COMPONENT	OBJECTIVES	COMPETENCY
I Science Skills and Attitudes, Applications, and Contexts of Chemistry	1. Use careful observations and exploratory activities to identify variables and to develop problem statements. **(SC.H.1.4.1)** 2. Distinguish among descriptive (laboratory and field observations), comparative (comparing two experiments with one common manipulated variable), and experimental (controlled experiment) investigation designs commonly used in chemistry. **(SC.H.1.4.1) (SC.H.3.4.1)** 3. Write hypotheses leading to different types of experimental designs for selected problem statements using variables identified as manipulated (independent) and responding (dependent). **(SC.H.1.4.1)** 4. Routinely analyze experiments in terms of: problem statement, hypothesis, manipulated and responding variables, quantification of variables, identification of variables held constant, the number of tests and trials, and the use of an experimental control. **(SC.H.2.4.2)** 5. Based upon an appropriate number of experimental trials and samples, systematically collect and organize data into tables or charts and properly distinguish among the types of qualitative (nominal and ordinal) and quantitative (interval and ratio) data analyzed. **(SC.H.1.4.0)** 6. Interpret experimental data by reordering and/or plotting graphs and then describing the central tendency of the data by the appropriate use of the mean, median, and/or mode and the variation of the data by the appropriate use of the range and/or the frequency distribution. **(SC.H.1.4.0)** 7. Write conclusions that briefly state what was investigated, describe whether or not the hypothesis was supported by the results, include sample results, compare the results with other investigations, provide possible explanations about the results, recommend additional studies, and discuss possible applications. **(SC.H.1.4.3)**	A. Apply science investigation skills to design and carry out appropriate types of experiments and to analyze the data collected to form conclusions on chemistry topics using established laboratory and safety procedures.

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	8. Analyze conclusions by classifying each sentence as a statement based upon either: an observation, the result of information gathered thorough the senses; an inference, the explanation or interpretation of observations; a fact, the activities performed during the investigation; or an opinion, inferences not directly supported by observations. **(SC.H.1.4.7)** 9. Identify the parts, functions, proper care, and use of appropriate scientific equipment, e.g., balances, and demonstrate accurate metric measurement by reading common laboratory apparatus to the nearest tenth of a unit of measure and describing the uncertainty of these measures. **(SC.H.1.4.0)** 10. Select attire (aprons, eye protection, containment of hair, clothes) to ensure personal protection and practice accepted safety procedures using appropriate science equipment for all science activities. **(SC.H.1.4.0)** 11. Identify appropriate safety procedures for typical laboratory emergencies such as, broken glass, chemical spills, chemical splashes on the skin or in the eye, and the prevention of fires. **(SC.H.1.4.0)** 12. Research, design, complete, and make an appropriate scientific report on the results of a long range experimental investigation on a suitable science topic.	
	1. Describe how discoveries made by chemists can have both beneficial and detrimental affects on the quality of human life. **(SC.G.2.4.6)** 2. Investigate the advantages and disadvantages of traditional and alternate energy resources such as, fossil fuels, nuclear energy, solar energy and energy efficiency/conservation projects. **(SC.G.2.4.1) (SC.G.2.4.5) (SC.G.2.4.6)**	B. Apply chemistry knowledge, principles and skills to clarify and make decisions involving critical social issues, such as environmental pollution, nuclear medicine, and pharmaceuticals, using fundamental chemical principles as a common thread.

COMPONENT	OBJECTIVES	COMPETENCY
	3. Investigate the chemistry of air pollution for phenomena such as acid rain, ozone depletion, and global warming. **(SC.G.2.4.6)** 4. Determine that results are tentative, are subject to different interpretations, and should be replicable by other scientists. **(SC.H.1.4.4) (SC.H.1.4.5) (SC.H.1.4.6) (SC.H.1.4.7)** 5. Explore research and career opportunities in chemistry. **(SC.H.3.4.6)** 6. Identify and describe the scientific contributions of chemical researchers from various ethnic and cultural backgrounds and recognize the importance of the continuous development and sharing of scientific information. **(SC.H.1.4.5)** 7. Identify examples illustrating that the continuous development of the scientific enterprise requires the sharing of information generated by scientists (science is a public process). 8. Establish a relationship between the Laws of Thermodynamics and pollution, such as, thermal pollution and energy efficiency.	
	1. Research the development of the Atomic Theory and its impact on modern science. 2. Research the development of the Kinetic Molecular Theory and its impact on modern science. 3. Research the development of the concept of heat energy and its impact on modern science.	C. Demonstrate the historical and social contexts of chemistry and its relationships with other disciplines by describing an example for one the following: how a technological device has allowed scientists to further understanding of the natural world; how a chemical science activity has influenced a political, economic, or cultural event or the reverse situation; or how chemistry is involved in the emergence of new fields of endeavor in the sciences.

COMPONENT	OBJECTIVES	COMPETENCY
II Atomic Theory and the Periodic Table	1. Write electron configurations/orbital diagrams for elements or monatomic ions **(SC.A.1.4.1) (SC.A.2.4.1) (SC.A.2.4.2)** 2. Explain Rutherford's, J.J. Thomson's, Bohr's and Planck's experiments and their implications for the structure of the atom. **(SC.A.2.4.1)** 3. Use the periodic table to describe trends in atomic and ionic size, in groups or periods, in ionization energy, in electron affinity, in metallic character, and in electronegativity. **(SC.A.2.4.5)** 4. Predict the type of bonding between two elements based on the location of those two elements on the periodic chart. **(SC.A.1.4.5) (SC.A.2.4.5)** 5. Identify the principal types of chemical bonds (ionic, covalent, metallic) and intermolecular forces (Van der Waal and hydrogen), how they are formed and examples of substances that contain these bonds. **(SC.A.1.4.5)** 6. Determine the properties of a substance based on its bond type. **(SC.A.1.4.1) (SC.A.1.4.2) (SC.A.1.4.5)** 7. Construct electron dot (Lewis) diagrams for ions or molecules. **(SC.A.1.4.5) (SC.A.2.4.1)** 8. Assign a set of quantum numbers to an individual electron. 9. Explain why each atom has characteristic spectral lines.	A. Using quantum mechanics, write the electron configurations and orbital diagrams and use this information to explain how these dictate the type of bond that could be formed.

COMPONENT	OBJECTIVES	COMPETENCY
III Chemical Reactions and Calculations	1. Write the name or formula for an inorganic or organic compound using accepted systems of nomenclature. **(SC.A.2.4.2) (SC.A.2.4.5)** 2. Identify and balance specific reactions such as composition, decomposition, replacement, ionic, or acid/base. **(SC.A.1.4.5) (SC.A.2.4.5) (SC.B.1.4.2)** 3. Using a balanced chemical equation, explain the law of conservation of matter. **(SC.B.1.4.2)** 4. Define the mole in terms of volume, mass, or number of particles. **(SC.B.1.4.2)** 5. Solve stoichiometric problems using mass/mass and volume/volume relationships. **(SC.B.1.4.2)** 6. Calculate empirical and molecular formulas based on percent composition and calculate percent composition based on empirical and molecular formulas. **(SC.A.2.4.5) (SC.B.1.4.2)** 7. Distinguish between strength and concentration of acids and bases based on laboratory experiences such as pH or conductivity. **(SC.A.1.4.4)** 8. Use the Arrhenius and Bronsted/Lowery definitions of acids and bases to classify compounds in appropriate chemical reactions. **(SC.A.2.4.5)** 9. Calculate pH from concentration data using a scientific calculator. **(SC.A.1.4.4)** 10. Calculate the concentration of an acid or base from titration data. **(SC.A.1.4.4)**	A. Quantitatively predict products based on the nature of the reactants and the possible reaction type.

COMPONENT	OBJECTIVES	COMPETENCY
	11. Define oxidation, reduction, oxidizing agent, reducing agent, oxidation number, and half reaction and apply these definitions to selected reactions. **(SC.A.1.4.5)** 12. Select the appropriate indicator and calculate the concentration of an acid or base from titration data. 13. Determine the oxidation number for all the elements in the reactants and products of a redox reaction. 14. Predict and balance chemical equations for specified composition, decomposition, replacement, ionic, acid/base, or redox reactions. 15. Solve stoichiometric problems using mass/mass, mass/volume, volume/volume, and limiting reagent relationships. 16. Define conjugate acid and conjugate base and be able to identify them in an equation.	
IV Factors Affecting Chemical Reactions	1. Describe the effects of temperature, concentration and surface area on the rate of reaction. **(SC.A.1.4.4)** 2. Draw potential energy diagrams of specific chemical reactions, both catalyzed and uncatalyzed and calculate such quantities as activation energy and heat of reaction. **(SC.A.1.4.4)** 3. Classify reactions as exothermic or endothermic based upon enthalpies of formation. **(SC.A.1.4.4)** 4. Describe the conditions in a chemical reaction that lead to increased or decreased entropy. **(SC.A.1.4.4)**	A. Use the kinetic molecular theory and LeChatelier's Principle to analyze and explain how factors, such as temperature, pressure, and concentration, can effect the rate of a reaction, the direction of equilibrium, and the quantity of product produced.

COMPONENT	OBJECTIVES	COMPETENCY
	5. Apply Gibb's free energy to chemical equations and predict the following: spontaneity, enthalpy, and entropy. 6. Compare the enthalpies of a series or reactions to the enthalpy of the overall reaction using Hess' Law. 7. Calculate the relative rates of diffusion of gases using Graham's Law. 8. Apply LeChatelier's Principle to determine the direction of the equilibrium shift for chemical systems in equilibrium.	
V Physical Changes	1. Apply the primary assumptions of the kinetic molecular theory to the behavior and properties of gases, liquids, and solids. **(SC.A.1.4.3) (SC.B.1.4.2) (SC.B.1.4.3)** 2. Qualitatively describe and quantitatively apply the relationships among pressure, temperature, volume, and the number of moles of gases. (Boyle's Law, Charles' Law, Dalton's Law, Avogadro's Law, and Ideal Gas Law). **(SC.B.1.4.2) (SC.B.1.4.3)** 3. Relate entropy to changes in the states of matter. **(SC.A.1.4.3), (SC.B.1.4.2)** 4. Analyze the solution process in terms of intermolecular forces and entropy. **(SC.A.1.4.1) (SC.A.1.4.2)**	A. Use the kinetic molecular theory to describe the phases of matter and relate the concept of entropy to each phase change.

COMPONENT	OBJECTIVES	COMPETENCY
	1. Solve specific heat problems. **(SC.A.1.4.1) (SC.A1.4.3)** 2. Based on laboratory investigations, plot temperature versus time graphs for phase changes. **(SC.A.1.4.3)** 3. Solve enthalpy problems based upon laboratory investigations (heat of combustion, heat of formation, heat of solution, heat of vaporization, heat of fusion). **(SC.A.1.4.3)** 4. Based upon laboratory investigations, describe solubility in terms of the effect of temperature, pressure, and solvent selection. **(SC.A.1.4.4)** 5. Calculate the concentration of solutions as expressed in molarity and molality. **(SC.A.1.4.4)** 6. Based on laboratory investigations, solve colligative property problems such as freezing point depression and boiling point elevation. 7. Use the theory of ionization to describe the role of water in the processes of dissociation and ionization.	B. Describe and calculate energy changes associated with physical changes by plotting and describing cooling/warming curves, and calculating the heats of combustion, formation, vaporization, and fusion for a given species.
VI Nuclear Reactions	1. Balance nuclear transmutation equations. **(SC.A.2.4.3)** 2. Based on half-life of various nuclear wastes, propose and analyze solutions for their storage. **(SC.A.2.4.3.) (SC.G.2.4.6)** 3. Compare and contrast the energetics of fission reactions to fusion reactions.	A. Write and balance nuclear transmutation equations and compare the energetics and waste products of a fission reaction to a fusion reaction.