Content Area:
Grade: Chemistry

Unit	Enduring Understandings	Essential Questions	Objectives	Skills
Section 1- Atomic Structure and Nomenclature	**Students will understand that:** ● All matter is made up of atoms of known elements ● The patterns of the periodic table influence the number and types of bonds formed by an element and between elements. ● Determine how changes in the number of subatomic particles impact the atom. ● Categorize samples as either being a pure substance or a mixture. ● Develop a procedure to separate a	What are the Core Ideas for Structure and Properties of Matter? How are elements determined? What is a main unifying theme of structure and properties of matter? What subatomic particles are in the nucleus? What makes up most of the volume of the atom? Where are electrons found in the atom? Why is a system of nomenclature important to chemistry? What is the difference between a covalent and an ionic bond?	Develop a working understanding of subatomic particles and how changes to these particles alter the atom. Integrate and apply nomenclature to name and write formulas for a variety of compounds. Analyze a sample to determine if it is a pure substance or a mixture and develop and apply a procedure to separate mixtures while working safely in a lab setting.	● Express key elements of natural phenomena across multiple representations in the domain. ● Describe representations and models of natural or man-made phenomena and systems of domains. ● Use representations and models to analyze situations or solve problems qualitatively and quantitatively. ● Justify the selection of a mathematical routine to solve problems. ● Apply mathematical

	mixture into its components. ● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● Science assumes the universe is a vast single system in which basic laws are consistent. ● A system of naming compounds accurately is required due to the similar appearance of many compounds with very different chemical properties. ● The ability to translate names to formulas for compounds is fundamental to	How do ionic and molecular compounds differ in their system of naming and formula writing?		routines to quantities that describe natural phenomena. ● Estimate quantities that describe natural phenomena. ● Collect data to answer a particular scientific question. ● Analyze data to identify patterns or relationships. ● Make claims and predictions about natural phenomena based on scientific theories and models

	chemistry and its ability to communicate reactions and processes. ● Accurate ionic formula writing takes into consideration the charges on the atoms formed when atoms lose or gain electrons in order to become stable.			
Section 2 - Chemical Reactions and Stoichiometry	**Students will understand that:** ● Demonstrate the law of conservation of mass and matter through both balanced chemical equations. ● Develop an investigation to demonstrate the law of conservation of mass and matter through macroscopic measurements.	What products could be predicted from the reactants given? How can you use the patterns learned from the periodic table to do so? What is the balanced chemical equation for this given reaction? What type of reaction is a given chemical reaction? What mass of product will be produced from	Evaluate and depict chemical reactions based on observation or written description. Problem solve complex narrative descriptions to create mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Connect macroscopic observations to quantized values representing the atomic level interactions during a chemical reaction.	● Express key elements of natural phenomena across multiple representations in the domain. ● Describe representations and models of natural or man-made phenomena and systems of domains. ● Use representations and models to analyze

	● Write a balanced chemical equation that symbolically represents the description of a chemical reaction. ● Chemical reactions can be classified. Based on the classification system, their products can be more easily predicted ● Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. Determine the mass of reactants required to produce the desired mass of product for a given	the given mass of reactants? What is the mole? How would you convert grams to moles, moles to grams, grams to particles, etc. Based on a given amount of reactants, calculate the theoretical yield of the product. What volume of gas would be made based on the number of moles present at STP? What is dimensional analysis?	Conduct experiments and investigations to demonstrate the law of conservation of mass and matter	situations or solve problems qualitatively and quantitatively. ● Justify the selection of a mathematical routine to solve problems. ● Apply mathematical routines to quantities that describe natural phenomena. ● Estimate quantities that describe natural phenomena. ● Collect data to answer a particular scientific question. ● Analyze data to identify patterns or relationships. ● Make claims and predictions about natural phenomena based on scientific theories and models.

	reaction.Connect the number of particles, moles, mass, and volume of substances to one another, both qualitatively and quantitatively. ● The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. ● The total amount of energy and matter in closed systems is conserved.			
Section 3 - Atomic Theory, Nuclear Processes and the Periodic Table	**Students will understand that:** ● Patterns of valence electrons justify the organization	What types of bonds form between given elements in the periodic table?	We are learning to develop an understanding of the periodic table as a model to predict the relative properties of	● Express key elements of natural phenomena across multiple

	of the periodic table of the elements. ● Periodic table can be used to predict the relative properties of the elements based on the patterns of valence electrons ● Explain using evidence the very strong force holding the protons and neutrons of an atomic nucleus together. ● Compare and contrast chemical and nuclear reactions ● Construct representations, at the particle level and graphically, of the changes that occur in a given radioactive sample. ● Explain how light and electrons	Is it possible to determine the number of bonds formed from given elements on the periodic table? Which elements are larger or smaller? Which elements have higher/ lower ionization energies? How does a nuclear fission reactor produce electricity? How do electrons act like a particle and a wave? What experiments played a key role in the development of atomic structure? What is the difference between nuclear fission and nuclear fusion? How can we predict physical and chemical properties of an element based on its location on the periodic table?	elements based on the patterns of electrons in the outermost energy level of atoms. 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. 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. Evaluate and analyze the scientific advances that lead to the modern atomic model with detailed examination of key experiments and scientists. Develop a detailed relationship between light and electrons through quantum mechanics.	representations in the domain. ● Describe representations and models of natural or man-made phenomena and systems of domains. ● Use representations and models to analyze situations or solve problems qualitatively and quantitatively. ● Justify the selection of a mathematical routine to solve problems. ● Apply mathematical routines to quantities that describe natural phenomena. ● Estimate quantities that describe natural phenomena. ● Collect data to answer a particular

	both demonstrate a wave particle duality explained through quantum mechanics. ● The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. ● Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus	How is $E=mc^2$ related to nuclear reactions?		scientific question. ● Analyze data to identify patterns or relationships. ● Make claims and predictions about natural phenomena based on scientific theories and models

	protons does not change in any nuclear process. ● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. ● In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved			
Section 4 - Bonding, Phases and Phase Changes	**Students will understand that:** ● Properties of gases can best be understood by considering the Kinetic Molecular Theory of Gases ● Gas properties relate to each other and these	What types of bonds form between given elements in the periodic table? Is it possible to determine the number of bonds formed from given elements on the periodic table?	We are learning to 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.	● Express key elements of natural phenomena across multiple representations in the domain. ● Describe representations and models of natural or man-made

	relationships are demonstrated in gas laws. ● A gas system acting ideally can utilize standard gas constants to determine unknown variables. ● Forces of attraction/ repulsion help explain how bonds are formed and overcome. Changes occur in chemical potential energy of substances when bonds are formed/ broken. ● Relate physical properties of compounds to the types of intermolecular forces found between the molecules. ● Through evidence, demonstrate why a larger	Why are certain molecules more polar than others? What type of intermolecular forces occur in a given substance? Which elements will have greater melting/boiling points and why? Why do gases behave the way they do? Why is the behavior of gases so easily predictable regardless of what type of gas? What is the difference between an ideal gas and a real gas? What causes pressure in a gaseous system? How does a chemical bond form on the molecular level? What forces are involved in the formation/disruption of chemical bonds/	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. Further develop and refine knowledge of the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. Integrate valence shell electron pair repulsion theory into student created drawings of molecules.	phenomena and systems of domains. ● Use representations and models to analyze situations or solve problems qualitatively and quantitatively. ● Justify the selection of a mathematical routine to solve problems. ● Apply mathematical routines to quantities that describe natural phenomena. ● Estimate quantities that describe natural phenomena. ● Collect data to answer a particular scientific question. ● Analyze data to identify patterns or relationships. ● Make claims and predictions

	amount of energy is required to vaporize a sample versus melt it. ● Relate changes in temperature and pressure to phase changes of a sample. ● Quantize the amount of energy gained or lost during phase changes and heating of samples. ● A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. ● Attraction and repulsion between electric charges at the atomic scale explain the structure,	intermolecular forces? How does the potential energy of matter change when these forces undergo changes?		about natural phenomena based on scientific theories and models

	properties, and transformations of matter, as well as the contact forces between material objects. ● Phase changes can occur through changes in temperature or changes in pressure. ● During a phase change temperature is not changing while energy is being added to the system. This energy is being used to overcome the intermolecular forces attracting the molecules together.			
Section 5 - Solutions, Reaction Energy, and Equilibrium	**Students will understand that:** ● Aqueous solutions can most easily be understood if one considers bonding type, polarity, and	How does a substance dissolve? How does one predict if a dissolved substance will behave as an electrolyte?	We are learning to develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the	● Express key elements of natural phenomena across multiple representations in the domain. ● Describe representations

	molar relationships. ● As a chemical reaction proceeds, there are changes in energy from reactant to products. Energy is either absorbed or released when a chemical reaction takes place. ● Explain factors that affect the rate of a chemical reaction. ● Explain the concept of chemical equilibrium and predict how to disturb equilibrium and the corrective shifts that occur. ● Develop an investigation that can accurately determine the concentration of an unknown acidic or basic	What is the difference between concentrated solutions and dilute solutions? Is a given reaction either endothermic or exothermic? What basic chemical principles can explain chemical reactions, their energy changes and conservation? How is the rate of a chemical reaction altered? How can your understanding of equilibrium and kinetics be meaningful in our world today? How can an equilibrium be altered in order to produce more of one thing? How can a solution concentration be described qualitatively? How can a solution concentration be	changes in total bond energy. 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. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. Relate concentration to pH and pOH scales and develop an investigation that can accurately determine the concentration of an unknown acidic or basic solution through the use of titration	and models of natural or man-made phenomena and systems of domains. ● Use representations and models to analyze situations or solve problems qualitatively and quantitatively. ● Justify the selection of a mathematical routine to solve problems. ● Apply mathematical routines to quantities that describe natural phenomena. ● Estimate quantities that describe natural phenomena. ● Collect data to answer a particular scientific question.

	solution through the use of titration. ● Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. ● In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of	described quantitatively?		● Analyze data to identify patterns or relationships. ● Make claims and predictions about natural phenomena based on scientific theories and models

	molecules present. ● Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.			