## AP Chemistry

Mr. Lynn

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## Course Objective

This course is intended to give the student the most thorough and comprehensive understanding of chemistry beyond that expected upon completion of a first year college chemistry course. There is a focus on student’s problem-solving and critical thinking skills so that they may successfully complete the AP Chemistry Examination in the spring.

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.

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 the Texas Instruments Nspire CAS CX Handhelds, Vernier LabQuests, Vernier Probes, and Vernier’s LoggerPro software.

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.*

**Attendance Procedure**

This course starts at a 0 mod of 7:00, 25 minutes earlier than the normal school day. Official school attendance won’t be taken until 7:25, so you won’t receive school discipline for being a minute or two late. However, missing the introduction to the lesson can make the material much more difficult to comprehend.

**Calculator**

A graphing calculator is required for this course. You will be able to use it for the free response section of the test, but NOT FOR THE MULTIPLE CHOICE. A minimum of a TI-82 will work. I would recommend a TI 84 or better. The N-Spire class are also acceptable. Technically you can pass the test with a TI 30.

**Class Procedure**

Because of the magnitude and specificity of AP Chemistry topics, some adjustments will need to be made in order to ensure that all required materials ore covered and to guarantee that the student can receive as much individual attention as possible.

1. Because of the amount of material, the pace of the course, and time constraints, students must be willing to put in a substantial amount of individual time into the class. In most cases, this means seeking other resources, working extra problems, and doing outside investigations.

2. Time is always a great concern. While 8 - 10 class periods per week is recommended for the AP Chemistry course, we have only five 70-minute periods per week. Furthermore, laboratory techniques and questions appear in one form or another on the exam. Labs typically require 1 - 3 hours each. Also, many problems must be worked in this course in order to increase the student’s rate of success.

a. Class time will not be spent going over homework. If you are having troubles, arrangements should be made for other time periods.

b. Students may need to complete labs ***outside*** of regular class time. This

may include before or after school and during lunch.

**Laboratory Work:**

**A minimum of 16 labs will be completed**, there will likely be more. Students collect, process, manipulate, and graph data from both qualitative and quantitative observations. **Inquiry** is emphasized in many of the experiments that students complete, **at least 6 labs will be inquiry labs**. Inquiry laboratory work requires students to **design**, carry out, and analyze data using guided inquiry principles. For all labs, students are required to create a report that is turned in to be graded. Several labs will take multiple days to complete.

**Students must keep a complete lab book of all experiments done in class with an updated table of contents page. It is recommended to keep a 3 ring binder for this. The lab book will be collected each nine weeks and graded.**

Below is a list of labs completed last year.

Predictions, Reactions and Net Ionic Equations Lab

Determination of percent composition of Silver Oxide lab

Enthalpy of reaction lab

**AP** **Inquiry** # 12 Hand Warmer lab

Mole ratio lab

Rate and order lab

**AP** **Inquiry lab #11** Rate law of crystal violet using Beer’s law

Reaction Rate lab

Equilibrium constant lab

Acid Dissociation, Ka lab

Buffers lab

Standardize NaOH lab

**AP** **Inquiry lab #4** how much acid is in fruit drinks and soft drinks

Ka by half titration lab

Ksp solubility of calcium hydroxide

Redox titration lab

**AP inquiry lab #8** Can we determine the percentage of H2O2

Electroplating lab

**AP Inquiry lab #1** Relationship between concentration and absorbance

Inquiry Ancient Coin lab

**AP Inquiry Lab #15** Can We Make a Rainbow Using LeChatelier’s Principle

**Grading and Tests**

1. Tests account for approximately 70% of the total grade.

2. Lab assignments account for approximately 30% of the total grade.

3. Homework is assigned but does not count for a significant part of your grade.

Tests are a combination of multiple choice and free-response questions. Most of the multiple-choice questions come from the chapter under study. Some questions, however, will come from previous chapters. All tests are comprehensive! The free-response questions are either problems that students work out or written explanations of why a given chemical phenomenon occurs. Tests will be graded as closely as possible to format of AP tests are graded.

**Students will likely need to adjust their perception of what a good grade on a test is. A 5 on the AP test is normally around a 70-75%. All raw percentages on tests will be adjusted to fit our school grading scale.**

**Text/Resources**

Zumdahl, Steven, and Susan Zumdahl. Chemistry, 8e. Brooks/Cole – Cengage Learning.

**Course Outline: [CR2]**

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| **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.*

#### Summer Assignment

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| **Text Reference/ Resource** | **Topics** | Assignment/ Evaluations |
| *Chapter 1*  *Chemical Foundations* | * Units of measurement, both SI and derived. * Significant figures and calculations. * Temperature scales. * Density. * Classification of matter. | End of chapter problems (odd numbers). |
| *Chapter 2* Atoms, Molecules and Ions | * Fundamental chemical laws – conservation of mass, definite proportions and multiple proportions. * Dalton’s atomic theory. * Early experiments of Thomson, Millikan, and Rutherford to characterize the atom. * The modern view of atomic structure, including protons, electrons, neutrons, isotopes, atomic number and mass number. * Molecules and ions; molecular vs. ionic. * An introduction to the periodic table with emphasis on classifications and properties. * Naming/formulas of simple compounds – binary ionic, polyatomic ionic, binary covalent, and acids. | End of chapter problems (odd numbers). |
| *Chapters 3*  *Stoichiometry and Types of Chemical Reactions* | * Average atomic mass. * Molar mass and calculations. * Percent composition of compound and mass percent problems. * Empirical formula, molecular formula and combustion analysis problems. * Stoichiometry of chemical equations, including limiting reactants and percent yield. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |

First Quarter

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| **Text Reference/ Resource** | **Topics** | **Assignment/ Evaluations** |
| *The Ultimate Chemical Equations Handbook* | * Symbols and nomenclature. * Simple inorganic formulas and nomenclature. * Oxidation numbers: anions and cations. * Ternary nomenclature: Acids and salts. * Complex ion formulas and nomenclature. * Organic nomenclature and simple reactions. * Balancing molecular equations. * Single replacement reactions. * Double replacement reactions. * Aqueous solutions and net ionic equations. * Redox equation balancing and reactions. * Electrolysis in aqueous solutions. * Complex ion reactions. | End of topic exercises assigned upon completion.  AP Format Equation Writing Quiz. |
| *Chapters 4*  *Solution Stoichiometry* | * Composition of solutions – molarity, ion concentration, and dilution. * Precipitation reactions – determining the mass of precipitate formed. * Acid-base neutralization and an introduction to titrations. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapter 6*  *Thermochemistry* | * The nature of energy – potential, kinetic, and conservation. * State functions. * System, surroundings, and the universe. * Exothermic v. endothermic. * The First Law of Thermodynamics. * Enthalpy and Calorimetry – constant pressure and constant volume calculations. * Hess’s Law. * Standard enthalpies of formation, including standard state conditions and standard heats of reaction. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapters7, 8 and 9*  *Atomic Theory Periodic table Bonding: General Concepts and Covalent Bonding: Orbitals* | * Types of chemical bonds, including covalent, ionic and metallic bonding. * Bonding properties. * Coulomb’s Law and lattice energy. * Electronegativity, bond polarity and dipole moments. * Covalent bond energies and chemical reactions – single, double and triple bond energies and enthalpy calculations. * Localized electron bonding model. * Lewis structures – octet rule, diagramming, resonance, exceptions/violations of the octet rule, and formal charges. * VSEPR – geometry, diagramming, molecular polarity, single and multiple central atoms. * Hybridization – types of hybrid orbitals, sigma and pi bonding | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |

Second Quarter

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| **Text Reference/ Resource** | **Topics** | **Assignment/ Evaluations** |
| *Chapter 12*  *Chemical Kinetics* | * Introduction to reactions rates – initial rate, instantaneous rate, and rates of appearance and disappearance. * Differential rate law – the meaning of reaction orders, the method of initial rates, solving for “k” and units of “k.” * Integrated rate law for zero, first and second order reactions, including half lives and graphical interpretation * Reaction mechanisms – molecularity, elementary steps, reaction intermediates, fast/slow/reversible reactions, and determination of a proper mechanism. * Collision Theory. * Transition State Theory. * Activation energy and the Arrhenius equation. * Potential energy diagrams. * Catalysis. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| Chapters 13, 14, 15, and 16 *Chemical Equilibrium, Acids and Base, Acid-Base Equilibria and Solubility and Complex Ion Equilibria* | * The Law of Mass Action, equilibrium expressions, and the equilibrium constant and the manipulation of “K.” * Kc vs. Kp and conversions. * Q vs. K and calculations. * Solving equilibrium problems using pressures, concentrations and the 5% rule. * Le Chatelier’s Principle and the effect of changes in concentration, pressure and temperature on “K.” * The nature of acids and bases, including definitions, conjugate acid-base pairs, hydronium and hydroxide, and Ka/Kb expressions. * Trends in acid strength. * Monoprotic and polyprotic acids; Amphoterism. * The auto-ionization of water and the ion-product constant, Kw. * Calculations of pH and pOH from hydronium and hydroxide concentrations. * Calculating the pH of strong acids and bases. * Calculating the pH of weaks acids and bases – equilibrium problems and % dissociation. * Calculating the pH of polyprotic acids solutions. * Acid-base properties of salts – neutral, acid and basic solution formation and calculations. * The effect of structure on acid-base properties, including trends in binary acid and oxyacid strengths. * Lewis acids and bases. * Calculations with solutions of acids and bases containing a common ion. * Buffered solutions – preparation, pH determination, function, the Henderson-Hasselbach equation, buffer capacity and indicators. * Calculations of titration/pH curves for systems of a strong acid – strong base, weak acid – strong base, and weak base – strong acid. * Solubility equilibria and solubility product constant (Ksp) calculations, including the common ion effect and selective precipitation. * Qsp vs. Ksp and the prediction of precipitate formation and Qualitative analysis. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |

#### Third Quarter

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| **Text Reference/ Resource** | **Topics** | **Assignment/ Evaluations** |
| *Chapter 17*  *Spontaneity, Entropy, and Free Energy* | * Spontaneous processes and entropy. * Positional entropy. * The 2nd Law of Thermodynamics. * The effects of temperature on spontaneity. * The 3rd Law of Thermodynamics. * Entropy changes in chemical reactions and calculations. * Free energy and spontaneity, including the role in chemical reactions, dependence on temperature, relationship to equilibrium and work, and calculations. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapter 18*  *Electrochemistry* | * Galvanic Cells – Oxidation and reduction, half reactions and the anode/cathode, diagramming, standard cell potentials and the standard reduction table, and line notations. * Cell potential, electrical work, free energy and calculations. * Dependence of cell potential on concentration, the Nernst equations and Q vs. K. * Electrolysis, including diagramming, electroplating, and stoichiometric calculations. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapter 5*  *Gases* | * Pressure – units and conversions, barometer/manometer diagramming and calculations. * The gas laws of Boyle, Charles and Avogadro including calculations. * The ideal gas law, the universal gas constant, and the derivation of other gas laws. * Gas stoichiometry – chemical reaction calculations, molar mass of a gas and gas density calculations. * Dalton’s law of partial pressures, mole fraction and water displacement. * Kinetic Molecular Theory – postulates, gas properties and the ideal gas law, the meaning of temperature, and root mean square speed. * Effusion, diffusion and Graham’s law. * Real vs. ideal gases and the van der Waal’s equation. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapter 10 and Chapter 11*  *Liquids and Solids*  *and Properties of Solutions* | * Intermolecular forces and bonding forces for solids, liquids and solutions, including covalent network, ionic, metallic, ion-dipole, dipole-dipole, H-bonding, ion-induced dipole, dipole-induced dipole, and London dispersion forces. * Properties of a liquid – surface tension, capillary action, and viscosity. * Properties of a solid – lattice structures/unit cells, ionic/molecular/metallic solids, bonding in ionic/metallic solids, coordination numbers/packing efficiency, and substitutional/interstitial alloys. * Vapor pressure and changes of state, including enthalpies of vaporization and fusion, phase diagrams, and heating curves. * Solubility and saturation. * Concentration – molarity, molality, mole fraction, parts by mass, and parts by volume. * Colligative properties, including Raoult’s Law and the van’t hoff factor. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapter 7*  *Atomic Structure and Periodicity* | * Electromagnetic radiation and the properties of light, including wavelength, frequency, the speed of light, reflection, refraction, and diffraction. * The nature of matter, specifically the ideas of Planck, Einstein, and de Broglie, including quantized energy, the photoelectric effect, duality and matter waves. * The atomic spectrum of hydrogen – continuous spectrum and line spectrum. * The Bohr model for hydrogen – electron energy quantization and calculations. * The quantum mechanical model, specifically the ideas of Schrodinger and Heisenberg, including quantum numbers, orbital shapes and energies, electron spin and the Pauli exclusion principle, polyelectronic atoms, the Aufbau principle, electron configurations and orbital diagrams. * The modern periodic table and the works of Mendeleev and Moseley. * Periodic trends – atomic radius, ionization energies, electronegativity, electron affinity, shielding effect, effective nuclear charge, ion size, and metallic character. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |

#### Fourth Quarter

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| **Text Reference/ Resource** | **Topics** | **Assignment/ Evaluations** |
| *Chapter 19*  *The Nucleus: A Chemist’s View* | * Nuclear stability and radioactive decay, including the band of stability and trends. * Types of decay – alpha, beta, gamma, positron and electron capture. * The kinetics of radioactive decay, half-life and radioactive dating. * Thermodynamic stability of the nucleus, binding energy and mass defect. * Fusion vs. fission. * Effects of radiation – somatic vs. genetic damage. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *Chapter 22*  *Organic and Biological Molecules* | * Alkanes, including isomerism and nomenclature. * Alkenes, alkynes and nomenclature. * Aromatic hydrocarbons. * Functional groups. | End of chapter problems (odd numbers).  AP Format Multiple Choice and Free Response Test. |
| *AP Exam Review* | * AP Released Multiple Choice Tests. * AP Released Free Response Tests. | Student will take 4 Mock AP Tests, w/ 75 minutes devoted to Multiple Choice, 40 minutes to Free Response “A” and 50 minutes to Free Response “B.” |