Chemistry Part 2
Course Outline & Objectives

Course Description:

This chemistry course provides a comprehensive exploration of fundamental and advanced chemical concepts, starting with stoichiometry and solubility to understand the quantitative relationships in chemical reactions and the dissolution of substances. Students will delve into enthalpy to explore heat changes in reactions and gas laws to analyze the behavior of gases under varying conditions. The course also covers reaction rates to investigate the speed of chemical reactions and introduces nuclear chemistry to understand radioactive processes and their applications. Additionally, students will get an overview of organic chemistry, focusing on the structure, properties, and reactions of carbon-containing compounds. This course integrates theoretical principles with practical applications to build a solid and comprehensive understanding of chemistry.

Credits - One Semester (0.5 Carnegie unit / CA: 5 credits)

Course Outline

Unit 1: Stoichiometry and Enthalpy

1.0 Introduction
1.1 Stoichiometry
1.2 Limiting and Excess Reactants
1.3 Percentage Yield
1.4 Energy and Heat
1.5 Enthalpy
1.6 Calorimetry and Enthalpy of Ice
1.7 Energy in our World Today and Tomorrow

Next Generation Science Standards

In Unit 1, students will review writing balanced equations and convert between units. They will also learn the importance of stoichiometry, the difference between heat and energy, what the enthalpy of a reaction is, and how it is calculated. Students will practice the scientific method as they complete each lab. They will also explore, through multimedia and research, information about fossil fuels and climate change. They will examine current forms of energy and some "alternative" types of energy used in our world today and evaluate what the energy of the future may be.

[HS-PS1-7] [HS-PS1-1] [HS-PS1-2] [PS1.A] [PS1.B] [HS-PS1-3] [HS-PS1-5] [HS-PS1-6] [HS-PS3-1] [HS-PS1-4] [PS3.A] [HS-PS3-2] [PS3.B] [HS-PS3-4] [HS-PS3-3]

Unit 2: Solutions and Solubility

2.1 Water and Life
2.2 Properties of Solutions
2.3 The Dissolving Process
2.4 Solubility and Saturation
2.5 Molarity and Dilutions
2.6 Solubility
2.7 Colligative Properties
2.8 Freezing Point Depression

Unit 2 introduces the chemistry of solutions. Water is introduced for four reasons life requires water. Students will learn why water acts as a wonderful solvent and provides a medium for metabolism. Properties of solutions, including the terminology of solvent and solute, mixtures, and entropy, are all discussed. The factors that affect solubility, interpreting solubility curves and exploring colligative properties will be learned. This unit discusses saturated, unsaturated, and supersaturated solutions. The students will receive experience making solutions and observing freezing point depression in sugar solutions.

[HS-PS1-3] [HS-PS1-6] [HS-LS1-1] [HS-LS1-2] [PS1.A] [LS1.C] [HS-PS1-2] [HS-PS1-4] [PS1.B] [HS-PS1-2] [HS-PS1-5] [HS-PS1-7] [SEP] [DCI] [HS-PS2-6] [PS2.B]

Course Outline

Unit 3: Acids and Bases

3.1 Properties of Acids and Bases and the Arrhenius Theory
3.2 Bronsted-Lowry Theory of Acids and Bases
3.3 The pH Scale
3.4 pH and pH Indicators
3.5 Strong and Weak Acids and Bases and Ocean Acidification
3.6 Chemical Equilibrium and Ka
3.7 Buffers
3.8 Buffers

Next Generation Science Standards

Unit 3 is an introduction to acids and bases. Students learn and study their general properties and the Arrhenius definitions for acids and bases. Bronsted and Lowry's theory will be looked at so that students can compare and contrast these theories. Students learn how to distinguish between strong and weak acids and bases in terms of the extent of dissociation, reaction with water, and electrical conductivity. The pH scale is reviewed, and students learn and consider the effects of acid deposition on limestone buildings and living things. Students will examine the chemistry of ocean acidification. An analysis of a strong acid and strong base is also included. Students have the opportunity to use their analytical and critical thinking skills by learning how to solve equilibrium and Ka or Kb calculations. The student will learn what a buffer is, how to make one, and the importance of buffers in our body.

[HS-PS1-2] [HS-PS1-4] [HS-PS1-3] [HS-PS1-5] [HS-PS1-7] [HS-PS1-1] [HS-PS1-6] [PS1.A] [PS1.B] [PS1.A] [HS-ESS3-6] [HS-LS1-6] [HS-ETS1-3]

Unit 4: Gases

4.1 Kinetic Molecular Theory of Gases
4.2 Pressure, Volume, Temperature
4.3 Boyle's Law
4.4 Ideal Gas Law
4.5 Ideal Gas Law Problems
4.6 Charles Law
4.7 Gas Law Stoichiometry

Unit 4 introduces students to gases as related to the study of Chemistry. This Unit introduces the assumptions behind the Kinetic Molecular Theory and explains some general properties of gases from a molecular perspective. Gas laws are introduced and discussed. The gas laws include Avogadro's Law, Boyle's Law, Lussac's Law, and Charles' Law. Students also learn and discuss how the ideal gas equation allows them to find pressure, volume, temperature, or number of moles. Using images from NASA, the students will also explore global images of climate change.

[PS1.A] [HS-PS1-4] [HS-PS1-5] [HS-PS1-7] [HS-PS2-6] [PS3.B] [HS-PS3-2] [PS3.A] [ESS2.D] [ESS3.D] [HS-ESS2-4] [HS-ESS3-5] [MS-ESS3-3]

Unit 5: Kinetics

5.1 Rates of Reaction
5.2 Reaction Order
5.3 Catalysts and Reaction Rates
5.4 Rates of Reaction - Concentration
5.5 Equilibrium Constant
5.6 LeChatelier's Principle
5.7 Rates of Reaction - Temperature

Unit 5 discusses ways to measure and consider the rate of a reaction. Students discuss the connection between concentration and reaction rate in terms of the Law of Mass Action and Rate Laws. The equilibrium constant (K) is defined, and students learn how it can be calculated in various reversible reactions. Students learn Le Chatelier's Principle and how it predicts changes in concentration when "stressing" reactions at equilibrium. Reaction orders and the effect of catalysts on the rate of reaction will be studied, and the students will evaluate graphically and mathematically the order of a reaction with respect to each reactant.

[HS-PS1-6] [HS-PS1.B] [HS-PS1-5] [HS-PS1-4] [HS-PS3.A] [HS-PS1-7] [HS-ETS1-3]

Course Outline

Unit 6: Nuclear and Organic Chemistry

6.1 Introduction to Nuclear Chemistry
6.2 Radioactive Decay and Half-Life
6.3 Uses of Radioisotopes and the Effects of Radiation
6.4 Introduction to Organic Chemistry
6.5 Organic Chemistry and Biology
6.6 Organic Chemistry in Everyday Life

Next Generation Science Standards

In Unit 6, students will learn about nuclear structure and stability, radioactive decay, and nuclear energy. Students will focus on the biological effects of radiation as well as technology related to energy, medicine, geology, and other areas. Students will examine various data sources about nuclear energy as well as major accidents that have occurred. Specifically, students will learn about the Chernobyl and Fukushima nuclear accidents. Students will be given an introduction to organic chemistry. Students will examine why the element carbon results in such a variety of compounds, how those compounds are classified, and the role of organic compounds in biology and industry. They will also be exposed to the importance of functional groups and how they play a role in the structure and function of organic compounds.

[HS-PS1-8] [HS-PS1-1] [HS-PS4-3] [HS-PS3-3] [HS-ESS3-4] [HS-PS1-2] [HS-PS1-3] [HS-PS2-6] [HS-LS1-6] [HS-LS1-7] [HS-PS1-5] [HS-ETS1-4] [HS-PS1-4]