AP Chemistry Syllabus

Course Description

This AP Chemistry course is designed to be the equivalent of the general chemistry course usually taken during the first year of college. For most students, the course enables them to undertake, as a freshman, second year work in the chemistry sequence at their institution or to register in courses in other fields where general chemistry is a prerequisite. This course is structured around the six big ideas articulated in the AP Chemistry curriculum framework provided by the College Board. **[CR2]** A special emphasis will be placed on the seven science practices, which capture important aspects of the work that scientists engage in, with learning objectives that combine content with inquiry and reasoning skills. AP Chemistry is open to all students that have completed a year of chemistry who wish to take part in a rigorous and academically challenging course.

Textbook: [CR1] Tro, Nivaldo J. *Chemistry: A Molecular Approach*. 3rd edition, 2013. Upper Saddle River, NJ: Pearson Education, Inc.

Required Materials: Textbook, Scientific Calculator, Bound Composition Notebook, 3-ring chemistry portfolio

Grading:

- Tests and Quizzes = 30%
- Portfolio = 25%
- Laboratory Reports = 25%
- Final = 20%

Tests and Quizzes:

No make up tests or quizzes will be offered. If a student is absent on the day of an assessment they will receive a score of 0. At the end of the semester, the lowest quiz or test score will be exempted from the students' grade. The 0 grade due to an absence will be dropped at this time. If a student does not miss any assessments, they can drop the score of their choice that will most benefit their grade. If a student misses more than one quiz or test then one 0 score will be dropped and the other 0 grades will be replaced with the average score of the remaining assessments. If a student knows of their absence in advance, they can make special arrangements with the teacher to take the exam prior their absence.

Laboratory Reports

Students will engage in laboratory work using basic laboratory equipment for a minimum of 25% of instructional time. **[CR5A]** AP Chemistry students are required to keep a laboratory notebook as a record of their laboratory experiences. Lab reports are detailed accounts of what occurs in the laboratory and are an extremely important part of the course. Students must follow the lab report format provided and label all sections very clearly. For purposes of safety and time management, it is important that students don't procrastinate when doing pre-lab and post-lab work. Late labs will be credited with 50% of the earned score. Absent students are responsible for obtaining lab data from another student and completing the lab report on time.

Lab Report Format [CR7]

Pre Lab: must be completed the night before the experiment. You will not be allowed to conduct the lab unless this portion is complete.

Heading – Title, Date, Lab Partner

Purpose – In your own words, a brief statement that tells why you are doing this lab. Extract the purpose of the lab from the background information.

Discussion of Background Principles – This includes what you need to know in order to understand and analyze what you observe during the lab. I will provide the topics of discussion for each lab.

Procedure –

Safety: A bulleted list of the safety precautions you must follow to protect yourself and those around you from harm.

Protocol: A summarized instruction for performing the of the lab procedure in numbered steps. This may include a diagram of the lab setup.

DO NOT COPY FROM THE LAB INSTRUCTIONS unless instructed to do so.

Data: This is the QUANTITATIVE portion of your lab report.

Include any raw numerical data that you measured during the experiment represented in an easy to read and organized fashion. *See "Hints for Success"

Observations: This is the QUALITATIVE portion of your lab report.

In a few sentences, describe any color changes, odors, precipitates, or other observations during the experiment. What did you do that caused the observed effect?

Data Processing:

Show work for ALL calculations related to the experiment. You must clearly label each calculation so I know what you are calculating. Include the formula you are using in words, show a substitution, then write your answer with units. DRAW A BOX AROUND YOUR ANSWER. Don't forget to include units! Include graphs here if appropriate. *See "Hints for Success"

Discussion Questions:

Answer any discussion questions that I have assigned or included on the lab instruction sheet.

Conclusion and Evaluation:

This is the most important part of your lab report. It must be at least two paragraphs.

- Paragraph 1:
  - Begin with a topic sentence that refers to the purpose of your lab.
  - State the significant data – summarize the results.
  - Explain what happened and/or tell what you infer from the data – What does the data tell you? Refer to the background information.
  - End this paragraph with a concluding sentence that tells what you learned.
- Paragraph 2: Was your data consistent with your expectations and/or known data? Discuss the likely sources of error or limitations in your experiment and how they may have affected your results. Be very specific to your lab experience. Provide specific recommendations that would improve your result.

AP Chemistry Unit Overview

Unit	Chapter	Title	Topics Covered	Labs	Activities	Big Idea	Learning Objective
0	1	Chemistry Fundamentals	• Scientific Method • Rounding • Significant Figures • Accuracy and Precision • Metric Conversions • Density • Spectroscopy • Classification of Matter • Polyatomic Ions Nomenclature • Determination of Atomic Masses • Percent Composition • Writing and Balancing Equations • Stoichiometry	1. Percent Copper in Brass – *Inquiry* – *Flinn Scientific* **[CR5B, CR6, SP2 & SP5]**	1. Pouring Gases (Demo) 2. Making Observations – Candle in a jar (Demo) 2. Error Analysis – Percent Composition of Hydrates	1 2	1.16 2.8
1	1, 2, 7, 8	Matter, Atomic History, Atomic Structure and the Periodic Table	• Physical and Chemical Properties and Changes • Separation Techniques: Distillation, Filtration, Chromatography, Recrystallization • Particle Representations of aqueous vs. solid ionic compounds • Law of Conservation • Law of Definite Proportions • History and Modern Atomic Structure • E. Ruthorford's Gold Foil Experiment • Isotopes • Mass Spectrometry • Periodic Table as a reference guide • Atomic Models – Bohr and	1. Physical Separation of a Mixture 2. Gravimetric Analysis of Calcium and Hard Water – *Flinn Scientific* **[CR5B, CR6, SP2, SP4 & SP7]**	1. Is air matter? 2. States of Matter pHET simulation 3. Kool Chromatography 4. Students use a mass spectrometer printout of the relative masses of isotopes of an element to determine (a) % of the isotopes and (b) the average atomic mass of the element **[CR3A]**	1 2 3 5	1.1 1.2 1.3 1.5 1.6 1.7 1.8 1.9 1.10 1.11 1.12 1.13 1.14 1.15 1.17 1.18

			Quantum • Electron Configuration • Valence Electrons and Lewis Dot Structures • Periodic Trends • Coulomb's Law • Shielding • Effective Nuclear Charge • Periodic Table Arrangement • Properties of Light and Waves • Energy Levels and atomic spectra of hydrogen • Quantum theory and electron orbitals • Photoelectron Spectroscopy				1.19 2.3 2.7 2.10 3.1 3.10 5.2
2	3	Chemical Names, Reactions and Stoichiometry	• Naming Review – Ionic Compounds, Molecules, Acids, Organic Compounds (basics) • Molecular and Empirical Formulas • Obtaining Empirical Formula from Experimental Data and Combustion Analysis • Percent Composition • Balancing Equations	1. Green Chemistry Analysis of a Mixture – *Flinn Scientific* **[CR5B, CR6, SP2 & SP4]** 2. Separating a Synthetic Pain Relief Mixture – *Flinn Scientific* **[CR5B, CR6, SP1, SP3 & SP7]**	1. Old Foamey (Demo) – Students identify reactants, products, balance the equation and answer questions about the reaction. **[CR3C]** This activity is continued throughout the year with appropriate reactions chosen for the unit being studied 2. Students will write a letter to a local congressperson regarding their position on local oil drilling and the necessity for dependence on oil **[CR4]**	1 3	1.4 3.3 3.4 3.5 3.6 3.10
3	4	Aqueous Solutions and their Properties	• Stoichiometry with Limiting Reagants • Theoretical Yield and % Yield • Reaction Types – precipitate, acid-base, gas evolution, oxidations	1. Analysis of Food Dyes in Beverages – *Inquiry* – *Flinn Scientific* **[CR5B, CR6, SP2 & SP5]** 2. Acidity of Beverages – *Flinn Scientific* **[CR5B & CR6 & SP2]**	1. Beer's Law pHET simulation 2. Analysis of Red Food Dye Colorimetry 3. 50mL + 50 mL = ? 4. Soap, Food Coloring and Milk 5. Salts and Solubility pHET	1 2 6	1.15 1.16 1.20 2.1 2.8 2.9

			• Net Ionic Equations • Particle Drawings of Solutions • Oxidation States • Solution Equilibrium and Factors that Affect • Types of solutions and Intermolecular forces • Molarity		simulation 6. Titration Simulation		2.11 2.13 2.14 2.15 6.21 6.22 6.23 6.24
4	5	Gases	• Properties of Gases • Gas Laws – Boyle, Charles, Gay-Lussac's, Combined • Dalton's Law of Partial Pressures • Molar Volume of Gases • Graham's Law • Kinetic Molecular Theory • Real Gases and Derivation from Ideal Gas Law • Gas Reaction Stoichiometry	1. Standard Molar Volume of a Gas **[CR5B & CR6 & SP2]** 2. Molar Mass of Butane **[CR5B & CR6 & SP2]**	1. Graham's Law tube 2. Soap Bubble in hot vs. cold	2	2.4 2.5 2.6 2.12
5	6, 17	Thermochemistry and Thermodynamics	• Laws of Thermodynamics • Enthalpy • Entropy • Free Energy • Endothermic and Exothermic Reactions • Energy Diagrams • Calorimetry, heat capacity and specific heat • Hess' Law • Heat of Formation and combustion • Bond Energies	1. Designing a Hand Warmer – *Inquiry – Flinn Scientific* **[CR5B, CR6, SP1, SP2, SP3, SP4, SP6 & SP7]**	1. Efficiency of a Microwave Oven 2. Given a set of conditions, students will determine if the situation is thermodynamically favorable by examining entropy, enthalpy and Gibbs Free energy **[CR3E]**	3 4 5 6	3.11 4.6 5.3 5.4 5.5 5.6 5.7 5.8 5.12 5.13 5.14 5.15 5.18 6.25

6	9, 10	Chemical Bonding, Molecular Geometry and Hybridization	• Ionic, Covalent, Metallic Bonding • Lewis structures • Bond Energy and Bond Length • Resonance structures and formal charge • Bond polarity, molecule polarity and dipole moments • Lattice Energy • VSEPR and molecular shape • Hybridization • Molecular orbitals and diagrams	1. Qualitiative Analysis and Chemical Bonding – *Flinn Scientific* **[CR5B, CR6, SP1 & SP6]**	1. Building Molecular Models – 'derivation' of VSEPR principles using MolyMod kits to determine molecular shape, bond angles, and lone e- pairs [CR3B]	2	2.17 2.18 2.19 2.20 2.21 2.22 2.23 2.24 2.25 2.26 2.27 2.28 2.29 2.30 2.31 2.32
7	11	Liquids, Solids and Intermolecular Forces	• Metallic, network and molecular solids • Surface Tension • Viscosity • Capillary Action • Properties of Water • Vapor Pressure • Phase changes • Heating and cooling curves • Particle Drawings of Intermolecular Forces	1. Separation of Dye Mixture using Chromatography – *Flinn Scientific* **[CR5B, CR6 & SP5]**		2 5	2.3 2.4 2.7 2.10 2.16 5.1 5.9 5.10 5.11
8	13	Kinetics	• Reaction rates • Factors that affect reaction rates • Collision theory • Rate equation determination – rate constants and mechanisms	1. Rate of Decomposition of Calcium Carbonate – *Inquiry* – *Flinn Scientific* **[CR5B, CR6, SP2 & SP5]** 2. Kinetics of Crystal Violet Fading – *Flinn Scientific* **[CR5B, CR6 & SP2]**	1. M&M Activity (O^{th}, 1^{st}, 2^{nd}, order) 2. Given reaction rate data, students generate graphs of [ ] vs. rate, ln[ ] vs. rate, and 1/[ ] vs. rate to identify the order of a reactant **[CR3D]**	4 5	4.1 4.2 4.3 4.4 4.5 4.6

			• Determining orders • Writing rate laws • Solving for rate constant • Half Life Equations • Identifying intermediates • Integrated rate law • Activation energy • Boltzmann distribution • Catalysts (surface, acid-base, enzymes) and biological systems				4.7 4.8 4.9 5.1 5.2
9	14	Chemical Equilibrium	• Characteristics of dynamic equilibrium • Equilibrium expression derived from rates • Factors that affect equilibrium – temperature, pressure, and concentration • Le Chatelier's Principle • Equilibrium constant • Kp, Kc, Q – qualitative and quantitative understandings • Solving equilibrium problems	1. Applications of Le Chatelier's Principle – *Flinn Scientific* **[CR5B, CR6, SP5, SP6 & SP7]**	1. Reversible Reactions pHET simulation 2. Dueling Graduated Cylinders 3. Given the stress put on a system at equilibrium, students predict the shift and resultant observations **[CR3F]**	5 6	5.16 5.18 6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9 6.10 6.22
10	15	Acids and Bases	• Definitions – Arrhenius and Bronsted-Lowry • Properties of Acids and Bases • K_A, K_B, K_W and the pH scale • pH of strong and weak acids and bases • Polyprotic acids • pH of salts • Molecular Structure of Acids and Bases • Characteristics of buffers	1. Acid-Base Titrations – *Flinn Scientific* **[CR5B, CR6 & SP2]** 2. Buffers in Household Products – *Inquiry* – *Flinn Scientific* **[CR5B, CR6, SP2, SP3 & SP7]** 3. Properties of Buffer Solutions – *Flinn Scientific* **[CR5B, CR6, SP2, SP3, SP4, SP6 & SP7]**	1. Acid-Base Solutions pHET simulation	1 2 3 6	1.20 2.2 2.9 3.7 6.11 6.12 6.13 6.14 6.15 6.16

			– identification, effectiveness, range and capacity • Titrations and pH curves • Choosing acid base indicators • pH and solubility • K_{sp} calculations				6.17 6.18 6.19 6.20
11	18	Redox and Electrochemistry	• Balancing redox reactions • Electrochemical cells • Electrode and cell potentials • The Nernst equation • Thermodynamically favorable and unfavorable equations • Applications	1. Analysis of Hydrogen Peroxide – *Inquiry* – *Flinn Scientific* **[CR5B & CR6 & SP2]**		3	3.2 3.8 3.9 3.12 3.13
12	19	Nuclear Chemistry	• Review of first order kinetics and half lives		1. Nuclear Fission pHET simulation	4	4.3
13	20	Organic Chemistry	• Nomenclature • Functional Groups and their properties • Lewis structures		1. Organic Chemistry Compounds Foldable	5	5.11

Second Semester Project:

Students choose a molecule of importance either natural or man-made and report on the importance of the molecule in our society. Topics may include but are not limited to nanotechnology and/or medicine. The project includes setting up a display of a model of the molecule along with information about the molecule's uses, sources, etc. **[CR4]**