

# AP Chemistry

## Overview of the AP Chemistry program

### Schedule

Our high school runs on a 4 day cycle. AP Chemistry meets 2 days a cycle for approximately 50 minutes and once a cycle for a double period of approximately 106 minutes.

### Teaching Strategies

I use the following strategies when teaching my AP Chemistry course.

1. Instruction is done Socratically. Class time is spent with leading questions and discussion.
2. Provide an safe learning environment that encourages students to take risks answering questions even when they are unsure of the answer, and to ask those questions that are troubling them even when they think no other students are confused.
3. Review time for tests is always student driven. Students know that they are expected to keep me busy with questions and problems to be answered in class and that if they do not have prepared questions that I will begin the next unit. This ensures that students begin preparing prior to the night preceding the test.
4. Homework problems are assigned for each unit. Students have access to a large number of problems on instructor developed worksheets and from the text. In addition, problems are assigned using the on-line program WebAssign that checks student work and allows them to go back and correct mistakes.
5. Students have access to a teacher developed and maintained web site. The web site provides students with access to class calendars, problems sets, old class tests, and links to important resources.
6. Teacher notes are done in class on a Smart® Airliner virtual white board and notes are uploaded each day so that students have access to what was written in class.
7. Teacher maintains a blog of class activities. This blog, detailing what happens in class each day is updated daily so that students who are out know what they have missed. It also allows quick distribution of announcements for all students.
8. An on-line forum is available to students to discuss upcoming assignments, tests, and other topics of interest.

### Course resources:

The AP Chemistry course at Lower Merion uses the following resources for instructional and evaluative purposes:

1. On-line blog and web-site with teacher developed problem sets and sample tests.
2. On-line lab manual. Some of these labs have been developed independently, others based on labs done at Cornell University in the freshman chemistry program, others were developed jointly with another Lower Merion teacher.

3. WebAssign – on-line homework site. Through this site, students do assigned problem sets with randomized numbers that encourage working together but discourage copying without understanding.
4. WinQual. Computer simulation of basic qualitative analysis that allows students to learn the basics of qual on their own time.
5. Atomic Microscope. Computer simulation of gas particles that allows easy visualization of gas laws and kinetic molecular theory.
6. Atomic Orbitals CD. Computer simulation that shows the  $\Psi$  graphs and electron distributions for atomic orbitals up through level 4. This program also contains simulations of the work by Thomson, Rutherford, Millikan and others.
7. Various other on-line resources gathered and made available to students through the website and blog.

**The Laboratory Program** – the laboratory program is designed to challenge students to minimize sources of error, minimize hazards, and to maximize reliability and yield. Students keep a laboratory notebook of all work done, do a full mathematical workup for all labs and a full laboratory report for at least two or three labs every quarter. Full laboratory reports include an abstract, theory discussion, data analysis and results, conclusion and full discussion of sources of error.

**Text** – Kotz, John C., Treichel, Paul M., and Weaver, Gabriela C. Chemistry and Chemical Reactivity, 6<sup>th</sup> edition. ISBN: 053499766X (ISBN13: 9780534997663)

## Course Outline

### Unit 1: Introductory and review material

**1.5 weeks**

Numbers, significant figures, error calculations, nomenclature (ionic, acidic, molecular, and basic organic—including hydrocarbons and common functional groups), reactions (combustion, synthesis, decomposition, single and double displacement), moles, stoichiometry (including limiting reagent and excess calculations).

**Labs:** Formula of a hydrate  
gravimetric analysis  
Formation and analysis of a double salt

### Unit 2: Atomic History

**1 week**

Historical development of the atomic theory (including subatomic structure) up to and including the introduction of quantum theory by Bohr.

**Labs:** Beer's Law

### Unit 3: Modern Electron Theory

**2 weeks**

Schrodinger's theory including electron configuration, ion formation, and stability.

### Unit 4: Periodicity

**<1 week**

Structure of the modern periodic table and periodic trends including electronegativity, ionization energy (including 2<sup>nd</sup> and 3<sup>rd</sup>), electron affinity (including 2<sup>nd</sup> and 3<sup>rd</sup>), atomic radius, and radius of the most common ions. General properties of families, including physical properties and reactivity.

**Unit 5: Bonding**

**1.5 weeks**

Ionic and covalent bonding. Lewis dot structures, formal charge, resonance, VSEPR theory, polarity.

**Labs:** Molecular Models

**Unit 6: Advanced Bonding Theories**

**1.5 weeks**

Valence bond theory, valence bond orbital overlap diagrams, molecular orbital theory, band theory of conductance.

**Unit 7: Gases**

**1.5 weeks**

Kinetic Molecular theory, 2-variable laws (Boyle, Charles, etc.), Dalton's law, ideal gas law, changing condition problems, gas stoichiometry, Graham's law, non-ideal behavior of gases, real-world applications

**Labs:** Boyle's Law

Gay Lussac's Law

Molar Mass of butane

Mole percent oxygen in air

**Unit 8: Condensed States of Matter**

**1.5 weeks**

Phases, phase changes, Boltzman distribution, phase diagrams, liquids, surface tension, soap, micelles, types of solids (ionic, metallic, molecular, network).

**Labs:** Condensed States of matter activities

**Unit 9: Mixtures**

**1 week**

Types of mixtures (solution, colloid, suspension), solvation, colligative properties

**Labs:** Molar mass by freezing point depression

**Unit 10: Thermochemistry and Thermodynamics**

**2 weeks**

Heat and temperature, calorimetry, bond energy (and lattice energy), Hess' Law, heats of formation, Gibb's Free Energy equation

**Labs:** Heat of fusion of ice or specific heat of metals

Hess' Law

**Unit 11: Kinetics**

**1.5 weeks**

Rates of reactions, collision theory, factors that effect rates, activation energy, rate laws, integrated rate laws, Arrhenius equation, mechanisms, catalysis.

**Labs:** Rate Law for the decomposition of crystal violet

**Unit 12: Equilibrium**

**2 weeks**

Equilibrium systems, equilibrium constants, calculating equilibrium concentrations (perfect squares and cubes, “little x” problems, “big x” problems), solubility, Le Chatelier’s principle, mathematical relationship between K and  $\Delta G$

**Labs:** K<sub>sp</sub> of PbCl<sub>2</sub>  
Le Chatelier’s Principle

**Unit 13: Acids and Bases**

**1.5 weeks**

Definitions (Arrhenius, Bronsted/Lowry, Lewis), reactions, conjugates, pH, pOH, K<sub>a</sub>, K<sub>b</sub>, K<sub>w</sub>, equilibrium calculations using acids, titration problems (M<sub>a</sub>V<sub>a</sub>=M<sub>b</sub>V<sub>b</sub> and finding the changing pH during a titration), acid and base anhydrides

**Labs:** Standardized titration of an acid

**Unit 14: Advanced equilibrium**

**1.5 weeks**

Common ion effect, multiple solubility problems, complex ion formation problems, polyprotic acids and bases

**Labs:** Titration curve for a diprotic acid titration

**Unit 15: Electrochemistry**

**1.5 weeks**

Oxidation numbers, redox reactions, oxidizing and reducing agents, standard cell potentials, reactivity of periodic families and cell potential, Nernst equation, relationship between equilibrium and cell potential, corrosion, batteries, fuel cells.

**Labs:** Redox titration

**Unit 16: Organic Chemistry**

**1 week**

General reaction types including SN<sub>1</sub>, SN<sub>2</sub>, E<sub>1</sub> and E<sub>2</sub>

**Lab:** Synthesis of t-butyl chloride from t-butyl alcohol

**Unit 17: AP Chemistry Exam review and preparation**

**2.5 weeks**

Review of general topics, use of formula sheet, specific coaching tips for multiple choice exams, practice testing.

**Other topics covered throughout the course as they fit in with other topics**

Nuclear reactions, nuclear decay, descriptive chemistry, qualitative analysis