

AP[®] Chemistry

AP[®] Chemistry is the equivalent of an introductory college-level chemistry course. AP[®] Chemistry has both the content and the laboratory components of typical college-level chemistry courses. The College Board recommends that students who take AP[®] Chemistry should have successfully completed a first-year course in chemistry and have the math skills attained in Algebra I and II. AP[®] Chemistry builds on the skills and knowledge attained in a standard high school course and provides the student with an opportunity to develop a deeper understanding of chemistry and the ability to think critically and to solve problems.

The following course materials are in no way intended to replace the extensive materials provided by the College Board. The AP[®] course outline and recommended laboratory experiences are revised periodically by the College Board. The teacher of this course should be sure to have the current AP[®] Chemistry course description book and materials from the College Board. These materials are available at the AP Central website <http://apcentral.collegeboard.com>.

Learners will study natural and technological systems. The strands and unifying concepts provide a context for teaching content and process skill goals. All goals should focus on the unifying concepts:

- Systems, Order and Organization
- Evidence, Models, and Explanation
- Constancy, Change, and Measurement
- Evolution and Equilibrium
- Form and Function

Strands: The strands are: Nature of Science, Science as Inquiry, Science and Technology, Science in Personal and Social Perspectives. They provide the context for teaching of the content Goals and Objectives.

Competency Goal 1: The learner will develop abilities necessary to do and understand scientific inquiry.

1.01 Design, conduct and analyze investigations to answer questions related to chemistry.

- Identify questions and suggest hypotheses.
- Identify variables.
- Use a control when appropriate.
- Select and use appropriate measurement tools.
- Collect and organize data in tables, charts and graphs.
- Analyze and interpret data.
- Explain observations.
- Make inferences and predictions.
- Explain the relationship between evidence and explanation.

- Identify how scientists share findings.
- 1.02 Analyze reports of scientific investigations.
- Appropriate sample.
 - Adequacy of experimental controls.
 - Replication of findings.
 - Consideration of alternative interpretations of the data.
- 1.03 Analyze experimental designs with regard to safety.
- Identify potential safety hazards given a scenario.
 - Differentiate between safe and unsafe procedures.
 - Use information from the MSDS (Material Safety Data Sheets) to assess chemical hazards.

Competency Goal 2: The learner will develop an understanding of the composition and properties of matter.

- 2.01 Analyze the structure of matter at the atomic level
- Evidence for the atomic theory.
 - Atomic masses; determination by chemical and physical means.
 - Atomic number and mass number; isotopes.
 - Electron energy levels: atomic spectra, quantum numbers, atomic orbitals.
 - Periodic relationships including, for example, atomic radii, ionization energies, electron affinities, oxidation states.
- 2.02 Examine the types of chemical bonds and the nature of each
- Types: ionic, covalent, metallic, hydrogen bonding, van der Waals (including London dispersion forces).
 - Relationships to states, structure, and properties of matter.
 - Polarity of bonds, electronegativities.
- 2.03 Analyze conceptual models of bonding and molecular shape and the relation to chemical and physical properties of matter.
- Lewis structures.
 - VSEPR.
 - Valence bond: hybridization of orbitals, resonance, sigma and pi bonds.
 - Geometry of molecules and ions, structural isomerism of simple organic molecules and coordination complexes; dipole moments of molecules; relation of properties to structure.
- 2.04. Assess the impact of nuclear chemistry
- Nuclear decay equations.
 - Half-life and radioactivity.
 - Chemical applications.

Competency Goal 3: The learner will build an understanding of the states of matter and the connection to chemical and physical properties.

- 3.01 Examine the relationships between pressure, volume and temperature of ideal gases
- Laws of ideal gases: Boyle's, Charles'.
 - The ideal gas equation.
 - Partial pressures and Dalton's Law.

- 3.02. Analyze kinetic-molecular theory
- Interpretation of ideal gas laws on the basis of this theory.
 - Avogadro's hypothesis and the mole concept.
 - Dependence of kinetic energy of molecules on temperature.
 - Deviations from ideal gas laws.
- 3.03. Assess the nature of liquids and solids
- Liquids and solids from the kinetic-molecular viewpoint.
 - Phase diagrams of one-component systems.
 - Changes of state, including critical points and triple points.
 - Structure of solids; lattice energies.
- 3.04. Examine the nature of solutions
- Types of solutions and factors affecting solubility.
 - Methods of expressing concentration (The use of normalities is not tested.).
 - Raoult's law and colligative properties (nonvolatile solutes); osmosis.
 - Non-ideal behavior (qualitative aspects).

Competency Goal 4: The learner will develop an understanding of chemical reactions.

- 4.01. Analyze the various types of common chemical reactions
- Acid-base reactions; concepts of Arrhenius, Brønsted-Lowry, and Lewis;
 - Coordination complexes; amphoterism.
 - Precipitation reactions.
 - Oxidation-reduction reactions.
 - Oxidation number.
 - The role of the electron in oxidation-reduction.
 - Electrochemistry: electrolytic and galvanic cells; Faraday's laws; standard half-cell potentials; Nernst equation; prediction of the direction redox reactions.
- 4.02. Apply the principles of stoichiometry
- Ionic and molecular species present in chemical systems: net ionic equations.
 - Balancing of equations including those for redox reactions.
 - Mass and volume relations with emphasis on the mole concept, including empirical formulas and limiting reactants.
- 4.03. Analyze systems in dynamic equilibrium
- Concept of dynamic equilibrium, both physical and chemical; Le Chatelier's principle; equilibrium constants.
 - Quantitative treatment for gaseous reactions using K_p and K_c .
 - Quantitative treatment for reactions in solution K_c .
 - Quantitative treatment of for acids and bases; using K_a and K_b , pK_a and pK_b and pH.
 - Quantitative treatment for precipitation reactions and the dissolution of slightly soluble compounds using the solubility product constant, K_{sp} .
 - Common ion effect; buffers; hydrolysis.
- 4.04. Analyze chemical kinetics
- Concept of rate of reaction.
 - Use of differential rate laws to determine order of reaction and rate constant from experimental data.

- Effect of temperature change on rates.
 - Energy of activation; the role of catalysts.
 - The relationship between the rate-determining step and a mechanism.
- 4.05 Analyze chemical thermodynamics
- State functions.
 - First law: change in enthalpy; heat of formation; heat of reaction; Hess's law; heats of vaporization and fusion; calorimetry.
 - Second law: entropy; free energy of formation; free energy of reaction; dependence of change in free energy on enthalpy and entropy changes.
 - Relationship of change in free energy to equilibrium constants and electrode potentials.

Competency Goal 5: The learner will build a knowledge of descriptive chemistry

- 5.01 Examine chemical reactivity and predict the products of chemical reactions.
- 5.02 Analyze the relationships in the periodic table: horizontal, vertical, and diagonal with examples from alkali metals, alkaline earth metals, halogens, and the first series of transition elements.
- 5.03. Explore organic chemistry on an introductory level
- Hydrocarbons and functional groups (structure, nomenclature, chemical properties).
 - Physical and chemical properties of simple organic compounds should also be included as exemplary material for the study of other areas such as bonding, equilibria involving weak acids, kinetics, colligative properties, and stoichiometric determinations of empirical and molecular formulas.