Wyoming Department of Education Required Virtual Education Course Syllabus

Niobrara County School District # 1

Program Name	Wyoming Virtual Academy	Content Area	SC
Course ID	D-SCI-306BVSG1-K	Grade Level	9-12
Course Name	Chemistry CR - Semester 2	# of Credits	0.5
SCED Code	03101B0.5022	Curriculum Type	K12 Inc

COURSE DESCRIPTION

Generally offered first semester. This course surveys all key areas of chemistry, including atomic structure, chemical bonding and reactions, solutions, stoichiometry, thermochemistry, organic chemistry, and nuclear chemistry. The course includes direct online instruction and related assessments, used with a problem-solving book. Instructions for hands-on labs are included. K12 lab kits contain all lab materials that cannot easily be found in the home.

WYOMING CONTENT AND PERFORMANCE STANDARDS

STANDARD#	BENCHMARK (Standard/Indicator) Use the Standards and Benchmarks as Spreadsheets
HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the macroscopic scale to infer the strength of electrical forces between particles.
HS-PS1-5	Apply scientific principles and use 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.
HS-PS1-6	Evaluate the design of a chemical system by changing conditions to produce increased amounts of products at equilibrium, and refine the design, as needed.
HS-PS1-8	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.
HS-PS2-4	Use mathematical representations to predict the gravitational and/or electrostatic forces between objects using Newton's Law of Gravitation and/or Coulomb's Law, respectively.
HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of materials.
HS-PS3-1	Create or apply 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.
HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
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.
HS-LS1-6	Construct explanations and revise, as needed, based on evidence for: 1) how carbon, hydrogen, and oxygen may combine with other elements to form amino acids and/or other large carbon-

	based molecules, and 2) how other hydrocarbons may also combine to form large carbon-based molecules.

UNIT OUTLINE	STANDARD#	OUTCOMES OBJECTIVES/STUDENT CENTERED GOALS
Unit 1: States of Matter Lesson 1: Semester Introduction	0	Complete the Course Introduction student activity. Complete the Semester Introduction.
Unit 1: States of Matter Lesson 2: The Behavior of Gases	0	Explain and apply standard temperature and pressure (STP) in measuring gas volume. Explain how collision theory explains the behavior of gases. Define compressibility as it relates to gases. Explain how random motion of molecules and their collisions with a surface relate to surface pressure in gases. Relate the random motion of molecules to the diffusion of gases. Explain standard temperature and pressure (STP).
Unit 1: States of Matter Lesson 3: Gas Laws	0	Define Boyle's law. Define Charles's law. Define Gay-Lussac's law. Compare and contrast the gas laws.

Unit 1: States of Matter Lesson 4: Review: Gases	0	Explain and apply standard temperature and pressure (STP) in measuring gas volume. Explain how collision theory explains the behavior of gases. Define compressibility as it relates to gases. Explain how random motion of molecules and their collisions with a surface relate to surface pressure in gases. Relate the random motion of molecules to the diffusion of gases. Explain standard temperature and pressure (STP). Define Boyle's law. Define Charles's law. Use Charles's law to solve problems involving gases. Define Gay-Lussac's law. Compare and contrast the gas laws.
Unit 1: States of Matter Lesson 5: Laboratory: Gas Laws 1	0	Determine how a change in temperature affects the volume of a gas. Determine values for quantities such as temperature, pressure, and volume for a gas liberated in a chemical reaction.
Unit 1: States of Matter Lesson 6: Laboratory: Gas Laws 2	0	Determine how a change in temperature affects the volume of a gas. Determine values for quantities such as

		temperature, pressure, and volume for a gas liberated in a chemical reaction.
Unit 1: States of Matter Lesson 7: Your Choice	0	00000
Unit 1: States of Matter Lesson 8: Mid-Unit Test	0	00000
Unit 1: States of Matter Lesson 9: The Ideal Gas Law	0	Solve problems using the ideal gas law in the form PV = nRT. Apply the combined gas law to the calculate temperature, pressure, and volume of an enclosed gas. Apply the ideal gas law to calculate the number of moles of a contained gas. Solve problems using the ideal gas law. Compare and contrast the properties of a "real" vs. an "ideal" gas.
Unit 1: States of Matter Lesson 10: Absolute Zero	0	Convert a temperature in Celsius to the Kelvin scale. Interpret graphical information about temperature in Celsius and kelvins. Describe 0 Kelvin as absolute zero. Describe the relationship between average kinetic energy and temperature. Show that Kelvin temperature is directly proportional to the average kinetic energy of the particles of a substance.

Unit 1: States of Matter Lesson 11: Review: Ideal Gas Law	0	Solve problems using the ideal gas law in the form PV = nRT. Apply the ideal gas law to calculate the number of moles of a contained gas. Solve problems using the ideal gas law. Compare and contrast the properties of a "real" vs. an "ideal" gas. Convert a temperature in Celsius to the Kelvin scale. Interpret graphical information about temperature in Celsius and kelvins. Describe 0 Kelvin as absolute zero. Describe the relationship between average kinetic energy and temperature. Show that Kelvin temperature is directly proportional to the average kinetic energy of the particles of a substance. Apply the combined gas law to calculate temperature, pressure, and volume of an enclosed gas.
Unit 1: States of Matter Lesson 12: Some Properties of Liquids	0	Describe the atomic or molecular structure of liquids and solids. In terms of intermolecular forces, explain why atoms and molecules in a liquid move in random patterns. Contrast the intermolecular forces of atoms and molecules in a liquid with those of a solid.

Unit 1: States of Matter Lesson 13: Some Properties of Solids	0	Describe the atomic or molecular structure of liquids and solids. Contrast the intermolecular forces of atoms and molecules in a liquid with those of a solid. Given examples of crystalline solids, describe their properties and bonding patterns.
Unit 1: States of Matter Lesson 14: Review: Liquids and Solids	0	Describe the atomic or molecular structure of liquids and solids. In terms of intermolecular forces, explain why atoms and molecules in a liquid move in random patterns. Contrast the intermolecular forces of atoms and molecules in a liquid with those of a solid. Given examples of crystalline solids, describe their properties and bonding patterns.
Unit 1: States of Matter Lesson 15: Your Choice	HS-PS1-3, HS-PS2-6 HS-PS3-2,	00000
Unit 1: States of Matter Lesson 16: Unit Test	0	00000

Unit 2: Solutions Lesson 1: Solutions	0	Define the term solute. Define the term solvent. Define the term solution. Define concentration. Define the term saturated solution. Define the terms solute, solvent, and solution. Give examples of solutes, solvents, and solutions. Describe two ways of expressing the percent concentration of a solution (volume/volume and mass/volume). Express the concentration for a given amount of solute and solvent.
Unit 2: Solutions Lesson 2: The Dissolving Process	0	Distinguish between solubility and dissolving. Apply the concept of random molecular motion to describe the dissolving process. Describe the factors that affect solubility.

Unit 2: Solutions Lesson 3: Review: Solutions and Dissolving	0	Define the term solute. Define the term solvent. Define the term solution. Define concentration. Define the term saturated solution. Define the terms solute, solvent, and solution. Give examples of solutes, solvents, and solutions. Express the concentration for a given amount of solute and solvent. Distinguish between solubility and dissolving. Apply the concept of random molecular motion to describe the dissolving process. Describe the factors that affect solubility. Describe two ways of expressing percent concentration of a solution (volume/volume and mass/mass).
Unit 2: Solutions Lesson 4: Laboratory: Factors Affecting Solution Formation 1	HS-PS2-6	Determine the effect that particle size and temperature have on dissolution rates.
Unit 2: Solutions Lesson 5: Laboratory: Factors Affecting Solution Formation 2	HS-PS2-6	Determine the effect that particle size and temperature have on dissolution rates.
Unit 2: Solutions Lesson 6: Molarity and Mole Fraction	0	Define molarity (molar concentration). Express the concentration of a solution as a mole fraction. Calculate the molarity of a solution (in mol/L).

Unit 2: Solutions Lesson 7: Molality and Mass Percent	0	Describe two ways of expressing percent concentration of a solution (volume/volume and mass/mass). Define molality (molal concentration). Calculate the molality of a solution.
Unit 2: Solutions Lesson 8: Review: Molarity and Molality	0	Define molarity (molar concentration). Express the concentration of a solution as a mole fraction. Describe two ways of expressing percent concentration of a solution (volume/volume and mass/mass). Define molality (molal concentration). Calculate the molality of a solution. Calculate the molarity of a solution (in mol/L).
Unit 2: Solutions Lesson 9: Colligative Properties	0	Describe these colligative properties of solutions: vapor-pressure lowering, boiling-point elevation, and freezing-point depression. Analyze the relationship between concentration of a solution and effects on vapor-pressure lowering, boiling-point elevation, and freezing-point depression.
Unit 2: Solutions Lesson 10: Separating Solutions	0	Describe the process of distillation. Explain how distillation, the application and removal of heat, is used to purify a compound by separating it

		into component parts. Describe other methods of separating solutions.
Unit 2: Solutions Lesson 11: Your Choice	0	00000
Unit 2: Solutions Lesson 12: Unit Test	HS-PS2-6	00000
Unit 3: Acids and Bases Lesson 1: Properties of Acids and Bases	0	Describe the properties of acids and bases. Know the Arrhenius, Bronsted-Lowry, and Lewis acid and base definitions. Define pH with regard to hydrogen ion concentration. Use pH to describe the acidity or alkalinity of substances.
Unit 3: Acids and Bases Lesson 2: Types of Acids and Bases	0	Know the Arrhenius, Bronsted-Lowry, and Lewis acid and base definitions. Know that acids are hydrogen-ion-donating substances and bases are hydrogen-ion-accepting substances.
Unit 3: Acids and Bases Lesson 3: Review: Acids and Bases	0	Describe the properties of acids and bases. Know the Arrhenius, Bronsted-Lowry, and Lewis acid and base definitions. Describe the observable properties of acids and bases. Give examples of some common acids and bases. Describe the observable properties of salt solutions. Define acids as hydrogen-ion-donating substances and

		bases as hydrogen-ion-accepting substances.
Unit 3: Acids and Bases Lesson 4: Measuring Acids and Bases	0	Define pH with regard to hydrogen ion concentration. Use pH to describe the acidity or alkalinity of substances. Relate the logarithmic nature of the pH scale to changes in hydrogen ion concentration. Calculate pH when given the hydrogen ion concentration. Given pH values, characterize solutions as acidic, basic, or neutral. Describe pH and how it is used to indicate acids, bases, and neutral solutions. Interpret graphs that display information about acidic, neutral, and basic solutions.
Unit 3: Acids and Bases Lesson 5: Buffers and Titration	0	Define titration. Explain the use of a classical titration apparatus. Explain how buffers stabilize pH.

Unit 3: Acids and Bases Lesson 6: Review: Measuring pH	0	Define pH with regard to hydrogen ion concentration. Use pH to describe the acidity or alkalinity of substances. Relate the logarithmic nature of the pH scale to changes in hydrogen ion concentration. Calculate pH when given the hydrogen ion concentration. Interpret graphs that display information about acidic, basic, and neutral solutions. Given pH values, characterize solutions as acidic, basic, or neutral. Describe pH and how it is used to indicate acids, bases, and neutral solutions. Define titration. Explain the use of a classical titration apparatus. Explain how buffers stabilize pH.
Unit 3: Acids and Bases Lesson 7: Laboratory: Titration: Testing Water Quality 1 Lesson 8: Discuss: Titration: Testing Water Quality	0	Apply the technique of titration to determine the acidity or alkalinity of a sample of water.
Unit 3: Acids and Bases Lesson 9: Laboratory: Titration: Testing Water Quality 2	0	Apply the technique of titration to determine the acidity or alkalinity of a sample of water.
Unit 3: Acids and Bases Lesson 10: Your Choice	0	00000
Unit 3: Acids and Bases Lesson 11: Unit Test	HS-PS1-5	00000

Unit 4: Chemical Thermodynamics Lesson 1: The Conservation of Energy	0	Explain the law of conservation of energy. Contrast exothermic with endothermic processes. Identify chemical potential energy as the energy stored in the chemical bonds of a substance. Give an example of an exothermic reaction. Give an example of an endothermic reaction. State the law of conservation of energy.
Unit 4: Chemical Thermodynamics Lesson 2: Measuring the Flow of Heat	0	Use calories and joules to calculate heat flow in chemical reactions. Explain that heat always flows from warmer to cooler objects. Describe the motion of molecules in heat flow. Contrast thermal energy, heat, and temperature. Define a calorie (cal) and a joule (J). Explain heat in terms of molecular energy.

Unit 4: Chemical Thermodynamics Lesson 3: Review: Thermal Energy	0	Explain the law of conservation of energy. Contrast exothermic with endothermic processes. Use calories and joules to calculate heat flow in chemical reactions. Identify chemical potential energy as the energy stored in the chemical bonds of a substance. Give an example of an exothermic reaction. Give an example of an endothermic reaction. State the law of conservation of energy. Explain that heat always flows from warmer to cooler objects. Describe the motion of molecules in heat flow. Contrast thermal energy, heat, and temperature. Define a calorie (cal) and a joule (J). Explain heat in terms of molecular energy.
Unit 4: Chemical Thermodynamics Lesson 4: Laboratory: Heat Transfer 1	HS-PS2-6, HS-PS3-1, HS-PS3-4, HS-PS3-3	Observe a closed system in which heat transfer takes place. Understand the construction and limitations of a simple calorimeter. Calculate the heat released in a phase change.

Unit 4: Chemical Thermodynamics Lesson 5: Laboratory: Heat Transfer 2	HS-PS2-6, HS-PS3-1, HS-PS3-4, HS-PS3-3	Observe a closed system in which heat transfer takes place. Understand the construction and limitations of a simple calorimeter. Calculate the heat released in a phase change.
Unit 4: Chemical Thermodynamics Lesson 6: Specific Heat	0	Define specific heat (of a substance). Contrast specific heat values for common substances. Calculate the specific heat of a substance.
Unit 4: Chemical Thermodynamics Lesson 7: Writing Thermochemical Equations	0	Define enthalpy and its use in understanding energy relationships in chemical reactions. Explain a thermochemical equation. Explain how the physical state of reactants and products relates to a thermochemical equation. Solve problems that involve heat flow and temperature change. Define heat of solution.

Unit 4: Chemical Thermodynamics Lesson 8: Review: More Aspects of Heat	0	Define enthalpy and its use in understanding energy relationships in chemical reactions. Define specific heat (of a substance). Contrast specific heat values for common substances. Calculate the specific heat of a substance. Explain a thermochemical equation. Explain how the physical state of reactants and products relates to a thermochemical equation. Solve problems that involve heat flow and temperature change. Define heat of solution.
Unit 4: Chemical Thermodynamics Lesson 9: Your Choice	0	00000
Unit 4: Chemical Thermodynamics Lesson 10: Unit Test	HS-PS2-6, HS-PS3-1, HS-PS3-4, HS-PS3-3	00000
Unit 5: Reaction Rates and Equilibrium Lesson 1: Reaction Rates and Energy of Activation	0	Define reaction rate. Define activation energy. Explain that the reaction rate is expressed as the decrease in concentration of reactants or the increase in concentration of products per unit time. Interpret a diagram that illustrates reaction rate with time. Explain the role of activation energy in a chemical reaction. Explain collision theory as it applies to chemical reactions.

Unit 5: Reaction Rates and Equilibrium Lesson 2: Factors Affecting Reaction Rates	0	Explain the effects of factors such as temperature, concentration, and particle size on the rate of a chemical reaction. Analyze the effects of changing various factors on reaction rates. Interpret a graph that displays data about reaction rate. Describe how a catalyst influences reaction rate. Name the factors affecting reaction rates.
Unit 5: Reaction Rates and Equilibrium Lesson 3: Review: Reaction Rates	0	Define reaction rate. Explain the effects of factors such as temperature, concentration, and particle size on the rate of a chemical reaction. Define activation energy. Explain that the reaction rate is expressed as the decrease in concentration of reactants or the increase in concentration of products per unit time. Interpret a diagram that illustrates reaction rate with time. Explain the role of activation energy in a chemical reaction. Explain collision theory as it applies to chemical reactions. Analyze the effects of changing various factors on reaction rates. Interpret a graph that displays data about reaction rate. Describe how a catalyst influences reaction rate.

		Name the factors affecting reaction rates.
Unit 5: Reaction Rates and Equilibrium Lesson 4: Laboratory: Reaction-Rate Factors 1 Lesson 5: Discuss: Reaction-Rate Factors	0	Analyze the effects of changing various factors on reaction rates.
Unit 5: Reaction Rates and Equilibrium Lesson 6: Laboratory: Reaction-Rate Factors 2	0	Analyze the effects of changing various factors on reaction rates.
Unit 5: Reaction Rates and Equilibrium Lesson 7: Equilibrium	0	Describe chemical equilibrium. Explain the equilibrium constant. Calculate an equilibrium constant expression for a reaction. Define the term reversible reaction.
Unit 5: Reaction Rates and Equilibrium Lesson 8: Le Chatelier's Principle	0	Apply Le Chatelier's principle to equilibrium systems. Explain Le Chatelier's principle. Describe the conditions under which Le Chatelier's principle applies. Predict the effects of changes

		in concentration on chemical equilibrium. Predict the effects of changes in temperature on chemical equilibrium. Predict the effects of changes in pressure on chemical equilibrium.
Unit 5: Reaction Rates and Equilibrium Lesson 9: Review: Equilibrium	0	Describe chemical equilibrium. Apply Le Chatelier's principle to equilibrium systems. Explain the equilibrium constant. Calculate an equilibrium constant expression for a reaction. Define the term reversible reaction. Explain Le Chatelier's principle. Describe the conditions under which Le Chatelier's principle applies. Predict the effects of changes in concentration on chemical equilibrium. Predict the effects of changes in temperature on chemical equilibrium. Predict the effects of changes in pressure on chemical equilibrium.
Unit 5: Reaction Rates and Equilibrium Lesson 10: Your Choice	0	00000
Unit 5: Reaction Rates and Equilibrium Lesson 11: Unit Test	HS-PS1-5	00000

Unit 6: Electrochemistry Lesson 1: Electrochemical Processes	0	Describe electrochemical processes. Describe the workings of an electrochemical cell. Discuss how chemical energy is converted into electrical energy. Discuss how electrical energy is converted into chemical energy. Define an electrochemical cell.
Unit 6: Electrochemistry Lesson 2: Voltaic Cells	0	Interpret a diagram of a voltaic cell. Compare and contrast an anode and a cathode.
Unit 6: Electrochemistry Lesson 3: Review: Electrochemistry	0	Describe electrochemical processes. Describe the workings of an electrochemical cell. Discuss how chemical energy is converted into electrical energy. Discuss how electrical energy is converted into chemical energy. Define an electrochemical cell. Interpret a diagram of a voltaic cell. Compare and contrast an anode and a cathode.
Unit 6: Electrochemistry Lesson 4: Laboratory: Electroplating 1	HS-PS2-4, HS-PS2-6	Interpret the chemistry of the electroplating process. Conduct an experiment on electroplating.
Unit 6: Electrochemistry Lesson 5: Laboratory: Electroplating 2	HS-PS2-4, HS-PS2-6	Interpret the chemistry of the electroplating process. Conduct an experiment on electroplating.

Unit 6: Electrochemistry Lesson 6: Dry Cells	0	Describe the chemistry of various kinds of batteries and dry cells. Compare and contrast a dry cell with a voltaic cell. Describe the chemistry of various kinds of batteries.
Unit 6: Electrochemistry Lesson 7: Electrolytic Cells	0	Define the processes that occur in an electrolytic cell. Interpret a diagram of an electrolytic cell.
Unit 6: Electrochemistry Lesson 8: Review: Electrochemical Cells	0	Describe the chemistry of various kinds of batteries and dry cells. Compare and contrast a dry cell with a voltaic cell. Describe the chemistry of various kinds of batteries. Define the processes that occur in an electrolytic cell. Interpret a diagram of an electrolytic cell.
Unit 6: Electrochemistry Lesson 9: Your Choice	0	00000
Unit 6: Electrochemistry Lesson 10: Unit Test	HS-PS2-4, HS-PS2-6	00000
Unit 7: Organic Chemistry Lesson 1: Hydrocarbons and Other Organic Chemicals	0	Explain that the bonding characteristics of carbon provide the foundations for organic chemistry and biochemistry. Explain that the bonding characteristics of carbon provide the biochemical foundations for life. Write a structural formula to represent an organic compound. Compare different bonding

		structures of hydrocarbons. Identify the functional groups of organic compounds. Discuss the chemistry of alcohols
Unit 7: Organic Chemistry Lesson 2: Laboratory: Modeling Organic Compounds	0	Create models of organic compounds. Explore isomers and functional groups of organic compounds.
Unit 7: Organic Chemistry Lesson 3: Polymers	0	Define polymer and give examples of organic and biochemical polymers. Define polymer. Explain how a polymer is formed. Give examples of polymers.

Unit 7: Organic Chemistry Lesson 4: Review: Hydrocarbons and Polymers	0	Define polymer and give examples of organic and biochemical polymers. Explain that the bonding characteristics of carbon provide the foundations for organic chemistry and biochemistry. Explain that the bonding characteristics of carbon provide the biochemical foundations for life. Write a structural formula to represent an organic compound. Compare different bonding structures of hydrocarbons. Identify the functional groups of organic compounds. Discuss the chemistry of alcohols. Define polymer. Explain how a polymer is formed. Give examples of polymers.
Unit 7: Organic Chemistry Lesson 5: Carbohydrates and Fats	0	Identify the structures of various organic molecules. Discuss the structure and biological importance of carbohydrates, lipids, proteins, and nucleic acids. Draw the structure of glucose. Show how glucose can be arranged into starch and glycogen. Draw a diagram of a lipid.

		Distinguish between fats, oils, and waxes.
Unit 7: Organic Chemistry Lesson 6: Proteins and Nucleic Acids	0	Identify the structures of various organic molecules. Discuss the structure and biological importance of carbohydrates, lipids, proteins, and nucleic acids. Describe the relationship of amino acids and proteins. Explain the importance of amino acids. Illustrate a peptide bond. Analyze the polypeptide structure of proteins. Describe a DNA polymer made of nucleotides. Describe DNA as a collection of nucleotides (nucleic acids).

Unit 7: Organic Chemistry Lesson 7: Review: Biochemistry	0	Identify the structures of various organic molecules. Discuss the structure and biological importance of carbohydrates, lipids, proteins, and nucleic acids. Draw the structure of glucose. Show how glucose can be arranged into starch and glycogen. Draw a diagram of a lipid. Distinguish between fats, oils, and waxes. Describe the relationship of amino acids and proteins. Explain the importance of amino acids. Illustrate a peptide bond. Analyze the polypeptide structure of proteins. Describe a DNA polymer made of nucleotides. Describe DNA as a collection of nucleotides (nucleic acids).
Unit 7: Organic Chemistry Lesson 8: Your Choice	0	00000
Unit 7: Organic Chemistry Lesson 9: Unit Test	HS-PS2-6, HS-LS1-6	00000
Unit 8: Nuclear Chemistry Lesson 1: Forces Within the Nucleus	0	Compare and contrast nuclear reactions and chemical reactions. Identify the forces that hold protons and neutrons together in the nucleus of an atom. Explain the differences

		between nuclear reactions and chemical reactions. Identify quarks as the particles of matter that make up protons and neutrons.
Unit 8: Nuclear Chemistry Lesson 2: Radioactivity and Half Life	0	Explain the process of radioactive decay, including the concept of half-life. Name the types of radiation. Explain the process of radioactive decay. Name the three main types of radiation: alpha, beta, and gamma. Compare the changes in the nucleus that result from alpha and gamma decay. Contrast the penetration of different types of radiation. Define a half-life. Given an amount of a radioactive substance, calculate how much remains after a certain number of half-lives have passed.

Unit 8: Nuclear Chemistry Lesson 3: Review: Nuclear Forces	0	Explain the process of radioactive decay, including the concept of half-life. Name the types of radiation. Compare and contrast nuclear reactions and chemical reactions. Identify the forces that hold protons and neutrons together in the nucleus of an atom. Explain the differences between nuclear reactions and chemical reactions. Identify quarks as the particles of matter that make up protons and neutrons. Explain the process of radioactive decay. Name the three main types of radiation: alpha, beta, and gamma. Compare the changes in the nucleus that result from alpha and gamma decay. Contrast the penetration of different types of radiation. Define a half-life. Given an amount of a radioactive substance, calculate how much remains after a certain number of half-lives have passed.

Unit 8: Nuclear Chemistry Lesson 4: Laboratory: Calculating Half-Life Lesson 5: Discuss: Calculating Half-Life	0	Define a half-life and how it is calculated. Recognize the symbol for half-life. Given a radioactive substance, calculate how much remains after a certain number of half-lives have passed.
Unit 8: Nuclear Chemistry Lesson 6: Transmutation of Elements	0	Identify naturally occurring isotopes of elements that are radioactive. Identify isotopes that are formed from nuclear reactions. Define transmutation of elements.
Unit 8: Nuclear Chemistry Lesson 7: Nuclear Fission and Fusion	0	Compare and contrast nuclear fission and nuclear fusion. Relate Einstein's mass-energy equivalence equation to the change of mass and release of large amounts of energy during fission reactions. Contrast the energy release of material in nuclear fusion and nuclear fission with the energy release of chemical reactions.
Unit 8: Nuclear Chemistry Lesson 8: Review: Nuclear Chemistry	0	Compare and contrast nuclear fission and nuclear fusion. Identify naturally occurring isotopes of elements that are radioactive. Identify isotopes that are formed from nuclear reactions. Define transmutation of elements. Contrast the energy release of material in nuclear fusion and

		nuclear fission with the energy release of chemical reactions. Relate Einstein's mass-energy equivalence equation to the change of mass and the release of large amounts of energy during fission reactions.
Unit 8: Nuclear Chemistry Lesson 9: Your Choice	0	00000
Unit 8: Nuclear Chemistry Lesson 10: Unit Test	HS-PS1-8	00000
Unit 9: Semester Review and Test Lesson 1: Semester Review	0	00000
Unit 9: Semester Review and Test Lesson 2: Your Choice	0	00000
Unit 9: Semester Review and Test Lesson 3: Your Choice	0	00000
Unit 9: Semester Review and Test Lesson 4: Semester Test	0	00000