AP Chemistry Syllabus – 2013

Curricular Requirements		Page(s)
CR1	Students and teachers use a recently published (within the last 10 years) college-level chemistry textbook.	2
CR2	The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework.	1, 5-7
CR3a	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 1: Structure of matter.	7
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.	7
CR3c	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 3: Chemical reactions	7
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	7
CR3f	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 6: Equilibrium	7
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.	7
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.	3
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.	4-5
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.	4-5
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.	3

STRUCTURE OF THE COURSE: **[CR2]**

AP Chemistry is built around six big ideas and seven science practices. The big ideas are:

- **Big Idea 1**: The chemical elements are fundamental building materials of matter, and all matter can be understood in terms of arrangements of atoms. These atoms retain their identity in chemical reactions. (Structure of Matter)
- **Big Idea 2**: Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them. (Properties of matter – characteristics, states, and forces of attraction)
- **Big Idea 3**: Changes in matter involve the rearrangement and/or reorganization of atoms and/or the transfer of electrons. (Chemical Reactions)
- **Big Idea 4**: Rates of chemical reactions are determined by details of the molecular collisions. (Kinetics)
- **Big Idea 5**: The laws of thermodynamics describe the essential role of energy and explain and predict the direction of changes in matter. (Thermodynamics)
- **Big Idea 6**: Any bond or intermolecular attraction that can be formed can be broken. These two processes are in a dynamic competition, sensitive to initial conditions and external perturbations. (Equilibrium)

The science practices for AP Chemistry are designed to get the students to think and act like scientists. The science practices are:

- **Science Practice 1**: The student can use representations and models to communicate scientific phenomena and solve scientific problems.
- **Science Practice 2**: The student can use mathematics appropriately.
- **Science Practice 3**: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
- **Science Practice 4**: The student can plan and implement data collection strategies in relation to a particular scientific question.
- **Science Practice 5**: The student can perform data analysis and evaluation of evidence.
- **Science Practice 6**: The student can work with scientific explanations and theories.
- **Science practice 7**: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

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. Pre-AP Chemistry and teacher recommendations are a pre-requisite for this course. The course meets five times per week for an approximately 55-minute class period. A minimum of 25 percent of instructional time is dedicated to lab activities. **[CR5a]**

Students should spend at least another hour outside of class studying on their own to master the material. Students are expected to keep up with the course pace. At the end of the prior school year, a letter of understanding was sent home for the students and parents to sign. The letter explained the requirements and expectations for this rigorous course.

Course Design:

Problem-solving skills are emphasized in lecture topics, laboratory reports, and inquiry laboratory activities. Previous AP questions are reviewed with each major topic. To prepare for the AP Exam, students will be timed throughout the entire year on their tests. Also students will take a mock exam. The results will be discussed with the students to help better prepare them for the exam.

Required Text [CR1]

Chang, Raymond. Chemistry, Tenth Edition. 2009

Additional Resources and Supplies

- The College Board. AP Chemistry Guided Inquiry Experiments: Applying the Science Practices. 2013
- Moog, Richard S., Farrell, John J. Chemistry: A Guided Inquiry**,** Fifth Edition.
- Students will be required to purchase a study book. A recommendation will be made, but students will have the final decision on which one to choose.
- The following website will be used: http://apchemistrynmsi.wikispaces.com/
- Khan Academy video's
- Scientific calculator (graphing preferred), binder, lab folder, divider pages, paper, pen, and pencils

Laboratory

The labs completed require following or developing processes and procedures, taking observations, and data manipulation. See lab list provided for lab details. Students communicate and collaborate in lab groups; however, each student writes a laboratory report to be filed in the lab folder for every lab they perform. A minimum of 25% of student contact time will be spent doing hands-on laboratory activities. **[CR5a]**

The 10 Parts of a Laboratory Report [CR7]

A specific format will be given to the student for each lab. Students must follow that format and label all sections very clearly. AP Chemistry lab reports are much longer and more in depth than the ones completed in the first year chemistry course. Therefore, it is important that students don't procrastinate when doing pre-lab and post-lab work. Late labs will not be accepted. Labs not completed in class must be done before/after school by appointment.

Pre-Lab Work: Pre-lab work is to be completed and turned in on the day the lab is performed.

1. **Title:** The title should be descriptive. For example, "pH Titration Lab" is a descriptive title and "Experiment 5" is not a descriptive title.
2. **Date:** This is the date the student performed the experiment.
3. **Purpose:** A purpose is a statement summarizing the "point" of the lab.
4. **Procedure Outline:** Students need to write an outline of the procedure. They should use bulleted statements or outline format to make it easy to read. If a student is doing a guided inquiry lab, they may be required to write a full procedure that they develop.
5. **Pre-Lab Questions:** Students will be given some questions to answer before the lab is done. They will need to either rewrite the question or incorporate the question in the answer. The idea here is that when someone (like a college professor) looks at a student's lab report, they should be able to tell what the question was by merely looking at their lab report. It is important to produce a good record of lab work.
6. **Data Tables:** Students will need to create any data tables or charts necessary for data collection in the lab.

During the lab

7. **Data:** Students need to record all their data directly in their lab report. They are NOT to be recording data on their separate lab sheet. They need to label all data clearly and always include proper units of measurement. Students should underline, use capital letters, or use any device they choose to help organize this section well. They should space things out neatly and clearly.

Post-Lab Work

8. **Calculations and Graphs:** Students should show how calculations are carried out. Graphs need to be titled, axes need to be labeled, and units need to be shown on the axis. To receive credit for any graphs, they must be at least ½ page in size. Students are expected to show a sample calculation for each problem done. Certain labs will require a calculation for propagation of error.
9. **Conclusions/Evaluations:** This will vary from lab to lab. Students will usually be given direction as to what to write, but it is expected that all conclusions will be well thought out and well written. The error/limitations, effect on product, suggestions for improvement may be done in chart form.

The Laboratory Folders – A record of lab work is an important document, which will show the quality of the lab work that students have performed. All lab reports will be filled in these folders and may be used for documentation for college level practical work.

Laboratory Activities [CR5b, CR6]

1. *MSDS use and Laboratory Safety*

2. *Determination of Percent water in a compound and empirical formula*. – Students will use gravimetric analysis to determine the percent water in a hydrate and then use that information to calculate an empirical formula. This will also review stoichiometry. (Science Practices 2, 5)

3. *Oxidation-Reduction Titration with Potassium Permanganate and Sodium Oxalate* – Students will standardize a solution of potassium permanganate in a titration lab to determine the concentration of potassium permanganate. (Science Practices 2, 5, 7)

4. *Titration of Strong Acid/Strong Base* – Students will use LabQuest and Titrations to determine the concentration of a solution of unknown pH. After determining the pH, they will find the molarity of the strong acid. This will be done by plotting a titration curve and finding the equivalence point. (Science Practices 2, 5)

5. *Microanalysis of Antacids* – Students will analyze various brands of antacid tablets to determine which one is more effective at neutralizing stomach acids. (Science practices 2, 5, 7)

6. *Specific heat/Calorimetry lab* – Students will perform a calorimetry lab to examine various substances and identify an unknown by finding its specific heat. Data collection will be done using Labquest. (Science Practices 2, 5)

7. *Beer's Law* – Students will determine the concentration of an unknown nickel (II) sulfate solution by using colorimeters and Beer's Law. (Science Practices 2, 5, 6)

8. *Rates of Reaction* – Students will study the effect of reactant concentration of the rate of the reaction. (Science Practices 2, 5)

9. *Rate Law Determination of Crystal Violet Reaction* – Using colorimetry and Beer's law, students determine the order of a reaction and it's rate law. (Science Practices 2, 5, 6)

10. *Acidity of Beverages* – **Guided Inquiry** – Students will determine the concentration of acids in various consumer beverages by titration with sodium hydroxide. Students will construct a procedure and design a data table. (Science Practices 2, 3, 4, 5, 7)

11. *Analysis of Food Dyes in Beverages* – Students will utilize spectroscopy and graphical analysis to determine the concentration of dye in a sports drink. (Science Practices 2, 5, 7)

12. *Separation of a Dye Mixture Using Chromatography* – **Guided Inquiry** – Students will investigate the factors that influence the separation of food dyes using paper chromatography. Students will conduct a procedure and data table. They will also have to decide which solvent to use for the best results. (Science Practices 1, 3, 4, 5)

13. *Qualitative Analysis and Chemical Bonding* – **Guided Inquiry** – Students experimentally investigate ionic and molecular substances deducing properties of their bonds in the process. (Science Practices 1, 3, 4, 6)

14. *Green Chemistry Analysis of a Mixture* – **Guided Inquiry** – Students design and carry out a green chemistry experiment that can quantitatively measure the weight percent of one compound in a mixture of two compounds. (Science Practices 2, 3, 4, 5, 7)

15. *LeChatelier's Principle* – **Guided Inquiry** – Students investigate various equilibrium systems to analyze patterns and trends in the principles, concepts, and definitions of equilibrium. (Science Practices 3, 4, 5)

16. *Buffers* – **Guided Inquiry** – Given a selection of chemicals, students prepare a buffer of a given pH. (Science Practices 1, 2, 3, 4, 5, 6)

17. *Heat of Reaction (Hess's Law)* – Students perform a series of reactions and calculate enthalpy, proving Hess's Law. (Science Practices 2, 5)

18. *Physical and Chemical Changes Lab* – Students are given the materials to conduct various procedures. The data collected is used to develop a set of criteria for determining whether a given change is chemical or physical. (Science Practices 1, 5, 6)

Chemistry Unit Overview

First Semester

Week(s)	Chapter(s)	Topics Covered	Big Idea(s) [CR2]	Learning Objective(s)
1-4	1-5	Classification of Matter Atomic Structure Average Atomic Mass Isotopes Nomenclature Composition Stoichiometry Reaction Stoichiometry Oxidation Reduction Gas Laws MS PES	1 2 3 5	1.1 1.2 1.3 1.4 1.17 1.18 1.19 2.4 2.5 2.6 2.12 2.15 2.17 3.1 3.2 3.3 3.4 3.5 3.6 5.2
5-8	2, 7-11, 24, 25	Atomic and Molecular Structure Atomic Theory Subatomic Particles Wave-Particle Nature of Electrons Quantum Numbers Electron Configuration Periodic Trends Lewis Dot Structures Geometry VSEPR Hybridization Polarity Intramolecular Bonding Intermolecular Bonding Reactions Biochemistry	1 3	1.5 1.6 1.7 1.8 1.9 1.10 1.12 1.13 1.15 2.1 2.17 2.18 2.21 2.23 2.24 5.1 5.8
9-10	4,12	Solutions Concentrations Electrolytes Solubility Rules Net Ionic Equations Colligative properties	2 3	2.8 2.9 2.14 3.1
11-14	4, 19	Electrochemistry	3	3.12

		Review Redox Balancing Oxidation and reduction Voltaic Cell Electrolytic Cell	5 6	3.13 3.2 3.8 5.15 6.1
15-18	6, 18	Thermochemistry Internal energy Specific heat and calorimetry Hess's Law Enthalpy Calculations Spontaneity Entropy Gibbs Free Energy	2 3 5 6	2.15 3.11 5.12 5.13 5.14 5.15 5.16 5.17 5.18 5.3 5.4 5.6 5.7 6.25
18		Midterm		

Second Semester

Week(s)	**Chapter(s)**	**Topics Covered**	**Big Idea(s) [CR2]**	**Learning Objective(s)**
1	6,18	Finish Thermochemistry	See above	See above
2-4	13, 23	Kinetics Relative Rates Rate Law Expression Order of Reactions Half-Life and Integrated rate law Review of Nuclear Chemistry	4	4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9
5-6	14, 18	General Equilibrium Equilibrium Expression K_c and K_p Le Chatlier's Principle	6	6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9 6.10
7-11	4, 15-16	Aqueous Equilibrium pH Calculations K_a, K_b Common Ion Effect Buffer Systems Titrations Solubility Product Constant K_{sp}	1 3 6	1.20 3.3 3.7 6.1 6.12 6.13 6.14 6.15 6.16

				6.17 6.18 6.19 6.20 6.21 6.22 6.23
12-18		Review for Exam; Relating units together Practice AP tests; AP Exam		

Activities for Big Ideas

- **PES Activity**: Given PES data, students will interpret graphs to answer questions about different elements in regards to their photoelectron spectroscopy. Students will also have to make predictions about which energy peaks correspond to which energy levels. (Learning Objective 1.7) **[CR3a]**

- **Geometry Activity**: Given various examples, students will be able to draw Lewis diagrams and predict the geometry using VSEPR of the various structures. With this activity they will also make predictions about polarity and intermolecular forces. (Learning Objectives 2.18 and 2.21) **[CR3b]**

- **Making a Simple Battery:** Students will be given materials to assemble a simple battery. Through this they will analyze data to identify the properties of the redox reactions. (Learning Objective 3.13) **[CR3c]**

- **Kinetics Activity**: Students will study given data (and graphs) and from that data determine rate law by inspection and by graphing. (Learning Objectives 4.7 and 4.8) **[CR3d]**

- **Thermodynamics Activity**: Given drawings of graphs and particulate diagrams, students will be able to relate temperature to the motions of particles. They also will analyze the energies involved in breaking and formation of chemical bonds and will draw/identify graphs associated with this. (Learning Objectives 5.2 and 5.8) **[CR3e]**

- **Equilibrium Constant Activity:** The student will be given data (tabular and graphical) for an equilibrium reaction and will have to calculate the equilibrium constant. This activity will be extended to compare the calculated values of Q to K. (Learning Objectives 6.4 and 6.5) **[CR3f]**

Societal/Technological Assignment [CR4]

Students will be given an assignment where they will have to research how Chemistry plays a vital role in Forensics. Students will research various equipment used in Forensics labs, and they also will evaluate how accurately various television shows/movies discuss the results of Chemistry analysis. Students will be given different equipment and then discuss their research in class.