Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
	Introduction to Chemistry						
		Chemistry	Intro to Plasma	Identify five traditional areas of study in chemistry.	Relate pure chemistry to applied chemistry.	Identify reasons to study chemistry.	
		Chemistry Far and Wide		Identify some areas affected by chemistry research.	Describe some examples of research in chemistry.	Distinguish between macroscopic and microscopic views.	
		Thinking Like a Scientist	Mystery Powder Analysis	Describe how Lavoisier transformed chemistry.	Identify three steps in the scientific method.	Explain why collaboration and communication are important in science.	
		Problem Solving in Chemistry	Determining Density via Water Displacement	Identify two general steps in problem solving.	Describe three steps for solving numeric problems.	Describe two steps for solving conceptual problems.	
	Measurement in Chemistry						
		Units of Measurement	Density Laboratory	Define SI base units for time, length, mass, and temperature.	Explain how adding a prefix changes a unit.	Compare the derived units for volume and density.	
		Scientific Notation and Dimensional Analysis		Express numbers in scientific notation.	Use dimensional analysis to convert between units.		
		How reliable are measurements?	Triple Beam Balance	Define and compare accuracy and precision.	Use significant figures and rounding to reflect the certainty of data.	Use percent error to describe the accuracy of experimental data.	
		Representing Data		Create graphs to reveal patterns in data.	Interpret graphs.		
		Density	Density via Comparison	Calculate the density of a material from experimental data.	Describe how density varies with temperature.		
	Matter						
		Properties of Matter	Density Experiment: Slice and Dice	Identify the characteristics of a substance.	Distinguish between physical and chemical properties.	Differentiate among the physical states of matter.	
		Changes in Matter		Describe what happens during a chemical change.	Identify four possible clues that a chemical change has taken place.	Apply the law of conservation of mass to chemical reactions.	

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Mixtures in Matter		Contrast mixtures and substances.	Classify mixtures as homogeneous or heterogeneous.	List and describe several techniques used to separate mixtures.	
		Elements and Compounds		Explain the difference between an element and a compound.	Distinguish between a substance and a mixture.	Identify the chemical symbols of elements, and name elements, given their symbols.	
	Atomic Structure						
		Defining the Atom	Intro to Plasma	Describe Democritus's ideas about atoms.	Explain Dalton's atomic theory.	Identify the special instruments necessary to observe individual atoms.	
		Subatomic Particles and the Nuclear Atom		Distinguish between the subatomic particles in terms of relative charge and mass.	Describe the structure of the nuclear atom, including the locations of the subatomic particles.		
		Distinguishing Among Atoms	Element Builder	Explain what makes elements and isotopes different from each other.	Calculate the number of neutrons in an atom.	Calculate the atomic mass of an element.	
		Unstable Nuclei and Radioactive Decay		Explain the relationship between unstable nuclei and radioactive decay.	Characterize alpha, beta, and gamma radiation in terms of mass and charge.		
	Electrons in Atoms						
		Models of the Atoms	Bohr Model: Introduction	Identify the inadequacies in the Rutherford atomic model.	Identify the new proposal in the Bohr model of the atom.	Describe the energies and positions of electrons according to the quantum mechanical model.	Describe how the shapes of orbitals related to different sub-levels differ.
		Electron Arrangement in Atoms	Electron Configuration	Describe how to write the electron configuration for an atom.	Explain why the actual electron configurations for some elements differ from those predicted by the aufbau principle.		
		Physics and the Quantum Mechanical Model	Herschel Experiment	Describe the relationship between the wavelength and frequency of light.	Identify the source of atomic emissions spectra.	Explain how the frequencies of emitted light are related to changes in electron energies.	Distinguish between quantum mechanics and classical mechanics.
	Periodic Table						

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Development of the Modern Periodic Table	Intro to Plasma	Trace the development and identify key features of the periodic table.			
		Classification of the Elements		Explain why elements in the same group have similar properties.	Identify the four blocks of the periodic table based on electron configuration.		
		Periodic Trends	Element Builder	Describe trends among the elements for atomic size.	Explain how ions form.	Describe periodic trends for first ionization energy, ionic size, and electronegativity.	
		Where did the elements come from?		Describe how the naturally occurring elements form.	Explain how a transmutation changes one element into another.	Describe how particle accelerators are used to create synthetic elements.	
	The Elements						
		Properties of s-Block Elements	Bohr Model of Hydrogen	Explain how elements in a given group are both similar and different.	Discuss the properties of hydrogen.	Describe and compare the properties of alkali metals and alkaline earth metals.	
		Properties of p-Block Elements		Describe and compare properties of p-block elements.	Define allotropes and provide examples.	Explain the importance to organisms of selected p-block elements.	
		Properties of d-Block and f-Block Elements	Element Builder	Compare the electron configurations of transition and inner transition metals.	Describe the properties of transition elements.	Explain why some transition metals form compounds with color and some have magnetic properties.	
	Ions and Ionic Compounds						
		Forming Chemical Bonds		Define chemical bond.	Relate chemical bond formation to electron configuration.	Describe the formation of positive and negative ions.	
		The Formation and Nature of Ionic Bonds	Ionic Bonds	Describe the formation of ionic bonds.	Account for many of the physical properties of an ionic compound.	Discuss the energy involved in the formation of an ionic bond.	
		Names and Formulas for Ionic Compounds		Write formulas for ionic compounds and oxyanions.	Name ionic compounds and oxyanions.		
		Metallic Bonds and Properties of Metals		Describe a metallic bond.	Explain the physical properties of metals in terms of metallic bonds.	Define and describe alloys.	

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
	Covalent Bonding						
		Molecular Compounds		Distinguish between the melting points and boiling points of molecular compounds and ionic compounds.	Describe the information a molecular formula provides.		
		The Nature of Covalent Bonding	Covalent Bonds	Describe how electrons are shared to from covalent bonds and identify exceptions to the octet rule.	Demonstrate how electron dot structures represent shared electrons.	Describe how atoms form double or triple covalent bonds.	Distinguish between a covalent bond and a coordinate covalent bond and describe how the strength of a covalent bond is related to its bond dissociation energy.
		Bonding Theories		Describe the relationship between atomic and molecular orbitals.	Describe how VSEPR theory helps predict the shapes of molecules.	Identify ways in which orbital hybridization is useful in describing molecules.	
		Polar Bonds and Molecules		Evaluate the strength of intermolecular attractions compared with the strength of ionic and covalent bonds.	Identify the reason why network solids have melting points.	Describe how electronegativity values determine the distribution of charge in a polar molecule.	Describe what happens to polar molecules when they are placed between oppositely charged metal plated.
	The Mole						
		Measuring Matter		Describe how a mole is used in chemistry.	Relate a mole to common counting units.	Convert moles to number of representative particles and number of representative particles to moles.	
		Mass and the Mole		Relate the mass of an atom to the mass of a mole of atoms.	Calculate the number of moles in a given mass of an element and the mass of a given number of moles of an element.	Calculate the number of moles of an element when given the number of atoms of the element.	Calculate the number of atoms of an element when given the number of moles of the element.

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Moles of Compounds		Recognize the mole relationships shown by a chemical formula.	Calculate the molar mass of a compound.	Calculate the number of moles of a compound from a given mass of the compound, and the mass of a compound from a given number of moles of the compound.	Determine the number of atoms or ions in a mass of a compound.
		Empirical and Molecular Formulas		Explain what is meant by the percent composition of a compound.	Determine the empirical and molecular formulas for a compound from mass percent and actual mass data.		
		The Formula for a Hydrate		Explain what a hydrate is and how its name reflects its composition.	Determine the formula for a hydrate from laboratory data.		
	Stoichiometry						
		The Arithmetic of Equations	Stoichiometry	Explain how balanced equations apply to both chemistry and everyday life.	Interpret balanced chemical equations in terms of moles, representative particles, mass, and gas volume at STP.	Identify the quantities that are always conserved in chemical reactions.	
		Chemical Calculations		Construct mole ratios from balance chemical equations and apply these ratios in stoichiometric calculations.	Calculate stoichiometric quantities from balanced chemical equations using units of mole, mass, representative particles, and volumes of gases at STP.		
		Limiting Reagent and Percent Yield	Limiting Reactants	Identify and use the limiting reagent in a reaction to calculate the maximum amount of product(s) produced and the amount of excess reagent that remains unreacted.	Calculate theoretical yield, actual yield, or percent yield given appropriate information.		

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Stoichiometry and Cars		Relate volume calculations in stoichiometry to the inflation of automobile safety air bags.	Use the concept of limiting reactants to explain why fuel-air ratios affect engine performance.	Compare the efficiency of pollution-control mechanisms in cars using percentage yield.	
	States of Matter and Intermolecular Forces						
		States and State Changes	Phase Changes	Relate the properties of a state to the energy content and particle arrangement of that state of matter.	Explain forces and energy changes involved in changes of state.		
		Intermolecular Forces	Intro to Plasma	Contrast ionic and molecular substances in terms of their physical characteristics and the types of forces that govern their behavior.	Describe dipole-dipole forces.	Explain how a hydrogen bond is different from other dipole-dipole forces and how it is responsible for many of water's properties.	Describe London dispersion forces, and relate their strength to other types of attractions.
		Energy of State Changes		Define the molar enthalpy of fusion and the molar enthalpy of vaporization, and identify them for a substance by using a heating curve.	Describe how enthalpy and entropy of a substance relate to state.	Predict whether a state change will take place by using Gibbs energy.	Calculate melting and boiling points by using enthalpy and entropy.
		Phase Equilibrium	Freezing Point of Salt Water	Identify systems that have multiple phases, and determine whether they are at equilibrium.	Understand the role of vapor pressure in changes of state between a liquid and a gas.	Interpret a phase diagram to identify melting points and boiling points.	
	Gases						
		Properties of Gases		Explain why gases are easier to compress than solids or liquids are.	Describe the three factors that affect gas pressure.		
		The Gas Laws	Boyle's Law and Charles' Law	State Boyle's law, and use it to solve problems involving pressure and volume.	State Charles's law, and use it to solve problems involving volume and temperature.	State Gay-Lussac's law, and use it to solve problems involving pressure and temperature.	State Avogadro's law, and explain its importance in determining the formulas of chemical compounds.
		The Ideal Gas Law	Temperature and Particle Motion	Relate the amount of gas present to its pressure, temperature, and volume by using the ideal gas law.	Compare the properties of real and ideal gases.		

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Gas Stoichiometry		Determine volume ratios for gaseous reactants and products by using coefficients from a chemical equation.	Calculate amounts of gaseous reactants and products in a chemical reaction using the gas laws.		
	Solutions						
		What Are solutions?	Solubility and Temperature	Describe the characteristics of solutions and identify the various types.	Relate the intermolecular forces and the process of solvation.	Define solubility and identify factors affecting it.	
		Solution Concentration		State the concentrations of solutions in different ways.	Calculate the concentrations of solutions.		
		Colligative Properties of Solutions	Colligative Properties	Explain the nature of colligative properties.	Describe four colligative properties of solutions.	Calculate the boiling point elevation and the freezing point depression of a solution.	
		Heterogeneous Mixtures		Identify the properties of suspensions and colloids.	Describe different types of colloids.	Explain the electrostatic forces in colloids.	
		Physical Properties of Solutions		Distinguish between nonelectrolytes, weak electrolytes, and strong electrolytes.	Describe how a solute affects the freezing point and boiling point of a solution.	Explain how a surfactant stabilizes oil-in-water emulsions.	
	Chemical Equilibrium						
		Equilibrium: A State of Dynamic Balance		Recognize the characteristics of chemical equilibrium.	Write equilibrium expressions for systems that are at equilibrium.	Calculate equilibrium constants from concentration data.	
		Factors Affecting Chemical Equilibrium		Describe how various factors affect chemical equilibrium.	Explain how Le Châtelier's principal applies to equilibrium system.		
		Using Equilibrium Constants		Determine equilibrium concentrations of reactants and products.	Calculate the solubility of a compound from its solubility product constant.	Explain the common ion effect.	
	Acids and Bases						

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		What are Acids and Bases?	pH Analysis	Describe the distinctive properties of strong and weak acids, and relate their properties to the Arrhenius definition of an acid..	Describe the distinctive properties of strong and weak bases, and relate their properties to the Arrhenius definition of a base.	Compare the Bronsted-Lowry definitions of acids and bases with the Arrhenius definitions of acids and bases.	Identify conjugate acid-base pairs.
		Acidity, Basicity, and pH	pH Analysis: Quad Color Indicator	Use K_w in calculations.	Explain the relationship between pH and H_3O^+ concentration.	Perform calculations using pH, $[H_3O^+]$, $[OH^-]$, and K_w.	Describe two methods of measuring pH.
		Neutralization and Titrations		Predict the product of an acid-base reaction.	Describe the conditions at the equivalence point in a titration.	Explain how you would select an indicator for an acid-based titration.	Describe the procedure for carrying out a titration to determine the concentration of an acid or base solution.
		Equilibria of Weak Acids and Bases		Write an equilibrium equation that shows how a weak acid is in equilibrium with its conjugate base.	Calculate Ka from the hydronium ion concentration of a weak acid solution.	Describe the components of a buffer solution, and explain how a buffer solution resists changes in pH.	
	The Nuclear Chemistry						
		Nuclear Radiation	X-ray Imaging	List the founding scientists in the study of radioactivity and state their discoveries.	Identify alpha, beta, and gamma radiation in terms of composition and key properties.		
		Radioactive Decay	Nuclear Decay	Explain why certain nuclei are radioactive.	Apply your knowledge of radioactive decay to write balanced nuclear equations.		
		Transmutation	Half-life	Describe how induced transmutation is used to produce a transuranium element.	Solve problems involving radioactive decay rates.		
		Fission and Fusion of Atomic Nuclei	Half-life	Compare and contrast nuclear fission and nuclear fusion.	Explain the process by which nuclear reactors generate electricity.		

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Applications and Effects of Nuclear Reactions		Describe several methods used to detect and measure radiation.	Explain an application of radiation used in the treatment of disease.	Describe some of the damaging effects of radiation of biological systems.	
	The Chemistry of Life						
		A Strategy for Life	Cell Energy Cycle	Identify the two major cell types that occur in nature.	Describe the chemical changes that occur during photosynthesis.		
		Carbohydrates	Dehydration Synthesis	Describe how two simple sugars can be linked.	Identify where glucose is found in nature.		
		Amino Acids and Their Polymers		Diagram the structure of an amino acid.	Describe how peptide bonds from and identify what determines the properties of peptides and proteins.	Describe how enzymes affect biochemical reactions.	
		Lipids	Identifying Nutrients	Identify the physical property that distinguishes lipids from other biological molecules.	Describe the structure of a lipid bilayer.		
		Nucleic Acids	DNA Fingerprint Analysis	Identify the functions of DNA and RNA.	Describe how information is sorted in genetic material and how it can mutate.	Describe how DNA fingerprinting and recombinant DNA technology are used.	
		Metabolism		Describe the function of ATP in cells.	Distinguish between catabolism and anabolism.	Describe how nitrogen becomes available for organism to use in synthesis.	
	Chemical Equations and Reactions						
		Balancing Chemical Equations	Balancing Chemical Equations	Identify combustion reactions, and write chemical equations that predict the products.	Identify synthesis reactions, and write chemical equations that predict the products.	Identify decomposition reactions, and write chemical equations that predict the products.	Identify displacement reactions, and use the activity series to write chemical equations that predict the products.
		Classifying Chemical Reactions		Write total ionic equations for reactions in aqueous solutions.	Identify spectator ions and write net ionic equations for reactions in aqueous solutions.		

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Write Net Ionic Equations		Write total ionic equations for reactions in aqueous solutions.	Identify spectator ions and write net ionic equations for reactions in aqueous solutions.		
	Energy and Chemical Change						
		Energy	Calorimetry Lab	Explain what energy is and distinguish between potential and kinetic energy.	Relate chemical potential energy to the heat lost or gained in chemical reactions.	Calculate the amount of heat absorbed or released by a substance as its temperature changes.	
		Heat in Chemical Reactions and Processes	Heat Transfer by Conduction	Describe how a calorimeter is used to measure energy absorbed or released.	Explain the meaning of enthalpy and enthalpy change in chemical reactions and processes.		
		Thermochemical Equations		Write thermochemical equations for chemical reactions and other processes.	Describe how energy is lost or gained during changes of state.	Calculate the heat absorbed or released in a chemical reaction.	
		Calculating Enthalpy Change		Use Hess's law of summation of enthalpies of reaction to calculate the enthalpy change for a reaction.	Explain the basis for the table of standard enthalpies of formation.	Calculate ΔH_{rxn} using thermochemical equations.	Determine the enthalpy change for a reaction using standard enthalpies of formation data.
		Reaction Spontaneity		Differentiate between spontaneous and nonspontaneous processes.	Explain how changes in entropy and free energy determine the spontaneity of chemical reactions and other processes.		
	Reaction Rates and Equilibrium						
		Rates of Reaction	Collision Theory	Describe how to express the rate of a chemical reaction.	Identify four factors that influence the rate of a chemical reaction.		
		Reversible Reactions and Equilibrium		Describe how the amounts of reactants and products change in a chemical system at equilibrium.	Identify three stresses that can change the equilibrium position of a chemical system.	Explain what the value of Keq indicates about the position of equilibrium.	

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Solubility Equilibrium		Describe the relationship between the solubility product constant and the solubility of a compound.	Predict whether precipitation will occur when two salt solutions are mixed.		
	Oxidation, Reduction and Electrochemistry						
		Oxidation-Reduction Reactions		Identify atoms that are oxidized or reduced through electron transfer.	Assign oxidation numbers to atoms in compounds and ions.	Identify redox reactions by analyzing changes in oxidation numbers for different atoms in the reaction.	Balance equations for oxidation-reduction reactions through the half-reaction method.
		Introduction to Electrochemistry		Describe the relationship between voltage and the movement of electrons.	Identify the parts of an electrochemical cell and their functions.	Write electrode reactions for cathodes and anodes.	
		Galvanic Cells		Describe the operation of galvanic cells, including dry cells, lead-acid batteries, and fuel cells.	Identify conditions that lead to corrosion and ways to prevent it.	Calculate cell voltage from a table of standard electrode potentials.	
		Electrolytic Cells		Describe how electrolytic cells work.	Describe the process of electrolysis in the decomposition of water and in the production of metals.	Describe the process of electroplating.	
	Hydrocarbons						
		Alkanes		Describe the structures of alkanes.	Name an alkane by examining its structure.	Draw the structure of an alkane given its name.	
		Cyclic Alkanes and Alkane Properties		Describe the properties of alkanes.	Distinguish between saturated and unsaturated hydrocarbons.	Name a cyclic alkane by examining its structure.	Draw the structure of a cyclic alkane given its name.
		Alkenes and Alkynes		Compare the properties of alkenes and alkynes with those of alkanes.	Describe the molecular structures of alkenes and alkynes.	Name an alkene or alkyne by examining its structure.	Draw the structure of an alkene or alkyne by analyzing its name.
		Isomers		Distinguish between the two main categories of isomers, structural isomers and stereoisomers.	Differentiate between cis- and trans- geometric isomers.	Recognize different structural isomers given a structural formula.	Describe the structural variation in molecules that results in optical isomers.

Chemistry - SC758

Unit	Topic	Lesson	Lab	Objective	Objective	Objective	Objective
		Aromatic Hydrocarbons and Petroleum		Compare and contrast the properties of aromatic and aliphatic hydrocarbons.	Explain what a carcinogen is and list some examples.	Describe the process used to separate petroleum into fractions and to balance each fraction's output with market demands.	Identify the fractions into which petroleum can be separated.
	Substituted Hydrocarbons and Their Reaction						
		Functional Groups		Describe a functional group and give examples.	Name and draw alkyl and aryl halide structures.	Discuss the chemical and physical properties of organic halides.	Describe how substitution reactions form alkyl and aryl halides.
		Alcohols, Ethers, and Amines		Identify the functional groups that characterize alcohols, ethers, and amines.	Draw the structures of alcohols, ethers, and amines.	Discuss the properties and uses of alcohols, ethers, and amines.	
		Carbonyl Compounds		Draw and identify the structures of carbonyl compounds including aldehydes, ketones, carboxylic acids, esters, and amides.	Discuss the properties and uses of compounds containing the carbonyl group.		
		Other Reactions of Organic Compounds		Classify an organic reaction into one of five categories: substitution, addition, elimination, oxidation-reduction, or condensation.	Use structural formulas to write equations for reactions of organic compounds.	Predict the products of common types of organic reactions.	
		Polymers		Describe the relationship between a polymer and the monomers from which it forms.	Classify polymerization reactions as addition or condensation.	Predict polymer properties based on their molecular structures and the presence of functional groups.	