Chemistry
Standard

This course is intended to teach and reinforce crucial academic skills to help students learn and strengthen their background in chemistry. *Career*Tech Chemistry is an introductory look at basic chemical principles and gives students hands-on lab experience. By performing experiments, analyzing data, manipulating numbers mathematically, and studying scientific information, students will acquire the skills and knowledge necessary to better understand the world. It will provide students with a solid foundation in the areas of structure and properties of matter as well as all aspects of chemical reactions. Mathematical computations are a strong part of chemistry and therefore math is integrated throughout the course. Upon completion of *Career*Tech Chemistry, a student will be prepared for advanced upper division science courses.

Course Description:

Chemistry is designed to prepare students for the complex thinking that will be expected in future science courses. This course will focus on the development of the student as a scientist through the study of chemistry. Being a scientist requires a broad set of tools, including theory, problem solving, written and oral communication, interpreting data and laboratory skills. Areas covered are: Matter, atoms & periodic table, molecules & compounds, chemical reactions & stoichiometry, Aqueous solutions & reactions, Gases, Energy & Chemical Reactions, Atomic & Molecular Structure. Good laboratory techniques and applicability will be emphasized. Prerequisites for this course are: Algebra I, Biology I

Developed by the
Innovative Initiatives Division
For the
Oklahoma Department of Career and Technology Education

Requirements for College Admission Status (Title 70 O.S. § 11-103.6)

These courses are to be taught by a highly qualified teacher with an Oklahoma Chemistry teaching certification. The students should be in the eleventh or twelfth grade or if a sophomore, they should be in a Focused Field of Career Study program. The prerequisites for this course are Biology I and Algebra I. The course should consist of 40% laboratory or fieldwork in order to be considered a lab science. The course will have at a minimum, but may exceed, a duration of 120 hours within a school year (72 hours theory/48 lab hours).

Chemistry

Objective	National Science Education Standards 9-12 Content Standards	Oklahoma Chemistry Content and Process PASS Standards
Laboratory Techniques		
• Display appropriate and safe chemistry classroom and laboratory behavior	A	
• Display proper equipment handling for laboratory use	A	
Matter and Measurements		
• Define matter, elements, atoms, and compounds	A, B	**Content** 1.1, 1.2, 1.3, 1.4
• Distinguish between chemical and physical properties	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Describe matter by its chemical and physical properties	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain the standard units for length, mass, time, and temperature	A	
• Explain the Scientific method and be able to use when presented real-world situations	A	
• Be able to use significant figures appropriately in scientific calculations	A	
• Be able to use scientific notation in scientific calculations	A, B	
• Compare and contrast precision and accuracy	A, B	**Content** 1.1, 1.2, 1.3

Atoms and Periodic Table		
• Explain the Atomic Theory and have an understanding of its history	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain the functional structure of the Periodic Table	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Define mole and explain how it is used in chemistry	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3
• Be able to calculate molar mass	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3
• Understand and explain the characteristic properties of families of elements	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
Molecules and Compounds		
• Be able to name and write formulas	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Determine empirical formula of a compound from its mass percent composition	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain the role of a valence electron in an ion	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Be able to describe an ion and how it will react with other elements	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
Chemical Reactions and Stoichiometry		
• Write and balance chemical equations	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.4
• Explain mass-mole relationships	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3
• Identify and define the types of chemical reactions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1
• Define and determine limiting reactants	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2
• Define and determine percent yield	A, B	**Content** 1.1, 1.2, 1.3, 1.4,

		1.5, 2.1, 2.2
Aqueous Solutions and Reactions		
• Define and explain the differences of the three types of aqueous reactions (acid-base, precipitations, gas-forming, oxidation-reduction)	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2
• Describe net ionic equations	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5
• Explain how to prepare molar solutions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Apply the pH scale to calculate the concentration of hydronium ions and hydroxide ions given the pH of a solution	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Describe how an acid base titration is formed	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
Gases		
• Define the Gas Laws (Boyles Law, Charles Law, Combined Gas Law, Ideal Gas Law, Dalton's Law) and be able to use mathematically.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4
• Define diffusion and effusion and be able to calculate the rates	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4
Energy and Chemical Reaction		
• Describe the affect of temperature on chemical reactions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.4
• Explain specific heat and have knowledge of how it can be measured	A, B	Content 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain enthalpy and how it can be used with Hess's Law	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Distinguish between heat and temperature		**Content** 1.1, 1.2, 1.3, 1.4,

		1.5, 2.1, 2.2, 2.3, 2.4
• Understand what is meant by caloric content in foods	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 5.3
Atomic Structure		
• Explain the Quantum Mechanical Model	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain energy levels and orbitals of atomic structures and be able to diagram	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Understand Bohr's Model and explain how its been modernized	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain electron configuration and be able to do electron dot configuration	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Describe trends in the Periodic Table and be able to predict an element's reactivity	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
Molecular Structure		
• Define and explain Lewis structures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain Ionic and covalent bonding and be able to determine how elements will combine	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Explain electronegativity and explain its effects on chemical reactions	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Define and explain Resonance structures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4
• Define and explain VSEPR structures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4

Labs/Activities		
Laboratory techniques Students will: • Use the scientific method to solve real-life problems presented in case study form. • Organize information to facilitate analysis of your data • Draw graphs that present data clearly and accurately • Interpret data in tables, charts, and graphs • Draw conclusions that are supported by experimental data • Analyze data using common statistical measures • Apply your knowledge of the scientific method to real-life situations	A	**Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4
Accuracy and precision Students will: • Experience differences between precision and accuracy • Formulate hypotheses about precision, accuracy, and probability • Calculate probability for experimental experiences • Discuss the outcome of the experiment	A, B	**Content** 1.1, 1.2, 1.3 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.7, 6.2, 6.3, 6.4
Separation of mixtures Students will: • Determine type of mixture • Conduct an investigation to separate a homogenous mixture • Discuss the outcome of the experiment • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Flame tests Students will: • Conduct an investigation to view	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.4

the different colors of flames emitted by the different solutions • Chart the color emitted by the different elements and identify like colors • Discuss the outcome of the experiment • Write a detailed lab report citing all steps taken in the scientific method.		**Process** 1.1, 1.2, 1.3, 2.1, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4
Percent composition of hydrates Students will: • Conduct an experiment to determine the number of moles of water associated with one mole of copper sulfate in the hydrate • Write the correct formula for the hydrate • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Polymers Students will: • Prepare a condensation polymer • Discuss common polymer they encounter in everyday life • Conduct an experiment to cross-link a polymer and observe the changes in the physical properties as a result of this cross-linking. The changes in physical properties of a cross-linked polymer are also studied as the temperature is varied. • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 5.3, 6.1, 6.2, 6.3, 6.4
Stoichiometry and Gravimetric Analysis Students will: • Recall chemical symbols as part of chemical equations • Convert word equations to chemical formulas	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1,

• Apply correct chemical nomenclature • Conduct an experiment to determine the mass of an element by isolating it in a solid compound of known identity and definite composition. • Write a detailed lab report citing all steps taken in the scientific method.		3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 5.1, 5.2, 6.1, 6.2, 6.3, 6.4
Stoichiometry of reactions Students will: • Apply the concept of stoichiometric coefficient relating to reaction ratios • Balance equations • Discuss the reasons for balancing equations • Calculate empirical formulas from percentage by mass data • Conduct an experiment testing computations of percent yield with actual lab results. • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Calorimetry and Hess's Law Students will: • Calculate the heat of formation of magnesium oxide using Hess's law • Assuming the heat capacity of the HCl is the same as that of water, calculate the amount of heat liberated when the magnesium reacted • Assuming the heat capacity of the acid is the same as that of water, conduct an experiment in order to calculate the amount of heat liberated when the MgO reacted	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4

Calorimetry and molarity Students will: • Calculate the number of moles (n) of sulfuric acid (volume in Liters Calculate the number of moles (n) of sulfuric acid (volume in Liters times molarity in mol/l) in mol/l) • Conduct an experiment to find the molar enthalpy of the fusion of ice.(melting of ice) • Calculate the total volume of the two solutions (both sulfuric acid and sodium hydroxide) • Calculate the mass of the two solutions combined • Calculate the molar enthalpy of sulfuric acid	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Boiling point elevation and molar mass Students will: • Determine the change in boiling point from the observed boiling point of the solution and the boiling point of the pure solvent • Determine the molar concentration, m, from the change in boiling point and the boiling point elevation constant • Determine the moles of unknown (the solute) from the molality of the solution and the mass of solvent (in kilograms) used to make the solution • Determine the molar mass from the mass of the unknown and the number of moles of unknown	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Equilibrium and expressions Students will: • Observe and describe some reactions, which are easily reversible, and some, which are not easily reversible. • Consider the implications for a system when the rates of the forward and the reverse reactions that define the system are equal.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 5.1, 5.3, 6.1, 6.2,

• Discuss non-chemical analogies, which illustrate or simulate equilibria. • Distinguish between dynamic equilibria and steady-state processes. • Discuss the influence of free energy on the spontaneity of reactions. • Understand why Le Chatelier's principle works. • Use Le Chatelier's principle to predict how various equilibrium systems will shift in response to external stress and then conduct a series of experiments altering, first the temperature in a stable chemical reaction and then the concentration effects. • Write a detailed lab report citing all steps taken in the scientific method. • Discuss industrial applications of Le Chatelier's principle.		6.3, 6.4
Acid-base titration Students will: • Perform an acid-base titration to determine the concentration of an acid solution • Use the results to calculate the unknown concentration of an acid or a base • Given data from three or more titrations, students should be able to identify the strongest concentration of unknown	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 5.2, 6.1, 6.2, 6.3, 6.4
Buffering (Acid-base) Students will: • Compare an unbuffered solution with a buffered solution by using the technique of titration • Interpret explanations of the effects of buffers • Collect data and record figures • Graph data and figures	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4

• Write a detailed lab report citing all steps taken in the scientific method.		
Reaction rate Students will: • Determine the rate of reaction at a given point in time • Determine the stoichiometric coefficients for a chemical reaction • Explore variables that affect reaction rate by experimentation. • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 6.1, 6.2, 6.3, 6.4
Redox titration Students will: • Find the % hydrogen peroxide in a commercially sold solution • Find the % iron in an unknown iron salt • Write the balanced net ionic equation for the reaction • Identify the oxidizing and reducing agents • Write a detailed lab report citing all steps taken in the scientific method.	A, B	**Content** 1.1, 1.2, 1.3, 1.4, 1.5, 2.3, 2.4 **Process** 1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 6.1, 6.2, 6.3, 6.4

Resources

Standards

National Science Standards (5th ed). (1998). National Research Council, Washington, D.C., National Academy of Sciences

Oklahoma Priority Academic Student Skills (2003). Oklahoma State Department of Education-PASS-{ *www.sde.state.ok.us*}

Textbooks

Zumdahl, Steven (2003). *Introductory Chemistry: A Foundation* (5th ed.). Boston: Houghton Mifflin.

Corwin, (2005). *Introductory Chemistry: Concepts and Connections*(4th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

Hill, Petrucci (2005). *General Chemistry* (4th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

Singh, M.M., Pike, R.M., Szafran, Z. (1995). *Microscale and Selected Macroscale Experiments for General and Advanced General Chemistry: An Innovative Approach* (1st ed.). John Wiley & Sons, Inc.

Burns, Ralph A. (2003). *Fundamentals of Chemistry in the Laboratory*(4th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

Corwin, (2006). *Lab Manual Introductory Chemistry* (4th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

Gloffke, Wendy and Doris Kimbrough (2002). *Introductory Chemistry Laboratory Manual* (2nd ed.). San Francisco, CA: Benjamin Cummings.

Tyner, Kathy L. (1995). *Laboratory Exercises for Preparatory Chemistry* (1st ed.). New York, NY: McGraw-Hill.