AP* Chemistry builds studentsâ€™ understanding of the nature and reactivity of matter. After studying the structure of atoms, molecules, and ions, students move on to solve quantitative chemical problems and explore how molecular structure relates to chemical and physical properties. Students will examine the molecular composition of common substances and learn to predictably transform them through chemical reactions. The equivalent of an introductory college-level chemistry course, AP Chemistry prepares students for the AP exam and for further study in science, health sciences, or engineering.

This course requires students to complete hands-on lab activities that depend on access to supervised laboratory facilities.

*AP is a registered trademark of the College Board.

Length: Two semesters

UNIT 1: WELCOME TO CHEMISTRY

LESSON 1: WHAT IS CHEMISTRY?

Discuss: Getting Acquainted
Introduce yourself to your classmates and instructor, learn who your classmates are and why they're taking this course, and become familiar with communicating in an online environment.
Duration: 0 hr 30 min Scoring: 15 points

Study: States of Matter
Review key concepts about the states of matter and the classification of matter (elements, compounds, and mixtures). Become acquainted with the tools chemists use to separate mixtures.
Duration: 1 hr

Discuss: What Would You Call This?
Join a debate on how to classify a substance that challenges the standard definitions of solid, liquid, and gas.
Duration: 0 hr 30 min Scoring: 15 points

Study: What Is the AP Chemistry Course?
Learn about the content of the AP Chemistry course, explore important study tips for success in AP courses, and read about policies and procedures for taking the AP Exam.
Duration: 1 hr

Study: Mastering Chemistry Skills
Review exponential notation, SI units, dimensional analysis, graphing, and algebraic operations.
Duration: 1 hr

Study: Measurement in Chemistry
Learn about the measurements chemists make in the laboratory and how to express the accuracy and precision of these measurements.
Duration: 1 hr

Practice: Check Your Chemistry Skills
Practice problems covering the important mathematical skills needed for success in chemistry.

Duration: 1 hr 30 min Scoring: 40 points

Lab: Measurement and Uncertainty
Learn about lab reports and practice gathering data.
Duration: 1 hr Scoring: 40 points

LESSON 2: STRUCTURE OF ATOMS

Study: Atomic Theory and Structure
Learn the key postulates of Dalton's Atomic Theory and the historically significant experiments that verified Dalton's theory.
Duration: 1 hr

Discuss: Do You Trust The Data?
Review the original data from experiments used to determine the structure of the atom, then decide whether you "believe" in atoms, based on this data.
Duration: 0 hr 30 min Scoring: 15 points

Study: Nuclear Structure
Learn the fundamental features of the nucleus: protons, neutrons, isotopes, atomic number, and atomic mass.
Duration: 1 hr

Practice: Dalton: Applying Postulates
Practice your skills at calculating relative atomic masses, isotopic abundance, and numbers of protons and neutrons in various atoms.
Duration: 1 hr 30 min Scoring: 40 points

Study: Molecules and Molecular Substances
Learn what molecules are and see how chemists represent them and name them.
Duration: 1 hr

Quiz: Molecular Structures and Models
Answer online questions about names and representations of molecular compounds.
Duration: 0 hr 45 min Scoring: 10 points

LESSON 3: IONS

Study: Ions and Ionic Substances
Learn how to name and write formulas of ionic compounds.
Duration: 1 hr

Quiz: Working with Ionic Compounds
Answer online questions that test your mastery of the names and representations of ionic compounds. Includes analysis of laboratory data on the mass percent water in a hydrate.
Duration: 0 hr 45 min Scoring: 10 points

Practice: Ionic or Molecular?
Use what you've learned about ionic and molecular substances to answer questions about their names and structures.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Atoms, Ions, and Molecules
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

LESSON 4: WRAP-UP

Review: Welcome to Chemistry
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Welcome to Chemistry
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Welcome to Chemistry
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 5: DIAGNOSTIC

Diagnostic: Welcome to Chemistry
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 30 points

UNIT 2: PERIODIC TRENDS AND ELECTRONIC STRUCTURE

LESSON 1: REACTIONS IN SOLUTION

Study: Ions and Molecules in Solution
Learn about the behavior of ions and molecules in solution. See the connection between the macroscopic behavior of a solution and the microscopic behavior of the atoms or ions that make up the compound.
Duration: 1 hr

Discuss: What Do You Think Will Happen?
Read some data about the physical properties of two compounds; then use this data to predict the compounds' behavior as an electrolyte under various conditions. Discuss your predictions with your classmates and respond to their ideas.
Duration: 0 hr 30 min Scoring: 15 points

Study: Chemical Equations
Learn how to write balanced chemical equations of several types: molecular equations, complete ionic equations, and net ionic equations.
Duration: 1 hr

Practice: Balancing a Chemical Equation
Practice balancing chemical equations as you work through a complex example step by step.
Duration: 0 hr 45 min

Practice: Writing Chemical Equations
Practice writing and balancing molecular equations. Complete ionic equations and net ionic equations.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: SURVEY OF CHEMICAL REACTIONS

Study: Precipitation Reactions
Learn how to use the solubility rules as a vehicle for predicting the products of chemical reactions. Explore an important laboratory application of the solubility rules.
Duration: 1 hr

Practice: Predicting Precipitation Reactions
Given a description of a reaction, write the structures of the reactants, determine if there is a precipitate, and provide a net ionic equation if a precipitate forms.

Duration: 1 hr 30 min

Study: Acid-Base Reactions
Learn the vocabulary used in acid-base reactions, then review equation-writing using neutralization reactions.
Duration: 1 hr 30 min

Quiz: Can You Find the Acid or Base?
Answer online questions about the type of acid or base (Arrhenius, Bronsted-Lowry, Lewis) in a chemical reaction.
Duration: 0 hr 45 min Scoring: 10 points

Study: Oxidation-Reduction Reactions
Learn the basic concepts of oxidation reduction ("redox") reactions and explore four kinds redox reactions.
Duration: 1 hr 30 min

Practice: Oxidation Numbers and Half Reactions
Practice balancing redox reactions using the half-reaction method.
Duration: 0 hr 45 min

Lab: Metals and Metal Ions
Observe various chemical reactions in an activity series.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Predicting Reaction Products
Do an integrative exercise to decide if a reaction occurs. If a reaction occurs, give a balanced net ionic equation for the formation of any products. If no reaction occurs, explain why.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Chemical Reactions
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

LESSON 3: WRAP-UP

Review: Periodic Trends and Electronic Structure
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Periodic Trends and Electronic Structure
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Periodic Trends and Electronic Structure
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Chemical Reactions
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 32 points

UNIT 3: QUANTITATIVE RELATIONSHIPS IN CHEMICAL REACTIONS

LESSON 1: MASSES AND MOLES

Study: Weights and Masses
Learn how to use atomic mass units to calculate molecular weight and formula weight.

Duration: 1 hr

Quiz: Calculating Weights and Masses
Answer online questions involving calculations of formula weight, molecular weight, and molar mass
Duration: 0 hr 45 min Scoring: 10 points

Study: The Mole Concept
Learn about the basic unit of chemical calculations: the mole. Extend your understanding by exploring related ideas such as Avogadro's number and molar mass.
Duration: 1 hr

Discuss: How Big Is a Mole?
Devise fun "mole" problems (such as "a mole of chocolate cookies would circle the globe X times"), solve the problem, and explain how you solved it. Propose and discuss alternate solutions to someone else's example.
Duration: 0 hr 30 min Scoring: 15 points

Lab: Analysis of a Hydrate
Observe the heating of a hydrated salt, form a hypothesis, and then conduct a quantitative experiment to test the hypothesis.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: CALCULATIONS WITH CHEMICAL EQUATIONS

Study: Mole Calculations
Learn more about the "Mole Concept" by applying it to advanced problems, such as mass percentage or determination of empirical and molecular formulas. Conduct a simulated synthesis and analysis of a simple compound.
Duration: 1 hr

Practice: Grams, Moles, and Formulas
Answer problems using calculations that relate amounts of products and reactants.
Duration: 1 hr 30 min Scoring: 40 points

Study: Stoichiometry, Part I
Explore the relationship between the mole concept and chemical reactions. Learn strategies for relating the amount of reactant and product in a chemical equation.
Duration: 1 hr 30 min

Quiz: How Much Will It Take?
Answer a set of stoichiometry problems.
Duration: 1 hr Scoring: 10 points

Lab: The Formula of a Compound
Analyze the silver found in an alloy using proper lab techniques.
Duration: 1 hr 30 min Scoring: 40 points

Study: Stoichiometry, Part II
Explore laboratory applications of stoichiometry by carrying out a simulated oxidation-reduction titration to standardize a solution of potassium permanganate.
Duration: 1 hr 30 min

Practice: Synthesis and Analysis of an Iron (III) Compound
Explore a laboratory simulation of the synthesis of a transition metal-ligand complex. Analyze data for the determination of metal, ligand, and water of hydration to find the formula of the complex.
Duration: 0 hr 45 min

Lab: Mass-Mole Relationships
Practice finding coefficients for two chemical reactants which would appear in balanced chemical equations.
Duration: 2 hr Scoring: 40 points

Lab: Analysis of Vitamin C
Prepare a standardized DCIP solution and use it to analyze over-the-counter Vitamin C tablets.
Duration: 1 hr 30 min Scoring: 40 points

Discuss: Share Your Secrets
Share your tips and tricks for solving stoichiometry problems.
Duration: 0 hr 30 min Scoring: 15 points

Practice: Chemical Calculations
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

LESSON 3: WRAP-UP

Review: Quantitative Relationships in Chemical Reactions
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Quantitative Relationships in Chemical Reactions
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Quantitative Relationships in Chemical Reactions
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Quantitative Relationships in Chemical Reactions
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 20 points

UNIT 4: THERMOCHEMISTRY

LESSON 1: OVERVIEW OF THERMOCHEMISTRY

Study: Energy: Definitions and Units
Learn about four kinds of energy: kinetic, potential, internal, and heat energy.
Duration: 1 hr

Practice: Exploring Energy and Its Units
Complete a set of problems involving calculations of energy and conversion between energy units
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: FIRST LAW OF THERMODYNAMICS

Study: First Law, Part I
Learn about enthalpy and enthalpy change. Use these concepts to explore heat capacity, specific heat, and heat of reaction.
Duration: 1 hr 30 min

Quiz: Using the First Law
Answer questions that require you to practice the calculations presented in this lesson.

Duration: 0 hr 45 min Scoring: 10 points

Study: First Law, Part II
Learn how to apply the concept of enthalpy to more complex chemical systems, including calorimetry, heat of formation, and Hess's Law.
Duration: 1 hr 30 min

Practice: Thermochemistry
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

Practice: Thermochemical Calculations
Use the first law of thermodynamics in a laboratory simulation in which you determine the heat of solution of an ionic compound.
Duration: 0 hr 45 min

Lab: Heat of a Reaction
Use data from various chemical reactions to verify Hess's law.
Duration: 1 hr 30 min Scoring: 40 points

Discuss: Heat and Temperature: What Is the Difference?
Explain in your own words what "heat" and "temperature" really mean, and respond to your classmates' definitions.
Duration: 0 hr 30 min Scoring: 15 points

Practice: More Thermochemical Calculations
Complete a set of thermochemistry problems.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: WRAP-UP

Review: Thermochemistry
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Thermochemistry
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Thermochemistry
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Thermochemistry
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 22 points

UNIT 5: ATOMIC STRUCTURE AND PERIODICITY

LESSON 1: THE NATURE OF MATTER

Study: Light: Waves and Photons
Learn about important features of light, including frequency, wavelength, and quantization.
Duration: 1 hr

Quiz: Energy, Frequency, and Wavelength
Answer online questions involving relationships between energy, frequency, and wavelength.
Duration: 0 hr 45 min Scoring: 10 points

Discuss: What Is a Color?
Discuss a question about light and color that will stretch your understanding of these two concepts.
Duration: 0 hr 30 min Scoring: 15 points

Study: Bohr Model of the Hydrogen Atom
Learn why atomic line spectra are evidence for the quantization of electron energy levels and energy level transitions.
Duration: 1 hr

Practice: Spectrophotometry
Explore a laboratory simulation of spectrophotometry, and learn about Beer's Law in the context of determining the concentration of chlorophyll in an unknown solution.
Duration: 0 hr 45 min

LESSON 2: QUANTUM THEORY

Study: Introduction to Quantum Mechanics
Learn the basic principles of quantum mechanics, quantum numbers, and atomic orbitals.
Duration: 1 hr

Quiz: Quantum Numbers and Atomic Orbitals
Answer questions about allowed combinations of quantum numbers, size, and shape of atomic orbitals, and so on.
Duration: 0 hr 45 min Scoring: 10 points

Study: Electron Energy Levels
Extend your understanding of quantum mechanics to the electronic structure of atoms. Learn about the electron configuration of atoms and see how the periodicity of the elements can be explained by their electron configurations.
Duration: 1 hr 30 min

Practice: Atomic Structure and Periodicity
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

Practice: Electron Configuration
Answer free-response questions about electron configuration.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: STRUCTURE AND PERIODICITY

Study: Periodic Trends and Electronic Structure
Learn about important periodic trends including atomic radius, ionic radius, ionization energy, and electron affinity.
Duration: 1 hr

Practice: Periodic Trends
Explore periodic trends in chemical and physical properties of the elements by completing a series of interactive exercises.
Duration: 0 hr 45 min

Lab: The Spectrum of Copper(II)
Investigate the stoichiometry of the reaction between copper(II) sulfate and potassium hydroxide.

Duration: 2 hr Scoring: 40 points

Practice: Periodicity and Structure
Answer several essay questions about key concepts in this lesson and their relationship to concepts introduced in the previous lesson.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 4: WRAP-UP

Review: Atomic Structure and Periodicity
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Atomic Structure and Periodicity
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Atomic Structure and Periodicity
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 5: DIAGNOSTIC

Diagnostic: Atomic Structure and Periodicity
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 40 points

UNIT 6: CHEMICAL BONDING

LESSON 1: REPRESENTATIONS OF CHEMICAL BONDS

Study: Lewis Structures
Learn to write electron dot structures for atoms. Use the octet rule to write electron dot structures for molecules, including ones with more than one resonance form.
Duration: 1 hr

Quiz: Lewis Structures
Answer questions about Lewis electron dot structures of atoms and molecules.
Duration: 0 hr 45 min Scoring: 10 points

Practice: Drawing Lewis Structures
Practice drawing Lewis electron dot structures of atoms and molecules (including resonance forms).
Duration: 1 hr 30 min Scoring: 40 points

Lab: Properties of Halogens
Perform qualitative chemical tests for the halogen group of elements to explore reactivity of the halogen family of elements with halides and how that reactivity relates to their Periodic Table positions and their electron configuration.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: TYPES OF CHEMICAL BONDS

Study: Covalent Bonding
Learn about bonding in molecules, and use electronegativity to predict the relative polarity of covalent bonds.
Duration: 1 hr

Quiz: Covalent Bonding

Answer questions about covalent bonding.
Duration: 0 hr 45 min Scoring: 10 points

Study: Ionic Bonding
Learn about bonding in ionic compounds. Explore lattice energy and its calculation using the Born-Haber Cycle.
Duration: 1 hr

Practice: Drawing Lewis Structures
Practice drawing more Lewis structures.
Duration: 1 hr Scoring: 40 points

Practice: Covalent and Ionic Bonding
Work several problems on key concepts in this unit.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: MORE ABOUT BONDING

Study: Properties of Covalent Bonds
Learn about three more features of covalent bonds: bond length, bond order, and bond energy.
Duration: 1 hr

Quiz: Properties of Covalent Bonds
Answer questions about bond length, bond order, and bond energy.
Duration: 0 hr 45 min Scoring: 10 points

Practice: Chemical Bonding
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

LESSON 4: WRAP-UP

Review: Chemical Bonding
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Chemical Bonding
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Chemical Bonding
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 5: DIAGNOSTIC

Diagnostic: Chemical Bonding
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 20 points

UNIT 7: MOLECULAR STRUCTURE, SHAPE, AND PROPERTIES

LESSON 1: BONDING AND MOLECULAR SHAPE

Study: Valence Bond Theory
Learn how to describe a bond as the overlap of atomic orbitals and why chemists use hybrid orbitals to explain some kinds of bonds.
Duration: 1 hr

Quiz: Valence Bond Theory
Answer questions about bonding and hybrid orbitals.
Duration: 0 hr 45 min Scoring: 10 points

Practice: Molecular Orbital Theory
Supplementary readings with practice problems.
Duration: 2 hr 30 min

Study: VSEPR and Molecular Shape
Learn how to use the central atom, bonding electron pairs, and lone electron pairs to predict the shape and polarity of molecules.
Duration: 1 hr

Practice: Molecular Structure and Shape
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

Practice: Using VSEPR
Practice drawing 3D structures of molecules and assigning shape names to molecules whose structures are shown.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: ISOMERISM

Study: Types of Isomers
Learn about the two main classes of isomers: structural isomers and stereoisomers.
Duration: 1 hr

Discuss: What Kind of Isomer?
Share your strategies for classifying molecules according to isomer type.
Duration: 0 hr 30 min Scoring: 15 points

Quiz: Types of Isomers
Answer online questions about isomers.
Duration: 0 hr 45 min Scoring: 10 points

LESSON 3: WRAP-UP

Review: Molecular Structure, Shape, and Properties
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Molecular Structure, Shape, and Properties
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Molecular Structure, Shape, and Properties
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Molecular Structure, Shape, and Properties
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 20 points

UNIT 8: THE GASEOUS STATE

LESSON 1: GASES AND GAS LAWS

Study: The Nature of Gases
Learn about the properties of gases, with emphasis on pressure and the common units of pressure.
Duration: 1 hr

Quiz: Gas Pressure
Answer questions about gases and gas pressure.
Duration: 0 hr 45 min Scoring: 10 points

Study: Empirical Gas Laws
Survey of mathematical laws that describe the relationship of the pressure, temperature, volume, and amount of a gas.
Duration: 1 hr

Practice: Boyle, Charles, and Avogadro
Complete a set of problems that use the three empirical gas laws.
Duration: 1 hr 30 min Scoring: 40 points

Study: The Ideal Gas Law
Derive the ideal gas law from empirical gas laws. Use the ideal gas law in a laboratory simulation of the determination of the molecular weight and molar volume of a gas.
Duration: 1 hr

Quiz: Using the Ideal Gas Law
Answer questions on terms in the ideal gas law. Work multiple-choice questions that integrate stoichiometry and the ideal gas law.
Duration: 0 hr 45 min Scoring: 10 points

Practice: Working with the Gas Laws
Complete a set of problems that involve the empirical gas laws and the ideal gas law.
Duration: 1 hr 30 min Scoring: 40 points

Lab: Molar Volume of a Gas
Determine the volume of one mole of a gas under conditions of standard temperature and pressure (STP).
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: MORE ABOUT GASES

Study: Gas Mixtures
Learn about Dalton's Law of Partial Pressure and its application.
Duration: 1 hr

Quiz: Dalton: Applying the Law of Partial Pressure
Answer questions about gas mixtures.
Duration: 0 hr 45 min Scoring: 10 points

Study: Kinetic Molecular Theory
Learn about the basic postulates of kinetic molecular theory and the molecular behavior of ideal and real gases.
Duration: 1 hr

Quiz: The Behavior of Gases
Answer questions about the behavior of real and ideal gases.
Duration: 0 hr 45 min Scoring: 10 points

Lab: Molar Mass of a Volatile Liquid
Use the ideal gas law to measure the molecular mass of volatile liquids.

Duration: 1 hr 30 min Scoring: 40 points

Discuss: Where Is the Boundary?
Discuss the definitions of real and ideal gases.
Duration: 0 hr 30 min Scoring: 15 points

LESSON 3: WRAP-UP

Review: The Gaseous State
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): The Gaseous State
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): The Gaseous State
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: The Gaseous State
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 31 points

UNIT 9: LIQUIDS, SOLIDS, AND PHASE CHANGES

LESSON 1: LIQUIDS AND SOLIDS

Study: Properties of Liquids
Learn about intermolecular forces and the macroscopic phenomena that result from them, such as miscibility, surface tension, and viscosity.
Duration: 1 hr

Quiz: Intermolecular Forces
Answer questions that relate the structure and chemical properties of liquids.
Duration: 0 hr 45 min Scoring: 10 points

Study: Structures of Solids
Learn about the classification of solid structures (crystalline and amorphous), types of crystalline solids, and physical properties of solids.
Duration: 1 hr

Practice: Solid Structures
Answer questions about the structure and properties of solids.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Solids, Liquids, and Gases
Complete a crossword puzzle using the terms from this unit.
Duration: 0 hr 30 min

LESSON 2: PHASE TRANSITIONS

Study: Changes of State
Learn about vapor pressure, boiling, and melting as molecular processes. Learn to interpret phase diagrams as descriptions of states of matter as a function of P and T.

Duration: 1 hr

Practice: Phase Diagrams
Learn to draw and interpret phase diagrams.
Duration: 0 hr 45 min

Practice: Enthalpy of Phase Changes
Complete a set of problems on integrating phase transitions and the first law of thermodynamics.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: WRAP-UP

Review: Liquids, Solids, and Phase Changes
Review concepts and skills learned in the unit to prepare for the Unit Quiz.
Duration: 2 hr

Test (CS): Liquids, Solids, and Phase Changes
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Liquids, Solids, and Phase Changes
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Liquids, Solids, and Phase Changes
Test your understanding of the key concepts covered in this unit.
Duration: 0 hr 45 min Scoring: 26 points

UNIT 10: REVIEW AND EXAM

LESSON 1: AP CHEMISTRY SEMESTER 1

Review: AP Chemistry Semester 1
Review concepts and skills learned in Units 1-9, to prepare for the Semester Final.
Duration: 4 hr

Exam: Semester Exam
Take a 45-minute exam covering material in Units 1-9.
Duration: 0 hr 45 min Scoring: 136 points

Final Exam: Semester Exam
Take a one-hour exam covering material in Units 1-9.
Duration: 1 hr Scoring: 164 points

UNIT 11: AQUEOUS SOLUTIONS: PROPERTIES AND REACTIONS

LESSON 1: BEHAVIOR OF SOLUTIONS

Study: Formation of Solutions
Discover what happens at the molecular level as ionic and molecular compounds dissolve.
Duration: 1 hr 30 min

Practice: Solutions and Solution Behavior
Demonstrate your understanding of common concentration units and the behavior of solutions by answering a set of numerical and conceptual questions.

Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: CHEMICAL AND PHYSICAL PROPERTIES OF SOLUTIONS

Study: Colligative Properties
Learn how solutes affect a solution's vapor pressure, boiling point, freezing point, and osmotic pressure.
Duration: 1 hr

Lab: Molar Mass by Freezing Point Depression
Measure molecular mass and determine the freezing point depression constant.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Solutes and Solvents
Solve problems that integrate key concepts and ideas of this unit.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Properties of Solutions
Complete a crossword puzzle.
Duration: 0 hr 30 min

LESSON 3: WRAP-UP

Review: Aqueous Solutions: Properties and Reactions
Review concepts and skills learned to prepare for the test.
Duration: 2 hr

Test (CS): Aqueous Solutions: Properties and Reactions
Take a 20-minute quiz covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Aqueous Solutions: Properties and Reactions
Take a 30-minute quiz covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Aqueous Solutions: Properties and Reactions
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 25 points

UNIT 12: EQUILIBRIUM

LESSON 1: BEHAVIOR OF EQUILIBRIUM SYSTEMS

Study: What Is Equilibrium?
Learn about the dynamic reversibility of many chemical reactions. Investigate chromatography, an important laboratory application of equilibrium.
Duration: 1 hr

Quiz: Reversible Reactions and Equilibrium Systems
Answer online questions about reversible reactions and the meaning of equilibrium.
Duration: 0 hr 45 min Scoring: 10 points

Study: Equilibrium Constants
Learn the definitions of K_c, K_p, and Q. Use these definitions in a laboratory simulation of the determination of an equilibrium constant.
Duration: 1 hr

Discuss: How Do You Define Equilibrium?
Share your ideas about the meaning of the term "equilibrium."
Duration: 0 hr 30 min Scoring: 15 points

Lab: Determination of the Equilibrium Constant
Measure the equilibrium constant for a complex ion.
Duration: 2 hr Scoring: 40 points

Practice: Working With the Equilibrium Constant
Complete a set of conceptual and quantitative problems about the equilibrium constant.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: QUANTITATIVE APPROACHES TO EQUILIBRIUM

Study: Calculations Involving Kc and Kp
Learn a number of methods for finding concentrations of species in a reaction using K_c or K_p.
Duration: 1 hr 30 min

Practice: Equilibrium Calculations
Complete a problem set using the quantitative tools presented in this lesson.
Duration: 1 hr 30 min Scoring: 40 points

Study: LeChatelier: Principle of Equilibrium and Stress
Learn how a change in reaction conditions can affect the direction of a reaction at equilibrium.
Duration: 1 hr

Quiz: LeChatelier: Applying the Principle
Use your knowledge of LeChatelier's Principle to answer multiple-choice questions about how an equilibrium system is affected by changes in T, P, V, or concentration of a reactant or product.
Duration: 0 hr 45 min Scoring: 10 points

LESSON 3: ADVANCED TOPICS IN EQUILIBRIUM

Study: Solubility Product Constants
Learn quantitative tools for expressing the solubility of a solute in a solution.
Duration: 1 hr

Study: Qualitative Inorganic Analysis
Explore an important laboratory application of K_{sp} by learning how chemists separate and identify the cations in a mixture.
Duration: 1 hr

Study: Common Ion Effect
Learn to solve equilibrium problems involving a common ion.
Duration: 1 hr 30 min

Practice: The Language of Equilibrium
Complete a crossword puzzle.
Duration: 0 hr 30 min

Lab: Qualitative Analysis of Cations
Use qualitative analysis to determine which cations are present in a mixture of unknown composition.
Duration: 2 hr Scoring: 40 points

Practice: Applications of Equilibrium
Integrated problem-solving exercise using topics and concepts from the entire unit.

Duration: 1 hr 30 min Scoring: 40 points

LESSON 4: WRAP-UP

Review: Equilibrium
Review concepts and skills learned to prepare for the test.
Duration: 3 hr

Test (CS): Equilibrium
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Equilibrium
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 5: DIAGNOSTIC

Diagnostic: Equilibrium
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 40 points

UNIT 13: ACIDS, BASES, AND ACID-BASE EQUILIBRIUM

LESSON 1: THE NATURE OF ACIDS AND BASES

Study: Introduction to Acids and Bases
Learn about pH and pOH, the pH scale, and acid-base indicators.
Duration: 1 hr

Quiz: Measuring Acidity and Basicity
Answer online questions about pH, pOH, and acid-base indicators.
Duration: 0 hr 45 min Scoring: 10 points

Lab: Classifying Acids and Bases
Identify the important characteristics of acids and bases by using hands on experience to explore the reactions of acids, bases and indicators.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: ACID-BASE EQUILIBRIUM

Study: Acid and Base Dissociation
Learn about the ionization of water, the relationship of pH and pOH, and the definitions of K_a and K_b. Discover how K_a and K_b relate to the strength of an acid or base.
Duration: 1 hr

Practice: Working with Kw, Ka, and Kb
Complete a set of problems that assess your understanding of the ionization of water and of acid and base dissociation constants.
Duration: 1 hr 30 min Scoring: 40 points

Lab: Standardization of a Base
Determine the exact concentration of a sodium hydroxide solution, so that you can use the solution in quantitative experiments.
Duration: 2 hr Scoring: 40 points

LESSON 3: ACID-BASE EQUILIBRIUM CALCULATIONS

Study: Calculations Involving Ka or Kb
Extend your understanding of solution equilibrium to systems involving acids or bases.
Duration: 1 hr 30 min

Practice: Finding Concentrations Using Ka or Kb
Practice using K_a or K_b to find the concentration of species in solution.
Duration: 1 hr 30 min Scoring: 40 points

Study: Acid-Base Titrations
Learn an important laboratory method for determining the concentration of an acid or base.
Duration: 1 hr

Quiz: Understanding Titration Curves
Answer online questions about titration curves and acid-base indicators.
Duration: 0 hr 45 min Scoring: 10 points

Lab: Dissociation of Weak Acids
Measure the acid dissociation constant of a weak acid.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 4: ADVANCED TOPICS IN ACID-BASE EQUILIBRIUM

Study: Polyprotic Acids
Learn how to solve acid-base equilibrium problems using molecules with more than one ionizable proton.
Duration: 1 hr 30 min

Discuss: What Makes This Hard?
Share your ideas and tricks about how to work with acids having more than one K_a.
Duration: 1 hr Scoring: 15 points

Study: Buffers
Learn all about buffers: what they are, how they work, how to make them in the laboratory, and how to calculate pH of buffer solutions.
Duration: 1 hr

Lab: The Behavior of Buffer Systems
Use good titration techniques to gather information about an unknown acid.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Solving Buffer Problems
Solve problems involving buffer calculations.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 5: WRAP-UP

Review: Acids, Bases, and Acid-Base Equilibrium
Review concepts and skills learned to prepare for the test.
Duration: 3 hr

Test (CS): Acids, Bases, and Acid-Base Equilibrium
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Acids, Bases, and Acid-Base Equilibrium
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 6: DIAGNOSTIC

Diagnostic: Acids, Bases, and Acid-Base Equilibrium
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 40 points

UNIT 14: CHEMICAL KINETICS

LESSON 1: RATE AND RATE LAWS

Study: Basic Principles of Kinetics
Learn about reaction rate, rate laws, and factors that affect the reaction rate.
Duration: 1 hr

Quiz: Rates and Rate Laws
Answer online questions about rates and rate laws.
Duration: 0 hr 45 min Scoring: 10 points

Study: Understanding Rate Laws
Learn how concentration affects reaction rate, and learn how to determine the rate of a reaction using two different methods.
Duration: 1 hr 30 min

Study: Graphing Kinetic Data
View a laboratory simulation of the kinetics of an organic reaction. Analyze the data to determine the rate constant and the order of the reaction with respect to each reactant.
Duration: 1 hr

Practice: Working with Rates and Rate Laws
Solve problems involving kinetics calculations.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: ENERGY AND RATE RELATIONSHIPS

Study: Temperature and Rate
Learn the underlying molecular basis for the effect of temperature on reaction rate.
Duration: 1 hr

Quiz: Temperature and Rate
Answer online questions about rate and temperature.
Duration: 0 hr 45 min Scoring: 10 points

Lab: Study of the Kinetics of a Reaction
Use microscale techniques to determine the kinetics of a reaction.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: RATE LAWS AND CHEMICAL REACTIONS

Study: Reaction Mechanisms
Learn about reaction mechanisms, deducing the rate law from the mechanism, and the effect of catalysts on the rate and the mechanism.
Duration: 1 hr

Study: Rate Laws and Mechanisms
Explore the relationship between reaction mechanisms and rate laws in more depth as you work through more challenging examples.

Duration: 1 hr 30 min

Practice: Mechanism and Rate
Answer numerical and conceptual questions about rates, rate laws, and mechanisms.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Kinetics Terms
Complete a crossword puzzle.
Duration: 0 hr 30 min

LESSON 4: WRAP-UP

Review: Chemical Kinetics
Review concepts and skills learned to prepare for the test.
Duration: 2 hr 30 min

Test (CS): Chemical Kinetics
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Chemical Kinetics
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 5: DIAGNOSTIC

Diagnostic: Chemical Kinetics
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 30 points

UNIT 15: THERMODYNAMICS

LESSON 1: THE SECOND LAW OF THERMODYNAMICS

Study: Energy and Spontaneity
Learn about the effect of entropy on reaction spontaneity.
Duration: 1 hr

Quiz: The Limitations of Enthalpy
Answer online questions about energy and spontaneity.
Duration: 0 hr 45 min Scoring: 10 points

Study: Entropy and Entropy Change
Learn about entropy and entropy change in chemical reactions and phase transitions.
Duration: 1 hr

Practice: Working with Entropy
Numerical and conceptual questions about entropy and spontaneity.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 2: EQUILIBRIUM AND THERMODYNAMICS

Study: Free Energy and Equilibrium
Learn a mathematical approach to spontaneity that incorporates enthalpy and entropy. Learn about the relationship between Delta G and K_c or K_p.
Duration: 1 hr

Practice: The Language of Thermodynamics

Complete a crossword puzzle.
Duration: 0 hr 30 min

Practice: Integrating Delta G and Keq
Numerical and conceptual questions about free energy and equilibrium.
Duration: 1 hr 30 min Scoring: 40 points

Lab: Water Analysis
Perform a chemical analysis of water using complex ion titration and pH measurement, and use calculations to determine the hardness and alkalinity of water.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: WRAP-UP

Review: Thermodynamics
Review concepts and skills learned to prepare for the test.
Duration: 2 hr

Test (CS): Thermodynamics
Take a 20-minute quiz covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Thermodynamics
Take a 30-minute quiz covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Thermodynamics
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 25 points

UNIT 16: ELECTROCHEMISTRY

LESSON 1: VOLTAIC CELLS

Study: The Activity Series of Metals
Apply your knowledge of redox reactions to a laboratory simulation in which you determine the relative oxidation strength of a group of metals.
Duration: 1 hr

Study: Voltaic Cells
Learn about electrochemical cells, a method for describing these cells, and how to write redox reactions using standard cell notation.
Duration: 1 hr

Discuss: Tips and Tricks
Share your ideas about how to write and interpret electrochemical cells.
Duration: 0 hr 30 min Scoring: 15 points

Discuss: Electrochemical Cell Reactions
Share your ideas about how to write and interpret electrochemical cells.
Duration: 0 hr 30 min Scoring: 15 points

LESSON 2: EQUILIBRIUM AND ELECTROCHEMICAL REACTIONS

Study: Calculations Involving Voltaic Cells

Learn how the potential of electrochemical cells varies with the concentration of reactants.
Duration: 1 hr 30 min

Study: The Nernst Equation
Explore the experimental applications of the Nernst equation by using simulated voltaic cells to conduct measurements of electrochemical potential under various concentration conditions.
Duration: 1 hr 15 min

Lab: Electrochemical Cells
Learn more about electrochemical cells.
Duration: 1 hr 30 min Scoring: 40 points

Practice: Working with Electrochemical Cells
Solve problems involving concepts and skills from the lessons in this unit.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: WRAP-UP

Review: Electrochemistry
Review concepts and skills learned to prepare for the test.
Duration: 2 hr 30 min

Test (CS): Electrochemistry
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Electrochemistry
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 4: DIAGNOSTIC

Diagnostic: Electrochemistry
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 36 points

UNIT 17: NUCLEAR AND ORGANIC CHEMISTRY

LESSON 1: THE NATURE OF RADIOACTIVITY

Study: Radioactivity
Learn about radioactive isotopes and the types of radioactive decay.
Duration: 1 hr

Study: Nuclear Equations
Learn to write balanced equations for radioactive decay processes.
Duration: 1 hr 30 min

Quiz: Balancing Nuclear Equations
Answer online questions about nuclear equations.
Duration: 0 hr 45 min Scoring: 10 points

LESSON 2: KINETICS AND ENERGETICS OF NUCLEAR REACTIONS

Study: Rate of Radioactive Decay
Review important concepts and kinetics and see how they are applied to nuclear reactions.
Duration: 1 hr

Practice: Nuclear Chemistry
Solve problems that integrate key concepts and ideas of this unit.
Duration: 1 hr 30 min Scoring: 40 points

LESSON 3: ORGANIC CHEMISTRY

Study: Hydrocarbons and Functional Groups
Learn about alkanes, alkenes, alkynes, cyclic hydrocarbons, and other important functional groups.
Duration: 1 hr

Discuss: Hydrocarbons and You
Share your ideas about the possibility of life forms based on elements other than carbon.
Duration: 0 hr 30 min Scoring: 15 points

Study: Isomers and Nomenclature
Learn about structural and stereoisomerisms, and the IUPAC system of nomenclature.
Duration: 1 hr 30 min

Lab: Synthesis and Analysis of Aspirin
Prepare and identify esters, then calculate their theoretical yield.
Duration: 2 hr Scoring: 40 points

Practice: Organic Chemistry Problems
Solve problems that integrate key concepts and ideas of this lesson.
Duration: 1 hr Scoring: 40 points

LESSON 4: WRAP-UP

Review: Nuclear and Organic Chemistry
Review concepts and skills learned to prepare for the test.
Duration: 2 hr

Test (CS): Nuclear and Organic Chemistry
Take a 20-minute test covering material in this unit.
Duration: 0 hr 20 min Scoring: 50 points

Test (TS): Nuclear and Organic Chemistry
Take a 30-minute test covering material in this unit.
Duration: 0 hr 30 min Scoring: 60 points

LESSON 5: DIAGNOSTIC

Diagnostic: Nuclear and Organic Chemistry
Test your understanding of the key concepts covered.
Duration: 0 hr 45 min Scoring: 36 points

UNIT 18: AP CHEMISTRY COURSE REVIEW

LESSON 1: FINAL COURSE REVIEW

Review: AP Chemistry Semester 2
Review concepts and skills learned throughout the course to prepare for the AP Exam.
Duration: 10 hr

Quiz: AP Practice I
Practice AP-style multiple-choice questions based on material from the first semester.
Duration: 1 hr Scoring: 30 points

Practice: The Language of Chemistry
Complete a crossword puzzle using the terms from the entire course.
Duration: 1 hr

Quiz: AP Practice II
Practice AP-style multiple-choice questions based on material from the second semester.
Duration: 1 hr Scoring: 30 points

Practice: AP Practice III
Practice AP-style free-response questions.
Duration: 2 hr 30 min Scoring: 40 points

Practice: AP Exam Practice
Take a self-proctored, full-length AP-style practice exam
Duration: 3 hr

Exam: AP Chemistry Semester 2
Take a 90-minute exam covering material in the entire course.
Duration: 1 hr 30 min Scoring: 140 points

Final Exam: AP Chemistry Semester 2
Take a 90-minute exam covering material in the entire course.
Duration: 1 hr 30 min Scoring: 160 points