SCIENCE DEPARTMENT **ADVANCED CHEMISTRY (H/AP): COURSE #439**

Contact Information

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The Department's Educational Philosophy

We believe that students should be exposed to the process of scientific inquiry so they can acquire and interpret scientific knowledge, and begin to realize the wider applicability of scientific problem-solving methods. By making the laboratory the focal point of learning, we seek to foster students' appreciation for the experience of doing science.

Guiding Principles

- Students must be able to collect and analyze data and formulate hypotheses.
- Inductive and deductive problem-solving skills are central to science education.
- An effective program in science addresses the limitations of data and conclusions.
- Students should be able to use or design a strategy for testing scientific concepts.
- A comprehensive science program will emphasize the delicate checks and balances in man's abiotic and biotic environments and the stresses upon these ecosystems, which could affect the destiny of the world.
- Science is integrally related to mathematics.
- An effective science program builds students' ability to communicate accurately and precisely.
- An effective science program stresses both cooperative and independent learning.

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Course Frequency: Full year course, seven times per six-day cycle
Credits Offered: Seven
Prerequisites: By Departmental Recommendation

Background to the Curriculum

Advanced Placement Chemistry is offered as a second-year chemistry course. This course encompasses the material included in a first-year college chemistry class and is supported by a substantive, project-based chemistry laboratory component. The course is designed to "contribute to the development of the students' abilities to think clearly and to express their ideas, orally and in writing, with clarity and logic. The course differs from the introductory chemistry course with respect to the kind of textbooks used, the topics covered, the emphasis on chemical calculations and the mathematical formulation of principles, and the kind of laboratory work done by students."[1] The students are also expected to take greater ownership of their learning.

Core Topics/Questions/Concepts/Skills

(Topics are designated by the College Board)

- Structure of Matter
- States of Matter
- Reactions
- Equilibrium
- Kinetics
- Thermodynamics

[1] Advanced Placement Course Description, Chemistry, The College Board.

Course-End Learning Objectives

Learning objectives	**Corresponding State Standard, *where applicable***
Structure of Matter	
1] Atomic theory and atomic structure	2.1, 2.2
a. Evidence for the atomic theory	2.3
b. Atomic masses; determination by chemical and physical means	
c. Atomic number and mass number; isotopes	
d. Electron energy levels: atomic spectra, quantum numbers, and atomic orbitals	2.3, 2.4, 2.5, 2.6, 2.7
e. Periodic relationships, including atomic radii, ionization energies, electron affinities, oxidations states	3.1, 3.2, 3.3, 3.4
2] Chemical Bonding	
a. Binding forces	
1. Types: ionic, covalent, metallic, hydrogen bonding, van der Waals (including London dispersion forces)	4.1
2. Relationships to states, structure, and properties of matter	4.3, 4.5
3. Polarity of bonds, electronegativities	4.3
b. Molecular models	
1. Lewis structures	4.2
2. Valence bond: hybridization of orbitals, resonance, sigma and pi	
3. Valence Shell Electron Pair Repulsion (VSEPR) Theory	4.4
c. Geometry of molecules and ions, structural isomerism, coordination complexes, dipole moments of molecules and relationship of structure to properties	4.5, 4.6, 4.7
3] Nuclear Chemistry: nuclear equations, half-lives, and radioactivity; chemical applications	2.8, 2.9, 2.10, 2.11
States of Matter	
1] Gases	
a. Laws of ideal gases	
1. Equation of state for an ideal gas	6.3
2. Partial pressures	6.5

b. Kinetic-molecular theory	
1. Interpretation of ideal gas laws on the basis of this theory	6.1, 6.3, 6.5, 6.6
2. Avogardro's hypothesis and the mole concept	
3. Dependence of kinetic energy of molecules on temperature	6.2
4. Deviations from ideal gas laws	6.4
2] Liquids and Solids	
a. Liquids and solids from the kinetic-molecular viewpoint	1.1, 1.2, 1.3, 1.4
b. Phase diagrams of one-component systems	
c. Changes of state, including critical points and triple points	
d. Structure of solids; lattice energies	
3] Solutions	
a. Types of solutions and factors affecting solubility	7.1, 7.2, 7.3
b. Methods of expressing concentration, molarity, molality, mole fraction, percent, weight fraction	7.4
c. Raoult's Law and colligative properties	7.5, 7.6
d. Non-ideal behavior of solutions	
<u>Reactions</u>	
1] Reaction types	
a. Acid-base reactions; concepts of Arrhenius, Bronsted-Lowry and Lewis; coordination complexes; amphoterism	8.1, 8.2, 8.3, 8.4, 8.5, 8.6
b. Precipitation reactions	5.2, 7.7
c. Oxidation-Reduction Reactions	
1. Oxidation number	11.2
2. The role of the electron in oxidation-reduction	11.1, 11.3
3. Electrochemistry: electrolytic and galvanic cells; Faraday's laws; standard half-cell potentials; Nernst equation; prediction of the direction of redox reactions	11.3, 11.4, 11.5, 11.6, 11.7
2] Stoichiometry	
a. Ionic and molecular species present in chemical systems: net ionic equations	5.2
b. Balancing of equations, including those for redox reactions	5.1, 11.3
c. Mass and volume relations with emphasis on the mole concept, including empirical and formulas and limiting reactants	5.3, 5.4, 5.5, 5.6
3] Equilibrium	
a. Concept of dynamic equilibrium, physical and chemical; LeChatelier's Principle; equilibrium constants	9.1, 9.2

b. Quantitative treatment 1. Equilibrium constants for gaseous reactions, Kp, Kc 2. Equilibrium constants for reactions in solution i. Constants for acids and bases; pK; pH ii. Solubility product constants and their application to precipitation and the dissolution of slightly soluble compounds iii. Common ion effect; buffers; hydrolysis	
4] Kinetics	
a. Concept of rate of reaction	9.3
b. Use of differential rate laws to determine order of reaction and rate constant from experimental data	9.3
c. Effect of temperature change on rates	9.3
d. Energy of activation; the role of catalysts	9.4, 9.5
e. The relationship between the rate-determining step and a mechanism	
5] Thermodynamics	
a. State functions	10.1
b. First law: change in enthalpy; heat of formation; heat of reaction; Hess's law; heats of vaporization and fusion; calorimetry	10.1, 10.3, 10.4
c. Second law: Entropy; free energy of formation; free energy of reaction; dependence of change in free energy on enthalpy and entropy changes	10.2
d. Relationship of change in free energy to equilibrium constants and electrode potentials	

Assessment

- Tests: Tests are built on old AP exam questions that stress the integration of learned concepts.
- Formal Lab Reports: Level-appropriate, project-based labs are an integral part of the course. Students must maintain a laboratory book in which all results are recorded on a daily basis. Formal lab reports are written and graded for organization, data presentation, completeness, accuracy and depth of analysis.
- Long-term independent assignments: Students are responsible for several independent, long-term assignments during the year. They are graded on completeness and accuracy.

Technology Learning Objectives Addressed in This Course

(This section is for faculty and administrative reference; students and parents may disregard.)

Course activity: skills &/or topics taught	Standard(s) addressed through this activity
1] Students utilize computers for graphing and for the acquisition of data during experiments. Students use computer setups involving pH probes, temperature probes and conductivity probes in the laboratory. **2]** Students explore relevant web sites such as AP Central and Chem2 for homework and tips. **3]** Some homework solutions are posted on the teacher's web site.	

Materials and Resources

Principle text

- Zumdahl, Chemistry, 7th ed. Houghton Mifflin, 2007

References

- Chang, R., Chemistry, 5th ed. New York, Random House, 1994
- Brown and LeMay, Chemistry the Central Science, 6th ed. Englewood, NJ, 1994

Labs: level-appropriate labs (college freshman) collected from various sources

Recommended study guides

- Princeton Review and Barrons AP Chemistry

Numerous audio-visual aids are used to supplement the course.