

Advanced Placement Chemistry

This course is the equivalent of an introductory-level college course in chemistry. AP Chemistry emphasizes the chemical calculations and mathematical formulations of the principle foundations of the field. Students engage in significant lab experiences and produce a detailed notebook of lab reports they have written. Students attain a depth of understanding of fundamentals and competence in dealing with chemical problems. Students are taught to think clearly and to express their ideas, orally and in writing, with clarity and logic. This course includes an emphasis on mathematical concepts, and students must have completed at least Algebra II in order to complete the required calculations.

Required Textbook:

Chemistry: The Molecular Nature of matter and Change, 5th Edition, by Martin Silberberg; McGraw-Hill Science/Engineering/Math

Labs:

The lab program requires students to apply chemical knowledge and critical thinking skills in hands-on and virtual investigations. To facilitate team work, students examine and discuss case studies in teamwork to identify collaborative skills as part of their pre-lab instruction. Students are required to produce lab reports that include a purpose, procedures, data, data analysis, error analysis, and conclusions. Students are required to keep a lab notebook of all lab work and formal lab reports completed in the course.

Labs are sequenced into the flow of instruction integrating concepts and processes. The labs teach the scientific method and require students to think, observe, and make decisions about their learning rather than merely memorize facts.

The AP Chemistry labs require the equivalent of one double class period per week to complete.

- 8 full hands-on labs with full lab reports required (approximately 20 hours)

Unit	Title and Objectives
Quantum Model	<u>Beer's Law & Colorimetry</u> Objectives: Students construct a Beer's Law plot from given data and use the plot to determine the concentration of an unknown. Also, students determine the concentration of FD&C Blue #1 dye in a commercial drink using colorimetry.
Chemical Bonding	<u>Qualitative Anion Test</u> Objectives: Students identify some commonly occurring anions and study some of the reactions used for their identification.
Properties of Mixtures	<u>Colligative Properties</u> Objectives: Students compare the freezing point of a pure solvent to that of the solvent in solution with a nonvolatile solute
Properties of Mixtures	<u>Chromatography of Food Dyes</u> Objectives: Students separate mixtures of compounds through paper chromatography and students identify what food dyes are found in certain foods.

Kinetics	<u>Reaction Order & Rate Laws</u> Objectives: Students study the effect of reactant concentration on the rate of the reaction between sodium thiosulfate and hydrochloric acid. Students determine the order of each reactant and the rate law for the reaction.
Acid-Base Equilibria	<u>Titration for Acetic Acid in Vinegar</u> Objectives: Students perform titrations. Students determine the concentration of an acetic acid solution.
Acid-Base Equilibria	<u>Determination of K_a for a Weak Acid</u> Objectives: Students perform a titration of a weak acid against a strong base. Students construct a titration curve. Student use the data obtained to determine K_a for the weak acid.
Acid-Base Equilibria	<u>Buffer Experiment</u> Objectives: Students combine a pair of compounds to form a buffer solution. Students observe changes as dilute and concentrated acids and bases are added to the buffer. Students assess the ability of water to act as a buffer.

- 22 virtual labs with full lab reports required (approximately 40 hours)

Special Note: Access to the virtual labs in this course is provided for review purposes.

<http://www.eduweblabs.com/advchem.html>

Teacher name: APBOARD

School: AP

Password: AP

- 14 interactive lab activities, which require students to complete a virtual lab as a part of a learning activity without turning in a full lab report (approximately 14 hours)

The hands-on labs require students to manipulate chemicals and equipment using the glassware and techniques typically found in chemical laboratories. The virtual labs replicate real lab performances and are also open-ended to allow students to make mistakes in processes and observations, thus teaching the complexity and ambiguity of empirical work. Some of the virtual labs include procedures, equipment, and materials rarely found in typical high school labs because of concerns about safety and the cost of equipment and so provides a more complete and advanced program for students.

Problem Sets:

For each unit students complete problem sets requiring the application of principles and concepts learned within each chapter to the textbook.

Course Outline:

Semester One

Unit: Introduction

This unit provides an introduction to the course in general and to chemistry in particular. It gives detailed instructions on scientific processes and the standard lab report form.

Discussion: Chemistry in your life

Quizzes and Exams: Unit exam

Assignment: Problems from text

Lab: Density Lab - virtual lab with full lab report required

Unit: Matter

The idea of unit 2 is to examine the properties and composition of the three types of matter: elements, compounds and mixtures. This examination will look at some of the key experiments that have brought us to our current theories of the atom. By describing atomic structure students will get their first glimpse at how the periodic table was made and how it can be used to organize and classify the elements. The last part of the chapter will look at how elements form compounds and how compound names and formulae are determined.

Quizzes and Exams: 1) Free Response question; 2) Unit exam

Assignment: 1) Problems from text

Lab: Percent of Oxygen in a Compound. Interactive lab activity

Unit: Stoichiometry of Formulas and Equations

Unit 3 looks at one of the most fundamental units of measurement that chemistry uses today...the mole. This unit will introduce students to the accounting methods used in chemical reactions.

Quizzes and Exams: 1) Free Response question; 2) Unit exam

Assignment: 1) Problems from text

Labs:

1. Stoichiometry: Virtual lab with full lab report required
2. Water within a Hydrate: Virtual lab with full lab report required
3. Precipitation of Chalk: Virtual lab with full lab report required

Unit: The Major Classes of Chemical Reactions

This unit will examine the three most common reaction processes and the associated role of water. Students will look at precipitation, acid-base and oxidation-reduction reactions and the reversible nature of all reactions

Quizzes and Exams: 1) Free Response question; 2) Unit exam

Assignment: 1) Problems from text

Labs:

1. Analysis of Bleach: Virtual lab with full lab report required
2. Reactions of Copper: Virtual lab with full lab report required

Unit: Gases and the Kinetic-Molecular Theory

This unit will look at the behavior of gases under a variety of environments. These gas laws are some of the defining moments in the evolution of chemistry as a science. Theories and applications of the gas laws will be presented. Students will differentiate between real and ideal gases.

Quizzes and Exams: 1) Free Response question; 2) Unit exam; 3) Midterm exam

Assignment: 1) Problems from text

Labs:

1. Boyle's Law: Interactive lab activity
2. Charles' Law: Interactive lab activity
3. Ideal Gas Law: Virtual lab with full lab report required

4. Diffusion of Gases: Interactive lab activity
5. Molar Mass by Vapor Density: Virtual lab with full lab report required

Unit: Thermochemistry: Energy Flow and Chemical Change

Thermochemistry is a branch of chemistry that deals with the interrelation of heat with chemical reactions or with a physical change of state. Amounts of heat released or absorbed in chemical transformations will be studied both qualitatively and quantitatively. This will include concepts of enthalpy in both simple and complex reactions.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Specific Heat of a Metal: Interactive lab activity
2. Hess's Law: Virtual lab with full lab report required

Unit: Gases, Quantum Theory and the Nature of Light

The ideas of quantum mechanics and how the inside of an atom works came from studies done on the behavior of light. Students will look at why the light emitted from a hydrogen atom suggests atoms with distinct energy levels.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Beer's Law and Colorimetry: Hands-on Lab with full lab report required
2. Spectrophotometry: Virtual lab with full lab report required
3. Electromagnetic Radiation: Interactive Lab activity
4. Bright Line of Sodium: Interactive Lab activity

Unit: Electron Configuration and Chemical Periodicity

This unit looks at the periodic table from its earliest history to the introduction of quantum theory. Students will discuss how electron configuration and nuclear charge lead to the trends in atomic properties that were observed long ago.

Quizzes and Exams: 1) Free Response question; 2) Unit exam

Assignment: 1) Problems from text

Unit: Models of Chemical Bonding

This unit looks at how atomic properties have given rise to the three major types of bonding and how each model of bonding explains the properties of substances.

Quizzes and Exams: 1) Free Response question; 2) Unit exam

Assignment: 1) Problems from text

Labs:

1. Qualitative Anion Test: Hands-on Lab with full lab report required
2. Qualitative Analysis: Virtual lab with full lab report required

Unit: VSEPR: The Shapes of Molecules

This unit looks at the geometry of molecules and how this shape can give rise to the function of the molecule.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Diameter of a Molecule: Virtual lab with full lab report required

Unit: Theories of Covalent Bonding

This unit uses two different models, Valence bond and Molecular orbital to help explain how covalent bonds work.

Quizzes and Exams: 1) Free Response question; 2) Unit exam 3) Semester Exam

Assignment: 1) Problems from text

Semester Two**Unit: Intermolecular Forces**

Using the kinetic-molecular model of states of matter students can calculate the energy needed to make changes between phases as the intermolecular forces change. The unique characteristics of water will also be studied here.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Phase Change: Interactive Lab activity

Unit: The Properties of Mixtures: Solutions and Colloids

This unit examines the intermolecular forces between solutes and solvents and how these forces affect their properties as a solvent. Students will also look at the connection between biology and how solutions behave.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Hybrid lab requiring a full report for both a full hands-on lab and a full virtual lab combined:
 - i. Colligative Properties: Hands-on lab
 - ii. Freezing Point Depression: Virtual lab
2. Chromatography of Food Dyes: Hands-on Lab with full lab report required
3. Heat of Solution: Virtual lab with full lab report required
4. Solubility of a Solid: Interactive Lab activity

Unit: Periodic Patterns in the Main-Group Elements

Students will look at the ideas of bonding, structure and reactivity to the main group elements and see how behavior correlates with their position in the periodic table. This unit will be a survey of the main groups of elemental families.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Unit: Organic Compounds and the Atomic Properties of Carbon

This is an introduction to organic chemistry. Students will focus on naming, properties of common functional groups and some important classes of organic reactions.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Synthesis of Aspirin: Virtual lab with full lab report required
2. Fractional Distillation: Interactive Lab activity

Unit: Kinetics: Rates and Mechanisms of Chemical Reactions

This unit will concentrate on the effects of concentration and temperature on rate and then create a reaction mechanism that explains how bonds are broken and product bonds are formed.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Reaction Order and Rate Laws: Hands-on lab with full lab report required
2. Rate of Reaction: Interactive Lab activity

Unit: Equilibrium: The Extent of Chemical Reactions

This unit examines the concentrations of reactants and products present once no further changes are occurring in a reaction. The equilibrium constant and the equilibrium quotient will be utilized in various problems.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Equilibrium Constant: Virtual lab with full lab report required

Unit: Equilibrium Reactions: Acids and Bases; Oxidation-Reduction

This unit examines the nature of acids and bases. Students will learn about dissociation constants, the pH scale, titration, salts and acid-base models.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Labs:

1. Hybrid lab requiring a full report for both a full hands on lab and a full virtual lab combined:
 - i. Acid-base titration: Virtual Lab
 - ii. Titration for Acetic Acid in Vinegar: Hands-on lab
2. Hybrid lab requiring a full report for both a full hands on lab and a full virtual lab combined:
 - i. Calculating K_A and pH: Virtual Lab
 - ii. Determination of K_a for a Weak Acid: Hands On lab
3. Using Buffers: Hands-on lab with full lab report required
4. Molar Mass and K_{sp} : Virtual lab with full lab report required
5. pH Curve: Interactive Lab activity
6. Serial Dilution and K_{sp} : Interactive Lab activity

Unit: Thermodynamics: Entropy, Free Energy and the Directions of Chemical Reactions

This unit looks at the geometry of molecules and how this shape can give rise to the function of the molecule.

Quizzes and Exams: 1) Free Response question

Assignment: 1) Problems from text

Unit: Electrochemistry

This unit examines the nature of electrochemistry. Topics include a review of redox reactions and half reactions, voltaic & electrochemical cells, and standard cell potentials.

Quizzes and Exams: 1) Free Response question 2) Unit quiz

Assignment: 1) Problems from text

Labs:

7. Winkler Test: Virtual lab with full lab report required
8. Activity Series: Virtual lab with full lab report required
9. Voltaic Cell: Virtual lab with full lab report required

Unit: Nuclear Chemistry

Students will learn about radioactive decay and the stability of different nuclei. In this unit students will perform calculations involving rates of nuclear decay. Applications of radioisotopes will be studied as well as topics involving fission and fusion.

Quizzes and Exams: 1) Free Response question 2) three quizzes 3) Unit quiz

Assignment: 1) NC-Isotope 2) Fission/Fusion

Labs:

1. Radioactive half life: Virtual lab activity

Final Exam