Wyoming Department of Education Required Virtual Education Course Syllabus

Washakie County School District # 1

Program Name	Washakie #1 Online	Content Area	SC
Course ID	W03101G0.5022	Grade Level	9-12
Course Name	WOL-Chemistry B	# of Credits	0.5
SCED Code	03101G0.5022	Curriculum Type	K12 Fuel Education

COURSE DESCRIPTION

This comprehensive course gives students a solid basis to move on to future studies. This course provides an in-depth survey of all key areas, including atomic structure, chemical bonding and reactions, solutions, stoichiometry, thermochemistry, organic chemistry, and nuclear chemistry. The course includes direct online instruction, laboratories, and related assessments, used with an online problem-solving book.

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.
HS-ETS1-5	Evaluate the validity and reliability of claims in a variety of materials.

Scope and Sequence		
UNIT OUTLINE	STANDARD#	OUTCOMES OBJECTIVES/ STUDENT CENTERED GOALS
Unit 1: States of Matter Lesson 1: Semester Introduction		Complete the Semester Introduction. Complete the Course Introduction student activity.
Unit 1: States of Matter Lesson 2: The Behavior of Gases		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: Boyle's Law		Define Boyle's law. Use Boyle's law to solve problems involving gases.
Unit 1: States of Matter Lesson 4: Charles's Law		Define Charles's law. Use Charles's law to solve problems involving gases.
Unit 1: States of Matter Lesson 5: Gay-Lussac's Law		Define Gay-Lussac's law. Use Gay-Lussac's law to solve problems involving gases.
Unit 1: States of Matter Lesson 6: Laboratory: Gas Laws 1		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: Laboratory: Gas Laws 2		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 8: Your Choice		
Unit 1: States of Matter Lesson 9: Mid-Unit Test		
Unit 1: States of Matter Lesson 10: The Ideal Gas Law		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 11: Absolute Zero		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.

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		Show that Kelvin temperature is directly proportional to the average kinetic energy of the particles of a substance.
Unit 1: States of Matter Lesson 12: Dalton's Law of Partial Pressures		Given sufficient information, calculate the partial pressure of a gas in a mixture. Apply Dalton's law to determine the total pressure of a mixture of gases.
Unit 1: States of Matter Lesson 13: Graham's Law of Effusion		Define Graham's law. Apply Graham's law to predict the effusion and diffusion of gases.
Unit 1: States of Matter Lesson 14: Phase Diagrams		Define triple point. Interpret phase diagrams.
Unit 1: States of Matter Lesson 15: Some Properties of Liquids		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 16: Some Properties of Solids		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 17: Your Choice		
Unit 1: States of Matter Lesson 18: Unit Test	HS-PS1-3 HS-PS2-6 HS-PS3-2	
Unit 2: Solutions Lesson 1: Solutions		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		Distinguish between solubility and dissolving. Apply the concept of random molecular motion to describe the dissolving process. Describe the factors that affect solubility.

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Unit 2: Solutions Lesson 3: 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 4: 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 5: Molarity and Mole Fraction		Define molarity (molar concentration). Express the concentration of a solution as a mole fraction. Calculate the molarity of a solution.
Unit 2: Solutions Lesson 6: Molality and Mass Percent		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 7: Colligative Properties		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 8: Separating Solutions		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 9: Your Choice		
Unit 2: Solutions Lesson 10: Unit Test	HS-PS1-6 HS-PS2-6	
Unit 3: Acids and Bases Lesson 1: Properties of Acids and Bases		Describe the properties of acids and bases. Describe the observable properties of acids and bases. Give examples of some common acids and bases. Describe the observable properties of salt solutions.
Unit 3: Acids and Bases Lesson 2: Arrhenius Acids and Bases		Know the Arrhenius, Bronsted-Lowry, and Lewis acid and base definitions. Explain the Arrhenius definition of acids and bases. Identify chemical formulas for acids and bases. Identify chemical formulas for salt solutions.
Unit 3: Acids and Bases Lesson 3: Bronsted-Lowry & Lewis Acids and Bases		Know the Arrhenius, Bronsted-Lowry, and Lewis acid and base definitions. Describe acids as hydrogen-ion-donating substances. Describe bases as hydrogen-ion-accepting substances. Explain the Lewis definition of acids and bases. Contrast the Arrhenius, Bronsted-Lowry, and Lewis definitions of acids

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		and bases. Explain the Bronsted-Lowry definition of acids and bases.
Unit 3: Acids and Bases Lesson 4: Measuring Acids and Bases		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.
Unit 3: Acids and Bases Lesson 5: Buffers and Titration		Define titration. Explain the use of a classical titration apparatus. Explain how buffers stabilize pH.
Unit 3: Acids and Bases Lesson 6: Laboratory: Titration: Testing Water Quality 1 Lesson 7: Discuss: Titration: Testing Water Quality		Apply the technique of titration to determine the acidity or alkalinity of a sample of water.
Unit 3: Acids and Bases Lesson 8: Lab: Titration: Testing Water Quality 2		Apply the technique of titration to determine the acidity or alkalinity of a sample of water.
Unit 3: Acids and Bases Lesson 9: Strengths of Acids and Bases		Explain that strong acids completely dissociate into metal ions and hydrogen (hydronium) ions. Contrast the properties of strong and weak bases. Explain that weak bases partially dissociate into metal ions and hydroxide ions. Solve problems involving dissociation constants. Contrast the properties of strong and weak acids.
Unit 3: Acids and Bases Lesson 10: Your Choice		
Unit 3: Acids and Bases Lesson 11: Unit Test	HS-PS1-5	
Unit 4: Chemical Thermodynamics Lesson 1: The Conservation of Energy		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.

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Unit 4: Chemical Thermodynamics Lesson 2: Measuring the Flow of Heat		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: 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 4: 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 5: Specific Heat		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 6: Changes in Enthalpy		Define enthalpy and its use in understanding energy relationships in chemical reactions. Define enthalpy. Recognize the symbol for enthalpy (H). Describe how enthalpy changes as a substance undergoes phase changes. Interpret a diagram that shows how enthalpy relates to phase changes of a substance.
Unit 4: Chemical Thermodynamics Lesson 7: Your Choice		
Unit 4: Chemical Thermodynamics Lesson 8: Mid-Unit Test	HS-PS2-6 HS-PS3-1 HS-PS3-4 HS-PS3-3	
Unit 4: Chemical Thermodynamics Lesson 9: Writing Thermochemical Equations		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 10: Heat During Changes of State		Analyze energy outcomes when a material melts. Analyze energy outcomes when a material condenses. Analyze energy outcomes when a material evaporates. Analyze energy outcomes when a material freezes.'
Unit 4: Chemical Thermodynamics Lesson 11: Hess's Law		Apply Hess's law to determine the heat of a reaction. Explain Hess's law.

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		Apply Hess's law to calculate the enthalpy change in a reaction. Apply Hess's Law to determine the heat of a reaction.
Unit 4: Chemical Thermodynamics Lesson 12: Your Choice		
Unit 4: Chemical Thermodynamics Lesson 13: Unit Test	HS-PS1-6 HS-PS2-6 HS-PS3-1 HS-PS3-4 HS-PS3-3	
Unit 5: Reaction Rate and Equilibrium Lesson 1: Reaction Rates and Energy of Activation		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 Rate and Equilibrium Lesson 2: Factors Affecting Reaction Rates		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 Rate and Equilibrium Lesson 3: Laboratory: Reaction-Rate Factors 1 Lesson 4: Discuss: Reaction-Rate Factors		Analyze the effects of changing various factors on reaction rates.
Unit 5: Reaction Rate and Equilibrium Lesson 5: Laboratory: Reaction-Rate Factors 2		Analyze the effects of changing various factors on reaction rates.
Unit 5: Reaction Rate and Equilibrium Lesson 6: Collision Theory		Describe how collision theory explains the effect of factors such as temperature, concentration, and pressure on the rate of chemical reactions. Define collision theory.
Unit 5: Reaction Rate and Equilibrium Lesson 7: Your Choice		
Unit 5: Reaction Rate and Equilibrium Lesson 8: Mid-Unit Test		
Unit 5: Reaction Rate and Equilibrium Lesson 9: Equilibrium		Describe chemical equilibrium. Explain the equilibrium constant. Calculate an equilibrium constant expression for a reaction. Define the term reversible reaction.
Unit 5: Reaction Rate and Equilibrium Lesson 10: Le Chatelier's Principle		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.

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		Predict the effects of changes in temperature on chemical equilibrium. Predict the effects of changes in pressure on chemical equilibrium.
Unit 5: Reaction Rate and Equilibrium Lesson 11: Spontaneous Reactions		Discuss the relationship between free energy and a spontaneous reaction. Define free energy.
Unit 5: Reaction Rate and Equilibrium Lesson 12: Entropy and Free Energy		Determine whether a reaction would be spontaneous by applying the Gibbs free-energy equation. Describe the relationship between entropy, enthalpy, and chemical reactions. Define entropy.
Unit 5: Reaction Rate and Equilibrium Lesson 13: Your Choice		
Unit 5: Reaction Rate and Equilibrium Lesson 14: Unit Test	HS-PS1-5	
Unit 6: Electrochemistry Lesson 1: Electrochemical Processes		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		Interpret a diagram of a voltaic cell. Compare and contrast an anode and a cathode.
Unit 6: Electrochemistry Lesson 3: Laboratory: Electroplating 1	HS-PS2-4 HS-PS2-6	Interpret the chemistry of the electroplating process. Conduct an experiment on electroplating. Interpret the chemistry of an electrolytic cell in the electroplating process.
Unit 6: Electrochemistry Lesson 4: Laboratory: Electroplating 2	HS-PS2-4 HS-PS2-6	Interpret the chemistry of an electrolytic cell in the electroplating process. Interpret the chemistry of the electroplating process. Conduct an experiment on electroplating.
Unit 6: Electrochemistry Lesson 5: Dry Cells		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 6: Electrolytic Cells		Define the processes that occur in an electrolytic cell. Interpret a diagram of an electrolytic cell.
Unit 6: Electrochemistry Lesson 7: Your Choice		
Unit 6: Electrochemistry Lesson 8: Unit Test	HS-PS2-4 HS-PS2-6	
Unit 7: Organic Chemistry Lesson 1: Hydrocarbons and Other Organic Chemicals		Identify the structures of various organic molecules. Explain that the bonding characteristics of carbon provide the foundations for organic chemistry and biochemistry.

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		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	HS-PS2-6	Create models of organic compounds. Explore isomers and functional groups of organic compounds.
Unit 7: Organic Chemistry Lesson 3: Polymers		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: Carbohydrates and Fats		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 5: Proteins and Nucleic Acids		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 6: Your Choice		
Unit 7: Organic Chemistry Lesson 7: Unit Test	HS-PS2-6 HS-LS1-6	
Unit 8: Nuclear Chemistry Lesson 1: Forces Within the Nucleus		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.

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UNIT OUTLINE	STANDARD#	OUTCOMES OBJECTIVES/ STUDENT CENTERED GOALS
		Identify quarks as the particles of matter that make up protons and neutrons.
Unit 8: Nuclear Chemistry Lesson 2: Radioactivity and Half-Life		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: Laboratory: Calculating Half-Life Lesson 4: Discuss: Calculating Half-Life		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 5: Transmutation of Elements		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 6: Nuclear Fission and Fusion		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 7: Your Choice		
Unit 8: Nuclear Chemistry Lesson 8: Unit Test	HS-PS1-8	
Unit 9: Semester Review and Test Lesson 1: Semester Review		
Unit 9: Semester Review and Test Lesson 2: Your Choice		
Unit 9: Semester Review and Test Lesson 3: Your Choice		
Unit 9: Semester Review and Test Lesson 4: Semester Test		
Unit 10: Honors Project 1: Liquid Breathing Lesson 1: Liquid Breathing	HS-ETS1-5	Explore physical and chemical properties of dissolving gases in liquids. Explore the physiology and hazards of scuba diving, especially diving to deep depths. Explore the physiology and chemistry of liquid breathing. Explain the potential uses of liquid breathing in diving and medicine.

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UNIT OUTLINE	STANDARD#	OUTCOMES OBJECTIVES/ STUDENT CENTERED GOALS
		Prepare a written report about liquid breathing. Share information about liquid breathing with other students.
Unit 11: Honors Project 2: Fuel Cells Lesson 1: Fuel Cells	HS-ETS1-5	Explore the various technologies of fuel cells. Explain the electrochemistry of fuel cells. Discuss the potential and real applications of fuel-cell technologies, especially with respect to automobiles. Prepare a written report discussing the advantages, disadvantages, and problems of using fuel cells in automobiles. Share information about fuel cells in automobiles with other students.