

Comprehensive Chemistry

COURSE DESCRIPTION: This comprehensive course gives students a solid basis to move on to future studies. The 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, virtual laboratories, and related assessments, used with a problem-solving book.

PREREQUISITES: Satisfactory completion of either Middle school Physical Science or Physical Science and solid grasp of algebra basics, evidenced by success in Algebra I (or equivalent)

COURSE LENGTH: Two Semesters

REQUIRED TEXT: Chemistry: Problems and Solutions

MATERIALS LIST: No required materials for this course

COURSE OUTLINE:

Semester 1

Unit 1: The Study of Chemistry

- Semester Introduction
- Chemistry and Society
- Matter and Energy
- Pure Substances
- Mixtures
- Laboratory: Paper Chromatography 1
- Laboratory: Paper Chromatography 2
- Properties of Substances
- Problem Solving in Chemistry
- Metric System: Base Units
- Metric System: Derived Units
- Graphing
- Scientific Method and Chemistry

Unit 2: Atomic Structure

- Early Theories of the Atom
- The Nuclear Atom
- Atomic Number and Mass Number
- Ions
- Isotopes and Atomic Mass
- Laboratory: Properties of Substances 1
- Laboratory: Properties of Substances 2
- The Bohr Atom
- Electron Orbitals
- The Quantum Atom and Atomic Spectra

Unit 3: The Periodic Table

- Atomic Number and the Periodic Law
- The Periodic Table
- Electron Arrangement Patterns
- Trends within the Periodic Table
- Metals
- Nonmetals
- Laboratory: Reaction of Metals 1
- Laboratory: Reaction of Metals 2
- Metalloids
- Inner Transition Metals

Unit 4: Chemical Bonding

- Monatomic Ions
- Polyatomic Ions
- The Ionic Bond and Salts
- Properties of Ionic Compounds
- Naming Ionic Compounds
- Laboratory: Salts: Precipitation Reactions 1
- Laboratory: Salts: Precipitation Reactions 2
- Bonding in Metals
- The Covalent Bond and Molecules

- Lewis Structures
- Molecular Shapes
- Van der Waals Forces

Unit 5: Chemical Reactions

- The Conservation of Mass
- Balancing Chemical Equations
- Combustion Reactions
- Synthesis Reactions
- Decomposition Reactions
- Oxidation-Reduction Reactions
- Single Displacement Reactions
- Double Displacement Reactions
- Laboratory: Chemical Reactions 1
- Laboratory: Chemical Reactions 2

Unit 6: Stoichiometry

- Stoichiometry and Its Uses
- Mole-Number Relationships
- Mole-Mass Relationships
- Mole-Volume Relationships
- Moles and Chemical Equations
- Laboratory: Stoichiometry of Chemical Reactions 1
- Laboratory: Stoichiometry of Chemical Reactions 2
- Calculating Yields of Reactions
- Percent Yield

Unit 7: Semester Review and Test

- Semester Review
- Semester Test

Semester 2

Unit 1: States of Matter

- Semester Introduction

- The Behavior of Gases
- Boyle's Law
- Charles's Law
- Gay-Lussac's Law
- Laboratory: Gas Laws 1
- Laboratory: Gas Laws 2
- The Ideal Gas Law
- Absolute Zero
- Dalton's Law of Partial Pressures
- Graham's Law of Effusion
- Phase Diagrams
- Some Properties of Liquids
- Some Properties of Solids

Unit 2: Solutions

- Solutions
- The Dissolving Process
- Laboratory: Factors Affecting Solution Formation 1
- Laboratory: Factors Affecting Solution Formation 2
- Molarity and Mole Fraction
- Molality and Mass Percent
- Colligative Properties
- Separating Solutions

Unit 3: Acids and Bases

- Properties of Acids and Bases
- Arrhenius Acids and Bases
- Bronsted-Lowery and Lewis Acids and Bases
- Measuring Acids and Bases
- Buffers and Titration
- Laboratory: Titration: Testing Water Quality 1
- Laboratory: Titration: Testing Water Quality 2
- Strength of Acids and Bases

Unit 4: Chemical Thermodynamics

- The Conservation of Energy
- Measuring the Flow of Heat
- Laboratory: Heat Transfer 1
- Laboratory: Heat Transfer 2
- Specific Heat
- Changes in Enthalpy
- Writing Thermochemical Equations
- Heat during Changes of State
- Hess's Law

Unit 5: Reaction Rate and Equilibrium

- Factors Affecting Reaction Rates
- Laboratory: Reaction-Rate Factors 1
- Laboratory: Reaction-Rate Factors 2
- Collision Theory
- Equilibrium
- Le Chatelier's Principle
- Spontaneous Reactions
- Entropy and Free Energy

Unit 6: Electrochemistry

- Electrochemical Processes
- Voltaic Cells
- Laboratory: Electroplating 1
- Laboratory: Electroplating 2
- Dry Cells
- Electrolytic Cells

Unit 7: Organic Chemistry

- Hydrocarbons and Other Organic Chemicals
- Laboratory: Modeling Organic Compounds
- Polymers
- Carbohydrates and Fats

- Proteins and Nucleic Acids

Unit 8: Nuclear Chemistry

- Forces within the Nucleus
- Radioactivity and Half-Life
- Laboratory: Calculating Half-Life
- Transmutation of Elements
- Nuclear Fission and Fusion

Unit 9: Semester Review and Test

- Semester Review
- Semester Test