PRE-AP CHEMISTRY
Course Syllabus

Course Number: STEM-0016
OCAS Code: 5051
Course Length: 120 Hours
Career Cluster: Science, Technology, Engineering and Mathematics
Career Pathway: Engineering and Technology
Career Major(s): Pre-Engineering Aerospace, Pre-Engineering Civil & Architecture, Pre-Engineering Mechanical, Biotechnology, PLTW Biomedical Science and Medicine
Pre-requisite(s): Algebra I, Biology I

Course Description: Pre-AP 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.


Course Objectives:

A. Observe and Measure.
1. Identify qualitative changes in reactions and quantitative changes in chemical reactions given conditions (e.g., temperature, mass, volume, time, position, length) before, during, and after an event. (PS 1.1)
2. Use appropriate tools (e.g., metric ruler, graduated cylinder, thermometer, balances, spring scales, stopwatches) when measuring objects and/or events. (PS 1.2)
3. Use appropriate System International (SI) units (i.e., grams, meters, liters, degrees, celsius, and seconds); and SI prefixes (i.e., micro-, milli-, centi-, kilo-) when measuring mass volume and temperature. (PS1.3)

B. Classify.
1. Using observable properties, place an object or event (i.e., chemical versus physical, electrons into charge, electron levels, and reaction types) into a classification system. (PS 2.1)
2. Identify properties by which a classification system is based. (PS 2.2)
C. **Experiment.**
1. Evaluate the design of a chemistry laboratory investigation. (PS 3.1)
2. Identify the independent variables, dependent variables, and controls in an experiment. (PS 3.2)
3. Use mathematics to show relationships within a given set of observations (i.e., conservation of mass and stoichiometry). (PS 3.3)
4. Identify a hypothesis for a given problem in chemistry investigations. (PS 3.4)
5. Recognize potential hazards and practice safety procedures in all chemistry laboratory activities. (PS 3.5)

D. **Interpret and Communicate.**
1. Select appropriate predictions based on previously observed patterns of evidence. (PS 4.1)
2. Report data in an appropriate manner. (PS 4.2)
3. Interpret data tables, line, bar, trend, and/or circle graphs. (PS 4.3)
4. Accept or reject hypotheses when given results of a chemistry investigation. (PS 4.4)
5. Evaluate experimental data to draw the most logical conclusion. (PS 4.5)
6. Prepare a written report describing the sequence, results, and interpretation of a chemistry investigation or event. (PS 4.6)
7. Communicate or defend scientific thinking that resulted in conclusions. (PS 4.7)
8. Identify and/or create an appropriate graph or chart from collected data, tables, or written description. (PS 4.8)

E. **Model.**
1. Interpret an atomic model which explains a given set of observations. (PS 5.1)
2. Select predictions based on models such as electron configuration, bonding, and compound formation. (PS 5.2)
3. Compare a given model to the physical world. (PS 5.3)

F. **Inquire.**
1. Formulate a testable hypothesis and design an appropriate experiment to identify an unknown substance. (PS 6.1)
2. Design and conduct scientific investigations in which variables are identified and controlled. (PS 6.2)
3. Use a variety of technologies, such as hand tools, balances, conductivity apparatus, thermometers, graduated cylinders, volumetric flasks, and computers to collect, analyze, and display data. (PS 6.3)
4. Inquiries should lead to the formulation of explanations or models (physical, conceptual, and mathematical). In answering questions, students should engage in
discussions (based on scientific knowledge, the use of logic, and evidence from the investigation) and arguments that encourage the revision of their explanations, leading to further inquiry. (PS 6.4)

Scientific Mathematics

G. Apply Scientific Notation and Significant Figures in Scientific Calculations. ¹
   1. Express numbers in scientific notation.
   2. Manipulate numbers expressed in scientific notation back to simple numbers.
   3. Determine the correct number of significant figures in given values.
   4. Manipulate values expressing the results in the correct number of significant figures.

H. Convert Within and Between English and Metric Measurement Systems. ¹,²
   1. Define and demonstrate the relative size of units in the metric system. (PS 1.3)
   2. Measure distance, area, volume, and weight in English and metric units. PS 1.3²
   3. Manipulate data between English and metric systems.
   4. Manipulate data within the metric system.
   5. Convert temperature units between different temperature systems. (PS 1.3)

I. Perform Concentration Calculations. ¹,²
   1. Set up and solve mathematical problems involving percent and proportions. (PS 3.3)
   2. Perform calculations on parts per million and similar concentrations. (PS 3.3)²
   3. Manipulate values between various types of concentrations.
   4. Describe the units involved in concentrations of molarity, normality, ppm and ppb.

J. Calculate Sample Statistics and Identify Outliers. ¹
   1. Describe the factors necessary to perform statistical calculations on sample data.
   2. Perform standard statistical calculations on sets of data. (PS 3.3)²
   3. Describe the use of the three values generally calculated from statistical sample data.
   4. Identify the probable sources of data sets generated in the laboratory.
   5. Develop control charts with warning limits and control limits. (PS 4.3; 4.8)²
   6. Describe the use of statistics and control charts in the work place. (PS 4.3; 4.8)²

K. Evaluate Data Sets and Data Results, and Identify Outliers. ¹
   1. Identify outliers and hypothesize their causes and corrective action.
   2. Identify the probable sources of data sets generated in the laboratory.
   3. Define the differences in qualitative and quantitative measurements.
   4. Define the differences in precision, accuracy and random data.

Lab Glassware and Equipment
L. **Perform Weighing and Volume Measurements.**
   1. Explain the sensitivity and care of equipment and glassware.
   2. Demonstrate proper use of balances. (PS 1.2; 6.3)
   3. Demonstrate reading volume in graduated glassware. (PS 1.2)
   4. Demonstrate proper use of pipets. (PS 1.2; 6.3)
   5. Identify and use proper glassware to deliver and contain specific volumes. (PS 1.2; 6.3)

M. **Identify and Use Basic Lab Equipment.**
   1. Identify the common equipment used in the laboratory. (PS 1.2; 6.3)
   2. Identify the meaning of the abbreviations used on labware. (PS 6.3)
   3. List the analysis with which each piece of equipment may be associated. (PS 6.3)

N. **Identify and Use Common Heating Equipment Used in Laboratory.**
   1. Identify the common electrical heating equipment used in the laboratory. (PS 6.3)
   2. Demonstrate the use of the common heating equipment. (PS 6.3)
   3. Describe the safety and procedures involved in the use of flame. (PS 3.5)

O. **Operate Basic Support Equipment in the Laboratory.**
   1. Identify the equipment used for support of laboratory operations and the laboratory environment.
   2. Describe the operation and use of support equipment.

**General and Inorganic Chemistry**

P. **Write Atomic and Molecular Structures.**
   1. Differentiate between physical and chemical properties of matter. (CS 1)
   2. Identify the symbols for the common elements. (CS 1.3)
   3. Identify elements, compounds, and mixtures by their properties. (CS 1.3; 1.4)
   4. Describe the structure of the atom and its effect on molecular formulas. (CS 1.1; 1.2)
   5. Describe the order and use of the Periodic Table. (CS 1.3)
   6. Use the mole concept to convert between moles and grams. (CS 2.3)

Q. **Define Oxidation States and Balance Reactions.**
   1. Write formulas for polyatomic ions and transition metals. (CS 2) (PS 3.3)
   2. Identify different chemical reactions. (CS 2; 2.1)
   3. Balance chemical equations. (CS 2.4)
   4. Write chemical equations for simple reactions. (CS 2) (PS 3.3)
   5. Solve simple stoichiometric problems. (PS 3.3)
   6. Balance simple basic chemical reactions. (CS 2.4)

R. **Utilize the Fundamentals of Acid/Base Reactions in Laboratory Analysis.**
   1. Describe the active ions in acids and bases. (CS 2)
   2. Predict, write and balance acid/base neutralization equations. (CS 2.4)
   3. Calculate normality and molarity of ionic compounds. (PS 3.3)

S. **Manipulate Molecular Quantities Including Formula Weights and Moles.**
   1. Calculate formula weights and molecular weights. (PS 3.3)
2. Calculate percent composition. (PS 3.3)²
3. Use formula weights and molecular weights in equations. (PS 3.3)²
4. Determine the molarity of solutions mathematically. (PS 3.3)²

T. Perform pH Measurements With pH Papers and pH Meters.¹ ²
   1. Explain the meaning of pH. (CS 1.2)²
   2. Define the pH scale. (PS 2.1; 2.2)²
   3. Use litmus and pH papers to test the pH of various solutions. (PS 6.3)²
   4. Calibrate a pH meter and test the pH of various solutions. (PS 6.3)²
   5. Describe the safety and care of electrodes. (PS 3.5)²

U. Perform Manual Acid/Base Titration.¹ ²
   1. Assemble a titration apparatus. (PS 6.3)²
   2. Explain the simple acid/base reaction. (CS 2.2; 2.3)²
   3. Explain the use of indicators. (CS 2.2; 2.3)²
   4. Read a buret properly. (PS 6.3)²
   5. Perform a manual acid/base titration to end point. (CS 2.2)²
   6. Calculate molarity using the standard titration calculation. (PS 2.3) (PS 3.3)²

V. Perform Inorganic/Organic Extractions.¹ ²
   1. Assemble a simple extraction apparatus. (PS 6.3)²
   2. Explain the principle of extraction. (PS 6.4)²
   3. Define in detail the safety concerns of extraction. (PS 3.5)²
   4. Perform a simple organic/inorganic extraction. (PS 3)²
   5. Use scientific method in experiment. (PS 6)

W. Identify Characteristic Physical Properties of Common Inorganic Chemicals.¹ ²
   1. Describe the characteristics of concentrated acids and bases. (PS 2.1; 2.2) (CS 1.4)²
   2. Explain and determine the pH properties of inorganic chemicals. (PS 2.1; 2.2) (CS 1.4)²
   3. Explain and determine the color properties of inorganic chemicals. (PS 2.1; 2.2) (CS 1.4)²
   4. Explain and determine the odor properties of inorganic chemicals. (PS 2.1; 2.2) (CS 1.4)²

X. Name Simple Inorganic and Molecular Compounds.¹
   1. Name and write formulas for binary and polyatomic inorganic compounds. (PS 2.1)²
   2. Name and write formulas for binary molecular compounds. (PS 2.1)²
   3. Name binary and polyatomic inorganic compounds. (PS 2.1; 2.2)²
   4. Name binary molecular compounds. (PS 2.1; 2.2)²
   5. Identify between ionic and molecular compounds. (PS 2.1; 2.2)²
   6. Identify base or acid ionic compounds. (PS 2.1; 2.2)²

¹ODCTE objective
²Priority Academic Student Skills (PASS) – High School Chemistry  PS=Process Standard  CS=Content Standard
Teaching Methods: The class will primarily be taught by the lecture and demonstration method and supported by various media materials to address various learning styles. There will be question and answer sessions over material covered in lecture and media presentations. Supervised lab time is provided for students to complete required projects.

Grading Procedures: 1. Students are graded on theory and shop practice and performance. 2. Each course must be passed with seventy (70%) percent or better. 3. Grading scale: A=90-100%, B=80-89%, C=70-79%, D=60-69%, F=50-59%.

Description of Classroom, Laboratories, and Equipment: Tulsa Technology Center campuses are owned and operated by Tulsa Technology Center School District No. 18. All programs provide students the opportunity to work with professionally certified instructors in modern, well-equipped facilities.

Available Certifications/College Credit: The student may be eligible to take state, national or industry exam after completion of the program. College credit may be issued from Oklahoma State University-Okmulgee or Tulsa Community College. See program counselor for additional information.

College Credit Eligibility: The student must maintain a grade point average of 2.0 or better.