

AP Chemistry  
Syllabus

**Overview**

Advanced Placement Chemistry is a two semester course to prepare students for the Advanced Placement exam, given in the spring and develop an understanding of chemistry, at a college freshman level.

Course work is rigorous and greatly accelerated. General chemistry is pre-requisite. Approximately eighteen laboratory investigations will be performed. A completed lab notebook is required and a laboratory, write –up will be completed for each lab. Laboratory investigations will be performed to assist in understanding of content and will follow text content as closely as time allows.

**Objectives:**

The Student will understand basic concepts of Chemistry:

1. Matter/energy interaction
2. Important contributions to chemistry through history
3. Classification of matter and energy
4. Calculations including:
  - a. amounts of matter and energy
  - b. rates of reactions
  - c. concentrations of solutions
  - d. equilibrium positions
  - e. pH
  - f. balanced chemical equations
  - g. volumes and pressures of gases and changes in volumes and pressures due to changes in temperature, pressure and volume in a system
  - h. equilibrium positions and shifts in that position due to changes in pressure, temperature and concentrations

**Objective:**

1. Present students with basic chemistry concepts
2. Present students with algorithms for calculations of matter energy interactions
3. Present students with a variety of laboratory investigations to develop laboratory skills and aid them in deeper understanding of concepts

**What You Should Expect**

Expect large daily reading assignments. Homework is not graded other than for completion. Solutions to homework questions and problems will be posted, to be reviewed by you, outside of class time. Homework problems will be reviewed during class time on a “need to” basis. In other words, if the students have no

questions over the homework it will not be reviewed in class. Representative homework will be suggested for each lesson and it will be up to the student to complete the suggested work and investigate further problems as needed. Expect approximately 17 to 22 tests given over the next 8 months.

An equivalent of ninety minutes (minimum) weekly will be devoted to laboratory investigations. As time is short, additional time outside of class may be available for additional lab work.

### **Materials Required**

Composition notebook for lab work. (prefer 100sheets Quad Rule) Pens (blue or black), scientific calculator, notebook for class.

### **Materials Recommended**

Loose leaf notebook (3-ring binder) and paper, or a legal pad type notebook with a binder to organize and protect notes and home work.

### **Text**

Zumdahl and Zumdahl, *Chemistry*, Houghton Mifflin, 2003, 6<sup>th</sup> edition ISBN# 0-618-22156-5

### **Laboratory**

Hall, James F. *Experimental Chemistry*, Houghton Mifflin, 2003, 6<sup>th</sup> edition ISBN# 0-618-22159-X

*\*All the following from Zumdahl*

*\*All labs from Hall*

<b>Unit</b>	<b>Chapter and Title</b>	<b>Time (days)</b>
1	Chapter 1 "Chemical Foundations"	5
	a. Scientific Method	
	b. Units of Measurement	
	c. Uncertainty <i>Precision and Accuracy</i>	
	d. Significant Figures	
	e. Dimensional analysis, Temperature and Density	
	Lab: The Laboratory Notebook and Lab Reports	
	Goal: Set standard for recording and reporting labs	
	<ul style="list-style-type: none"><li>• The Laboratory Balance</li><li>• Mass Determinations</li><li>• Density Determinations</li></ul>	
	Goals: Establish skills reading laboratory instruments, Identifying uncertainty in measurements, Calculations using proper significant figures and Dimensional analysis	8
	Chapter 2 "Atoms, Molecules and Ions"	6
	History and Fundamental Chemical Laws	

b. Atomic Structure, Molecules and Ions	
a. Introduction to the Periodic Table	
b. Naming Simple Compounds	
Lab:	
• Determination of Boiling Point	
• Determination of Melting Point	
Goals:	
Examine characteristics of pure substances	
Use of laboratory instruments	
Determination of uncertainty in measurements	
Proper use of significant figures in calculations and reporting	
	6
Chapter 3 “Stoichiometry”	7
a. Atomic masses, the Mole, Molar mass	
b. Percent composition, Formula determination, Chemical equations	
c. Balancing equations, Stoichiometric calculations, Limiting reactant	
Lab:	
• Hydrates	
Goal: Determination of empirical formulas	
Determination % composition of compounds	
Structure of ions and crystals	3
• Stoichiometric Determinations	
Goal: Determine limiting reagents	
Theoretical yield, experimental error	3
Chapter 4 “Types of Chemical Reactions and Solution Stoichiometry”	6
Water, Aqueous solutions, Strong and weak electrolytes	
c. Composition of solutions, dilutions	
d. Types of chemical reactions	
e. Acid-base reactions, precipitation reactions	
f. Redox reactions, Balancing Redox reactions	
Lab:	
• The Gas Laws	
Goal: Illustrate the effects of pressure on volume and temp.	
Apply gas laws to calculate and predict outcome of changes	
In pressure, volume, and temperature of a gas, observe and	

Calculate extent of effusion and diffusion of gases 1

### End First Nine Weeks

Unit	Chapter and Title	Time (days)
	Chapter 5 "Gases"	5
	Pressure, Gas Laws	
	b. Ideal gas law	
	c. Gas stoichiometry, Partial pressures	
	d. The Kinetic Molecular Theory of Gases, Boyles law, Charles law, Avogadro's law, Dalton's law, Root Mean Square Velocity	
	e. Effusion and Diffusion, Real Gases	
	Lab:	
	<ul style="list-style-type: none"><li>Vapor Pressure</li></ul>	
	Goal: Relate vapor pressure to boiling point, sublimation	
	And particle density	3
	Chapter 6 "Thermo-chemistry"	4
	Enthalpy and Calorimetry	
	Hess's Law	
	Standard Enthalpies of Formation	
	Lab:	
	<ul style="list-style-type: none"><li>Calorimetry</li></ul>	
	Goal: Calculate specific heat of a substance, observe	
	Thermodynamics of a system	3
3	Chapter 7 "Atomic Structure and Periodicity"	6
	a. Electromagnetic Radiation	
	b. The Nature of Matter	
	c. The Atomic Spectrum of Hydrogen	
	d. The Bohr Model	
	e. The Quantum Mechanical Model of the Atom	
	f. Quantum Numbers	
	g. Orbital Shapes and Energies	
	h. Electron Spin and the Pauli Principle	
	i. Polyelectronic Atoms	
	j. The History of the Periodic Table	
	k. The Aufbau Principle and the Periodic Table	

	l. Periodic Trends in Atomic Properties	
	m. The Properties of a Group: The Alkali Metals	
	Lab:	
	• Atomic Spectroscopy	
	Goal: Illustrate and determine energy states of electrons	
	Introduce quantum theory	3
	Chapter 8 “Bonding: General Concepts”	6
	a. Types of Chemical Bonds	
	b. Electronegativity	
	c. Bond Polarity and Dipole Moments	
	d. Ions: Electron configurations and Sizes	
	e. Formation of Binary Ionic Compounds	
	f. Partial Ionic Character of Covalent Bonds	
	g. The Covalent Chemical Bond: A Model	
	h. Covalent Bond Energies and Chemical Reactions	
	i. The Localized Electron Bonding Model	
	j. Lewis Structures	
	k. Exceptions to the Octet Rule	
	l. Resonance	
	m. Molecular Structure: The VSEPR Model	
	Chapter 9 “Covalent Bonding: Orbitals”	6
	a. Hybridization and the Localized Electron Model	
	b. The Molecular Orbital Model	
	c. Bonding in Homonuclear Diatomic Molecules	
	d. Bonding in Heteronuclear Diatomic Molecules	
	e. Combining the Localized Electron and Molecular Orbital Models	
	Lab: Molecular Properties	
	Goal:	
	Investigate the geometry of molecules, to better understand	
	Bonding and hybridization of orbitals	2
4	Chapter 10 “Liquids and Solids”	6
	a. Intermolecular Forces	
	b. The Liquid State	

- c. An Introduction to Structures and Types of Solids
- d. Structure and Bonding in Metals
- e. Molecular Solids
- f. Ionic Solids
- g. Vapor Pressure and Changes of State
- h. Phase Diagrams

Lab:

- Colligative Properties of Solutions

Goal:

Investigate the properties and characteristics of solutions

Including BP elevation and calculations of molar mass

3

### **End First Semester**

Chapter 11 "Properties of Solutions"

6

- a. Solution Composition
- b. The Energies of Solution Formation
- c. Factors Affecting Solubility
- d. Vapor Pressure of Solutions
- e. Boiling Point Elevation and Freezing Point Depression
- f. Osmotic Pressure
- g. Colligative Properties of Electrolyte Solutions

Lab:

- Rates of Chemical Reactions

Goal: Calculation of rate, order and half-life of chemical reaction

3

Chapter 12 "Chemical Kinetics"

8

- a. Reaction Rates
- b. Rate Laws
- c. Form of the Rate Law
- d. Integrated Rate Law
- e. Reaction Mechanisms
- f. Catalysis

\* Second Semester will begin with lab work

Lab:

- Chemical Equilibrium

Goal: Find shifts in equilibrium position due to Common Ion Effect, predict shifts

In equilibrium positions by applying LeChâtelier's Principle

Calculate the equilibrium constant

4

5 Chapter 13 "Chemical Equilibrium" 7

- The Equilibrium Condition
- The Equilibrium Constant
- Equilibrium and Pressures
- Heterogeneous Equilibria
- Applications of the Equilibrium Constant
- Solving Equilibrium Problems
- Le Châtelier's Principle

Lab:

- Solubility Product of Silver Acetate

Goal: Calculate  $K_{sp}$  from concentration of a saturated solution

Calculate solubility from a known  $K_{sp}$

3

Chapter 14 "Acids and Bases" 7

- The Nature of Acids and Bases
- Acid Strength
- The pH Scale
- pH and Strong Acid Solutions
- pH and Weak Acid Solutions
- Bases
- Polyprotic Acids
- The Lewis Acid-Base Model

Lab:

- Acids, Bases, and Buffered Systems

Goal:

Observe the characteristics and properties of acid and base solutions

Select and prepare a buffer

5

**End Third Nine Weeks**

6 Chapter 15 “Applications of Aqueous Equilibria”

7

a. Acid Base Equilibria Including:

\* Common Ion Effect

\* Buffers

\* Titrations and pH Curves

\* Acid – Base Indicators

b. Solubility Equilibria Including:

\* Solubility Equilibria and the Solubility Product

\* Precipitation and Qualitative Analysis

c. Complex Ion Equilibria

Lab:

- Acid/Base Titrations

Goal:

Volumetric analysis, preparation of a titrant, standardization of titrant

Titration of an unknown sample

4

Chapter 16 “Spontaneity, Entropy and Free Energy”

7

a. Spontaneous Processes and Entropy

b. Entropy and the Second Law of Thermodynamics

c. Temperature and Spontaneity

d. Free Energy

e. Entropy Changes in Chemical Reactions

- f. Free Energy and Chemical Reactions
- g. Free Energy and Pressure
- h. Free Energy and Equilibrium
- i. Free Energy and Work

**8 Review 10-15**

**Post AP Exam**

Lab:

- Inorganic Preparations

Goal:

Investigation of preparations of substances that mimic commercial preparations 4

**Recommendations**

1. Don't fall behind.
2. Come see me after school for help.
3. Form a study group(s) with classmates or other peers.
4. Arrange time after school for additional lab time.

**What I Expect**

I primarily assume you have taken this class because you wish to have a deeper understanding of chemistry. I also assume you wish to sit for the AP exam and earn college credit and that you are willing to put forth the effort to achieve this. I expect you to adjust your schedule so you don't miss class. I expect you to be ready to work (settled down and attentive) **before** the start of class.

**Laboratories and Grading**

Laboratories are matched to content as closely as possible, however there may be some overlap and/or lag due to time constraints.

Grading will be from tests. Laboratories will be graded for completeness of lab notebook and quality of write-up. Homework will be checked for completeness only.