High School Chemistry

Instructional Focus:

- Employ the Scientific Method in solving a problem or question of your own design.
- Read and analyze data to communicate conclusions.
- Write conclusions that are logical and supported by evidence.
- Given data, calculate the mean and formulate conclusions.

Properties of Matter and Intro to Chemistry

Standard	Objective	Examples
MSBSD-CH-1a. Identify and use appropriate units of measurement and the sources and implications of uncertainty in measurements. **MSBSD-CH-1b**. Ask questions, predict, observe, describe, measure, classify, make generalizations, analyze data, develop models, make inferences, and communicate **[11] MSBSD.SA.1.1** Asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating. **MSBSD.SA.1.2** Recognizing and analyzing multiple explanations and models, using this information to revise students own explanation or model if necessary. (L)	Students will: • List and describe the steps of the scientific process. • Measure quantities using appropriate SI units for measurement (i.e., grams, meters, liter, second, etc.) • Explain that all measurements have some amount of error or uncertainty and to compensate for this scientists use significant figures. • Identify the number of significant figures in a measurement and express the measurement properly in scientific notation. • Identify basic lab equipment (i.e., beaker, graduated cylinder, balance, Bunsen burner, and thermometer.) • Convert from one unit to another given a conversion factor using dimensional analysis or factor-label method. • Know when and how to create either a bar or line graph.	
MSBSD-CH-2a. Describe the nature of physical and chemical properties and changes of matter. **MSBSD-CH-2b.** Compare and contrast states of matter at the molecular level.	Students will: • Demonstrate the ability to classify the different kinds of matter. • Demonstrate the ability to explain how matter may be identified, classified, and changed. • Demonstrate the ability to summarize and apply the Law of Conservation of Matter and Energy.	Homogeneous vs Heterogeneous mixtures, Mixtures vs Substances, Physical vs Chemical changes, Physical vs Chemical properties Density

Atomic Structure

Standard	Objective	Examples
MSBSD-CH-3. Describe how the properties and arrangements of the subatomic particles contribute to the structures of atoms.	Students will: • Explain how science is a developing field where theories are constantly challenged. • Contrast the modern understanding of atomic structure with historic understandings.	Contrast the contributions of Dalton, Thomson, Rutherford, and Bohr in the development of the modern understanding of atomic structure.

MSBSD-CH-4. Describe how the structure of the periodic table reflects the numbers of electrons and protons and the configuration of electrons in an atom. **NGSS: HS-PS3-3.A.** At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.	Students will: • Use language appropriate to atomic structure including atom, ion, isotope, subatomic particle, atomic number, mass number, average atomic mass, and atomic mass unit. • Identify and calculate the number of protons, neutrons, and electrons in any atom, ion, or isotope given sufficient information. • Calculate average atomic mass from isotopic data. • Identify an element as belonging to the *s*-, *p*-, *d*-, and block in the Periodic Table. • Use the Aufbau principle to fill an energy level diagram. • Determine the orbital notation for the electron arrangement in an atom or ion using Hund's rule and Pauli's exclusion principle. • Demonstrate the ability to explain the source and common use of atomic spectra.	
Periodic Table		
Standard	**Objective**	**Examples**
MSBSD-CH-5. Describe how the structure of the periodic table reflects the numbers of electrons and protons and the configuration of electrons in an atom. **NGSS: HS-PS1-1.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 level of atoms. **MSBSD.SB1.1** Predicting the properties of an element (i.e., reactivity, metal, non-metal) using the periodic table and verifying the predictions through experimentation. (L)	Students will: • Describe how 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. • Collect and use information on the Periodic Table, including atomic number, atomic mass, family designation, period number, and classification of the element (metal, nonmetal, or metalloid). • Identify regions of the periodic table including alkali metals, alkaline earth metals, transition metals, halogens, and noble gases. • Relate the family or group of elements to their corresponding number of valence electrons. • Compare ionization energy, electronegativity, and atomic radius; contrast the trends in these properties as one proceeds across a period and down a family of elements on the Periodic Table.	
Intermolecular Bonds		
Standard	**Objective**	**Examples**
MSBSD-CH-6. Distinguish among ionic, polar, and Nonpolar covalent bonds. **NGSS: HS-PS 2-6**. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. **SB3.1 P**redicting how an atom can interact with other atoms based on its electron configuration and verifying the results. (L)	Students will: • Describe how atoms interact with one another by transferring and sharing valence electrons. • Use electronegativity values to determine whether a compound is ionic, polar or nonpolar covalent. • Illustrate ionic and covalent bonds utilizing electron dot notation. • The ability to recognize various shapes that molecules can exhibit.	Use appropriate materials to build adequate models of simple molecules and polyatomic ions representing the shapes of these species. Why electrically conductive materials are often made of metal.
Nomenclature		
Standard	**Objective**	**Examples**

MSBSD-CH-7. Compose a proper formula and name compounds.	Students will: • Name and write formulas for binary ionic compound and polyatomic ionic compounds using roman numerals, if needed. • Name and write formulas for binary covalent compounds.	
Chemical Reactions and Equations		
Standard	**Objective**	**Examples**
MSBSD-CH-7. Write and balance equations, classify chemical reactions and predict the products. **NGSS: PS-1-2.** 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. **NGSS: PS-1-7.** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	Students will: • Distinguish between reactants and products in a chemical reaction. • Write a word or symbolic equation to represent a chemical reaction. • Explain how a balanced chemical equation supports the Law of Conservation of Mass. • Categorize the types of chemical reactions based on the nature of observed changes. • Predict the products of reactions.	
Mole Calculations and Stoichiometry		
Standard	**Objective**	**Examples**
MSBSD-CH-9. Use balanced chemical equations and the mole concept to determine the quantities of reactants and products.	Students will: • Given mass of the sample, use the mole concept to determine the number of moles and number of atoms or molecules in samples of elements and compounds. • Using a balanced chemical equation, calculate the quantities of reactants needed and products made in a chemical reaction that goes to completion. • Perform calculations to determine the composition of a compound or mixture when given the formula.	% Composition, % Yield, Limiting Reactants, Empirical and Molecular Formulas, and Molar Volume
Gas Laws		
Standard	**Objective**	**Examples**
MSBSD-CH-10a. Using the kinetic molecular theory, describe and explain the behavior of ideal gases. **MSBSD-CH-10b.** Using the ideal gas equation of state $PV=nRT$, examine the relationship among the number of moles, volume, pressure and temperature for ideal gases.	Students will: • Use kinetic molecular theory to explain changes in gas volumes, pressure, moles and temperature. • Apply the gas laws to problems involving the temperature, volume, pressure, and amount of a gaseous substance. • Explain how the total pressure in a mixture of gases is equal to the sum of the partial pressures of each gas present.	Charles, Gay-Lussac, Boyle, Combined and Ideal, Dalton
MSBSD-CH-11. Describe the attractive forces between molecules and their effect on chemical and physical properties. **NGSS: HS-PS1-3.** 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.	Students will: • Describe van der Waals forces (London forces and dipole-dipole forces) and hydrogen bonds.	

Solutions		
Standard	**Objective**	**Examples**
MSBSD-CH-12. Describe the composition and characteristics of solutions.	Students will: • Describe the composition and properties of types of solutions (dilute, concentrated, unsaturated, saturated, and supersaturated.) • Explain how temperature, pressure and polarity of the solvent affect the solubility of a solute. • Describe the concentration of solutes in a solution in terms of molarity. Perform calculations using molarity, mass and volume. • Describe the concentration of solutes in a solution in terms of % by volume and mass. • Prepare a dilute solution using a given molarity.	$M_1V_1=M_2V_2$
Heat and Energy		
Standard	**Objective**	**Examples**
MSBSD-13. Recognize that chemical reactions result in either the release or absorption of energy and apply the law of conservation of energy. **NGSS: HS-PS3-1.** 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 flows in and out of the system are known. **NGSS: HS-PS3-4.** 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).	Students will: • Explain that atoms and molecules are in constant motion and that this motion increases as thermal energy increases. • Demonstrate how chemical reactions and phase changes are exothermic or endothermic. • Solve problems involving heat flow and temperature changes by using known values of specific heat, phase change constants (i.e., latent heat values) or both.	$q=mC\Delta T$
MSBSD-CH-14. Describe factors that affect the reaction rate. **NGSS: HS-PS1-4.** 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. **NGSS: HS-PS1-5.** 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.	Students will: • Predict the effects of adding a catalyst or changing the temperature, surface area, concentration, or pressure on the rate of a reaction. • Interpret a potential energy diagram including activation energy. • Explain the role of activation energy in chemical reactions and its change with the addition of a catalyst.	

Acids, Bases and Equilibrium		
Standard	**Objective**	**Examples**
MSBSD-CH-15. Demonstrate the ability to explain chemical equilibrium. **NGSS: HS-PS1-6.** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.	Students will: • Explain that some chemical reactions are reversible. • Discuss dynamic equilibrium. • Use Le Chatelier's Principle to explain how equilibrium systems adjust to stresses such as temperature and concentration changes.	
MSBSD-CH-14 Use acid-base definitions to identify acids and bases when given their formulas and reactions. For any aqueous solution, explain the meaning of the value indicated by the pH scale in terms of the hydrogen ion concentration.	Students will: • Use Arrhenius and Brønsted-Lowry definitions to classify substances as acids or bases. • Describe the characteristic properties of acids and bases. • Compare and contrast the dissociation and strength of acids and bases in solutions. • Given the hydronium (H_3O^+) ion concentration in a solution, calculate the pH and vice versa. Explain the meaning of these values. • From acid-base titration data, calculate the concentration of an unknown solution.	