understand the how to manipulate a reversible reaction using the concepts of equilibrium.	● I can explain a reversible reaction. ● I can determine the favored direction of a reversible reaction based on the size of the equilibrium constant. ● I can determine which direction a reversible reaction will moved based off of change in concentrations of components of the reaction, temperature, volume, and pressure of the reaction.

SUBJECT: Principles of Chemistry	GRADE: 10-11
Unit Title: Nuclear Chemistry	2-3 weeks

UNIT OVERVIEW
The Nuclear Chemistry unit will cover the concept of nuclear chemistry and nuclear reactions. Fission and fusion reactions will be covered, as well as balancing nuclear equations to determine alpha, beta, and gamma radiation.

LRG SKILLS AND DISPOSITIONS	PA STANDARDS
S4 - Critical Thinking and Problem Solving	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.

COMPETENCIES	LEARNING TARGETS
I understand the what the difference in nuclear reactions are and how different types of radiation can be produced.	● I can determine if an isotope is stable based on the number of protons and neutrons in the atom. ● I can balance nuclear reactions so that the total number of neutrons and protons do not change in a nuclear process. ● I can differentiate between nuclear fission and fusion. ● I can identify the three different types of radiation – alpha, beta, gamma.