

# AP Chemistry Syllabus

Derived from

AP<sup>®</sup> Chemistry Sample Syllabus 3

Syllabus 1029719v1

(with parts of Syllabus 1, 2, 4)

With modifications to reflect actual course and time allotted

(as we have many less days than from school start to exam date than in the sample syllabus)

Resubmission 1 - changes in red

Curricular Requirements		Page(s)
CR1	Students and teachers use a recently published (within the last 10 years) college-level chemistry textbook.	1
CR2	The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework.	1, 3
CR3a	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 1: Structure of matter.	5
CR3b	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 2: Properties of matter-characteristics, states, and forces of attraction.	5
CR3c	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 3: Chemical reactions.	4
CR3d	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 4: Rates of chemical reactions.	7
CR3e	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 5: Thermodynamics.	5
CR3f	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 6: Equilibrium.	8
CR4	The course provides students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.	5
CR5a	Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.	1
CR5b	Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.	3, 4, 5, 6, 7, 8, 9
CR6	The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.	3, 4, 5, 6, 7, 8, 9
CR7	The course provides opportunities for students to develop, record, and maintain evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, and graphic presentations.	2

## Course Description:

The purpose of Advanced Placement Chemistry is to provide a college level course in chemistry and to prepare the student to seek credit and/or appropriate placement in college chemistry courses. This course meets five times per week for a double period. A total of 95 minutes per day is spent on AP Chemistry. Laboratory periods average two to three days per week. Little time is spent on lecture since it is my philosophy that learning is active not passive. Students are engaged in hands-on laboratory work, integrated throughout the course that accounts for more than 25% of the class time. [CR5a] Emphasis is placed on depth of understanding of a topic, rather than breadth of topics. Two days prior to each chapter test is spent in study groups using old AP Chemistry Free Response questions/Study Guides for review.

## Objectives:

Students will:

1. Learn the inquiry process through numerous laboratory investigations.
2. Gain an understanding of the six big ideas as articulated in the AP Chemistry Curriculum Framework. [CR2]
3. Apply mathematical and scientific knowledge and skills to solve quantitative, qualitative, spatial, and analytic problems.
4. Apply basic arithmetic, algebraic, and geometric concepts.
5. Formulate strategies for the development and testing of hypotheses.
6. Use basic statistical concepts to draw both inferences and conclusions from data.
7. Identify implications and consequences of drawn conclusions.
8. Use manipulative and technological tools including Spectronic 21, PASCO Probes with DataStudio software on standard personal computers with graphing and data calculation either in DataStudio or using Microsoft Office Excel
9. Measure, compare, order, scale, locate, and code accurately.
10. Do scientific research and report and display the results of this research.

11. Learn to think critically in order to solve problems.

## Textbook, Laboratory Manual, and Study Guides:

Zumdahl, Steven S. and Zumdahl Susan A. Chemistry, 7th Edition. Boston, New York, Houghton Mifflin Company, 2007. [CR1]

Ohn-Sabatello Tina, Morlan Gordon and Knoespel, Sheldon. Fast Track to a Five, Evanston, IL, McDougall-Littell division of Houghton Mifflin Company, 2006.

Vonderbrink, Sally. Laboratory Experiments for Advanced Placement Chemistry. Batavia: Flinn Scientific, 2001

Hal, James. Experimental Chemistry, Houghton Mifflin

CR5a—Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.

CR2—The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework.

CR1—Students and teachers use a recently published (within the last 10 years) college-level chemistry textbook

## Laboratory Work:

All of the laboratory experiments in this course are hands on. Students work individually or in a group of two depending upon the lab. They collect, process, manipulate, and graph data from both qualitative and quantitative observations. Inquiry is emphasized in many of the experiments that

students complete. The laboratory work requires students to design, carry out, and analyze data using guided inquiry principles. For all labs, students are required to report the purpose, procedure, all data, data analysis, error analysis, results, and conclusions in a lab report that is submitted for grading. [CR7] All laboratory experiments are intended to be completed in one double period (84 minutes) except the following guided-inquiry labs that require two days of work or two double lab periods:

- Percent Sulfate in a Mixture
- Finding the Ratio of Moles of Reactants in a Chemical Reaction
- Hess's Law
- Spectroscopy Lab – Concentration of Copper ion of an Unknown
- Bleach (REDOX) Titration
- Determining Order of a Reaction
- Progressive Precipitation
- Electrochemical Cells

**Technology:**

12. Students use a Spectronic 21, PASCO Probes with DataStudio software on standard personal computers with graphing and data calculations either in Data Studio or using Microsoft Office Excel

**Laboratory Notes and Reports:**

All students are required to write a full laboratory report for every lab. A copy of raw data should be included with the report which includes Title, Objective, Equipment, Materials, Procedure, Data, Observation, Calculations, Results and Discussion, and Conclusions. Students should keep all graded reports in a binder

**Tests:**

A chapter test is assigned for each chapter. A comprehensive, standardized semester exam is administered at the end of 1<sup>st</sup> semester and a final exam at the end of the year.

**AP Exam Review:**

The final 10 full class days before the AP Chemistry Exam are used for exam review and practice tests using old AP Chemistry exam materials. Students work in cooperative groups to solve a packet of free response problems from previous exams. Students practice net ionic equations and are quizzed on their progress. Several practice AP Exams are administered as part of the two-week review prior to the AP Chemistry Exam.

CR7–The course provides opportunities for students to develop, record, and maintain evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, and graphic presentations.

**Course Outline: [CR2]**

Chapters in Zumdahl Chemistry	AP Chemistry Topic Covered
1. Chemical Foundations	None
2. Atoms, Molecules, and Ions	Atomic Theory & Atomic Structure (BI 1 & 2)
3. Stoichiometry	Stoichiometry (BI 3)
4. Solution Stoichiometry & Chemical Analysis	Reaction Types & Stoichiometry (BI 3)
5. Gases	Gases (BI 1 & 2)
6. Thermochemistry	Thermodynamics (BI 5)
7. Atomic Structure and Periodicity	Atomic Theory & Atomic Structure (BI 1 & 2)
8. Bonding -- General Concepts	Chemical Bonding (BI 1 & 2)

9. Covalent Bonding: Orbitals	Chemical Bonding (BI 1 & 2)
10. Liquids and Solids	Liquids & Solids (BI 1 & 2)
11. Properties of Solutions	Solutions (BI 2)
12. Chemical Kinetics	Kinetics (BI 4)
13. Chemical Equilibrium	Equilibrium (BI 6)
14. Acids and Bases	Equilibrium (BI 6)
15. Applications of Aqueous Equilibria	Equilibrium (BI 6)
16. Spontaneity, Entropy, and Free Energy	Thermodynamics (BI 5)
17. Electrochemistry	Reaction Types (BI 3)
18. The Nucleus -- A Chemist's View	Nuclear Chemistry
19. The Representative Elements: Groups 1A Through 4A	Descriptive Chemistry (BI 2)
20. The Representative Elements: Groups 5A Through 8A	Descriptive Chemistry (BI 2)
22. Organic Chemistry	Descriptive Chemistry
AP Chemistry Exam Review	All

(BI) refers to Big Ideas. Big Idea 1 – Structure of matter, Big Idea 2 – Properties of matter-characteristics, states and forces of attraction, Big Idea 3 – Chemical reactions, Big Idea 4 – Rates of chemical reactions, Big Idea 5 – Thermodynamics, Big Idea 6 – Equilibrium.

### **Assignments:**

#### **Chapter 1: Chemical Foundations (summer assignment)**

Read: Pages 1-30

Problems: odd numbers 25 to 71

CR2 —The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework.

CR5b —Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

CR6 —The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.

**Chapter 2: Atoms, Molecules, and Ions (summer assignment)**

Read: Pages 39-69

Problems: odd numbers 25 to 67

**Chapter 3: Stoichiometry (summer assignment)**

Read: Pages 77-115

Problems: odd numbers 27 to 105

*The first three chapters of Zumdahl are assigned as summer review work as this material was taught and used continuously in Honors Chemistry I. The material is reviewed with students the first 3 days of school with an assessment given after the review.*

*Labs: Several labs listed in the sample syllabus #3 have also been performed in Honors Chemistry I*

*Chemical Reactions of Copper and Percent Yield (SP 1.4, 2.1, 2.2, 4.2, 5.1, 6.1, 6.4; LO 1.19, 3.2, 3.3, 3.4, 3.10)*

*Decomposition of a compound to confirm the conservation of matter and the law of definite proportions. (SP 4.3, 6.1; LO 3.6)*

*Determination of the Formula of a Hydrate (SP 2.1, 4.2, 6.4; LO 3.5) [CR5b] & [CR6]*

**Chapter 4: Types of Chemical Reactions and Solution Stoichiometry**

(10 days)

Read: Pages 127-170

Problems: all 17 to 20, odd numbers 21 to 39, odd numbers 43 to 77

Labs: *Guided Inquiry: Percent Sulfate in a Mixture (SP 6.4, 7.1; LO 2.1) [CR5b] & [CR6]*

*Guided Inquiry: Finding the Ratio of Moles of Reactants in a Chemical Reaction (SP 2.1, 2.2, 4.2, 5.1, 6.4; LO 3.3, 3.5) [CR5b] & [CR6]*

Review: *Fast Track to a Five* pages 83-96

**Activity:** Utilizing an eduweb laboratory simulation, students have the opportunity to manipulate various factors that influence a redox reaction. [CR3c]

**CR5b**—Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

**CR6**—The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.

**CR3c**—The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 3: Chemical reactions.

## Chapter 5: Gases (5 days)

Read: Pages 179-217

Problems: 33, 35, 39, 43, 49, 51, 53, 55, 57, 65, 69, 73, 81, 83, 85, 87, 89

The Determination of the Molar Mass of a Volatile Liquid (SP 1.3, 1.4, 6.4, 7.2; LO 2.4, 2.5)

[CR5b] &

[CR6]

Review: [Fast Track to a Five](#) pages 97-108

**Activity:** Using Davidson.edu applet, develop Boyle's and Charles' Law using computer simulations of mercury manometers while varying pressure and temperatures. Then complete a series of online visual problems involving these laws. [CR3b]

**Activity:** Using Zumdahl section on atmospheric chemistry as an introduction, have students investigate the Clean Air Act and how it affects various atmospheric problems including LA type SMOG, acid rain, the ozone hole (Montreal Protocol), global warming and CO<sub>2</sub> and other greenhouse gases. [CR4]

## Chapter 6: Thermochemistry (10 days)

Read: Pages 229-265

Problems: 21, 23, 27, 31, 33, 35, 41, 43, 45, 47, 57, 59, 61, 63, 65, 67, 67, 71, 73

Labs: *Guided Inquiry*: Hess's Law (SP 4.2, 5.1, 6.4; LO 5.6, 5.7)

[CR5b] & [CR6]

Review: [Fast Track to a Five](#) pages 109-124

**Activity:** Using Davidson.edu applet, perform a bomb calorimetry experiment using computer simulations. Specifically determine the heat of combustion of methane. [CR3e]

## Chapter 7: Atomic Structure and Periodicity (10 days)

Read: Pages 275-320

Problems: odd numbers 31 to 109.

Labs: *Guided Inquiry*: Spectroscopy Lab - Concentration of Copper ion of an Unknown (SP 1.4, 6.1; LO 1.5, 1.6, 1.7, 1.8, 1.14, 1.15) [CR5b] & [CR6]

A Chemical Activity Series (SP 3.1, 3.2, 3.3, 4.2, 4.3, 4.4, 5.1; LO 3.3) [CR5b] & [CR6]

Spectroscopy Lab - Emission Lines of Some Metallic Elements (SP 1.4, 6.1; LO 1.5, 1.6, 1.7, 1.8, 1.14, 1.15) [CR5b] & [CR6]

Review: [Fast Track to a Five](#) pages 125-140

**Activity:** Periodic Table Dry Lab

Students will graph values for atomic and ionic radius, electronegativity, ionization energy, and electron affinity to predict periodic trends and explain the organization of the periodic table. [CR3a]

CR3a—The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 1: Structure of matter.

CR3b—The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 2: Properties of matter—characteristics, states, and forces of attraction.

CR4—The course provides students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

CR3e—The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 5: Thermodynamics.

CR5b—Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

CR6—The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.

**Chapter 8: Bonding: General Concepts (Chapter 8 & 9 are tested together-15 days)**

Read: Pages 329-382

Problems: 23, 25, 29, 31, 39, 41, 53, 55, 57, 59, 61, 63, 65.

Lab: *Guided Inquiry*: Bleach (REDOX) Titration (SP 2., 2.2, 2.3, 5.1, 5.2, 5.3; LO 1.18, 3.8, 3.9) [CR5b] & [CR6]

Review: Fast Track to a Five pages 141-168

**Chapter 9: Covalent Bonding: Orbitals**

Read: Pages 391-417

Problems: 27, 31, 33, 67, 69, 71, 73, 75, 87, 89, 91, 93, 97, 99, 101, 103.

Lab: Qualitative Analysis for Anions (SP 4.1, 4.2, 4.3, 5.2, 6.1; LO 2.10, 2.15, 3.1, 3.2, 6.23) [CR5b] & [CR6]

Review: Fast Track to a Five pages 141-168

**Chapter 10: Liquids and Solids (10 days)**

Read: Pages 425-474

Problems: 29, 31, 35, 37, 39, 79, 81, 83, 85, 87, 91, 93, 95.

Labs: continuation of Qualitative Analysis for Anions (SP 4.1, 4.2, 4.3, 5.2, 6.1; LO 2.10, 2.15, 3.1, 3.2, 6.23) [CR5b] & [CR6]

Review: Fast Track to a Five pages 169-180

CR5b —Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

CR6 —The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format



**Chapter 11: Properties of Solutions (10 days)**

Read: Pages 485-518

Problems: 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 437, 49, 51, 57, 59, 61, 63, 65, 67, 69, 71, 73, 75.

Lab: Freezing Point Depression (SP 1.1, 1.2, 6.4; LO 2.8) [CR5b] & [CR6]

Review: Fast Track to a Five pages 181-194

**Chapter 12: Chemical Kinetics (10 days)**

Read: Pages 527-566

Problems: 19, 21, odd numbers 25 to 69

Labs: *Guided Inquiry*: Determining Order of a Reaction (SP 2.6; LO 1.16, 4.2, 4.3, 4.4) [CR5b] & [CR6]

Determining the Activation Energy of a Reaction (SP 2.5; LO 4.5, 4.6) [CR5b] & [CR6]

Review: Fast Track to a Five pages 195-210

**Chapter 13: Chemical Equilibrium (10 days)**

Read: Pages 579-613

Problems: odd numbers 17 to 63.

Lab: Equilibrium Constant Determination by Spectroscopy (SP 4.2; LO 6.9) [CR5b] & [CR6]

Le Chatelier's Principle Using Four Systems (SP 1.4, 6.4; LO 6.1, 6.2, 6.8, 6.9, 6.10) [CR5b] & [CR6]

**Activity:** Using Davidson.edu applet, perform a study of factors affecting reaction rates through a computer simulations. [CR3d]

**CR5b**—Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

**CR6**—The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.

**CR3d**—The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 4: Rates of chemical reactions.

Students view the  $\text{NO}_2/\text{N}_2\text{O}_4$  Equilibrium simulation available on the General Equilibria Animations Index page at Iowa State University and verbally report and discuss their answers to teacher supplied questions regarding the number of reactant and product molecules present at a particular point in the equilibrium process, the breaking and forming of bonds during the process, and how the reactant and product molecules are changing in order to illustrate the dynamic nature of equilibrium. [CR3f]

Review: [Fast Track to a Five](#) pages 211-226

**Chapter 14: Acids and Bases (Chapter 14 & 15 are tested together-15 days)**

Read: Pages 623-672

Problems: odd numbers 27 to 123

Labs: Use of a Primary Standard--  $\text{KHC}_8\text{H}_4\text{O}_4$  [CR5b] & [CR6]

Determination of a  $K_a$  by Half Titration (SP 2.1, 2.2, 2.3, 5.1, 5.2, 5.3; LO 2.2, 3.7)

[CR5b] & [CR6]

Review: [Fast Track to a Five](#) pages 227-254

**Chapter 15: Applications of Aqueous Equilibria**

Read: Pages 681-739

Problems: odd numbers 23 to 67 and odd numbers 65 to 115.

Labs: *Guided Inquiry*: Progressive Precipitation (SP 1.5, 2.2, 4.2, 5.1, 6.4; LO 1.19, 2.10, 3.2, 3.3) [CR5b] & [CR6]

Buffered Solutions (SP 2.3, 4.2, 6.4; LO 1.4, 6.18, 6.20) [CR5b] & [CR6]

Review: [Fast Track to a Five](#) pages 255-270

**Chapter 16: Spontaneity, Entropy, and Free Energy (10 days)**

Read: Pages 749-782

Problems: odd numbers 23 to 55 and 61, 63, 65, 67

Review: [Fast Track to a Five](#) pages 109-124

CR3f—The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 6: Equilibrium.

CR5b—Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

CR6—The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.

**Chapter 17: Electrochemistry (10 days)**

Read: Pages 791–829

Problems: : odd numbers 23 to 90

Electroplating (SP 3.1, 3.2, 3.3, 4.2, 4.3, 4.4, 5.1; LO 3.3) [CR5b] & [CR6]

*Guided Inquiry:* Electrochemical Cells (SP 2.2, 2.3, 5.1, 6.4; LO 3.12, 3.13) [CR5b] & [CR6]

Review: Fast Track to a Five pages 271-284

**Chapter 18: The Representative Elements: Groups 1A Through 4A (Chapter 18 & 19 are tested together-8 days)**

Read: Pages 875–895

Problems: 2, 8, 10, 16, 18, 19, 22, 24, 26, 28, 30, 32, 34, 36, 39, 42, 44, 46, 48, 51, 53, 56, 57, and 62.

**Chapter 19: The Representative Elements: Groups 5A through 8A**

Read: Pages 901–936

Problems: 2, 6, 8, 10, 12, 14, 16, 18, 20, 22, 23, 25, 28, 29, 32, 33, 38, and 46.

**\*Refers to Learning Objectives (LO) or Science Practices (SP)**

CR5b—Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.

CR6—The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.

**Post AP Exam Labs (25 days)**

- Aspirin Synthesis and Analysis (SP 2.2, 4.1, 4.2, 5.1, 6.2, 6.4 ) [CR5b] & [CR6]
- Esterification (Banana oil and oil of wintergreen) (SP 2.2) [CR5b] & [CR6]
- Qualitative Analysis for Anions (SP 4.1, 4.2, 4.3, 5.2, 6.1; LO 2.10, 2.15, 3.1, 3.2, 6.23) [CR5b] & [CR6]
- 16 Unknown White Powder Identification (SP 4.1, 4.2, 4.3, 6.1, 6.2) [CR5b] & [CR6]