**AP Chemistry**

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| **Course Description** |

The AP Chemistry course is designed to be the equivalent of a two semester introductory college chemistry course. Spanning both semesters, the course meets daily for a 90 minute period. Instruction consists mostly of laboratory, lecture, discussions, demonstrations, and written assignments which may include research projects, in-class assignments, homework, and online activities. Laboratory will require students to observe proper safety precautions and turn in a written lab report.

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| **Course Materials** |

Required Materials: 3-ring binder (one inch), paper, pen, pencil, scientific calculator, composition notebook

(*Because chemistry professors at some institutions ask to see a record of the laboratory work done by an AP student before making a decision about granting credit or placement in the chemistry program, students should keep a laboratory portfolio that includes reports of their laboratory work in such a fashion that the reports can be readily reviewed. Organize your notebook accordingly!*) The textbook is *Chemistry: AP Edition Chemistry*  9th edition by Zumdahl and Zumdahl, published by Brooks Cole, Cengage Learning (2014). **Students are encouraged to purchase a Student Study Guide to prepare for course exams and an AP review book to help them study for the exam. The teacher prepares in-depth analyses of homework questions that students may use to review homework.**

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| **Instructional Philosophy** |

Students taking AP Chemistry can expect an engaging, hands-on learning experience. Assessments will be designed to apply the rigors which students will experience during the taking of the AP Examination, so that students will be prepared with the content and test-taking skills required to reach their full potential during that examination. Students enrolled in the course are juniors and seniors who have successfully taken honors chemistry and are enrolled in upper level, honors math courses. Students are expected to be self-motivated with the **time and dedication to devote to a rigorous course**. Students should have good note-taking and study habits. The course is a year-long class and students are required to take both semesters and sit for the AP exam in order to earn AP credit.

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| **Course Standards** |

**Every AP Course is Required to Include These Topics**

**I. Structure of Matter (20%)**

A. Atomic theory and atomic structure (Enduring Understanding 1.A)

1. Evidence for the atomic theory

2. Atomic masses; determination by chemical and physical means

3. Atomic number and mass number; isotopes

4. Electron energy levels: atomic spectra, quantum numbers, atomic orbitals (Enduring Understanding 1.B and 1.D)

5. Periodic relationships including, for example, atomic radii, ionization energies, electron affinities, oxidation states

(Enduring Understanding 1.C)

B. Chemical bonding

1. Binding forces

a. Types: ionic, covalent, metallic, hydrogen bonding, van der Waals (including London dispersion forces)

(Enduring Understanding 2.B, 2.C and 2.D)

b. Relationships to states, structure, and properties of matter (Enduring Understanding 2.A)

c. Electronegativity differences, polarity of bonds, molecular symmetry, and polarity of molecules.

2. Molecular models

a. Lewis structures

b. Valence bond: hybridization of orbitals, resonance, sigma and pi bonds

c. VSEPR

3. Geometry of molecules and ions, structural isomerism of simple organic molecules and coordination

complexes; dipole moments of molecules; relation of properties to structure

C. Nuclear chemistry: nuclear equations, half-lives, and radioactivity; chemical applications

**II. States of Matter**

A. Gases

1. Laws of ideal gases

a. Equation of state for an ideal gas

b. Partial pressures

2. Kinetic molecular theory

a. Interpretation of ideal gas laws on the basis of this theory

b. Avogadro’s hypothesis and the mole concept

c. Dependence of kinetic energy of molecules on temperature

d. Deviations from ideal gas laws

B. Liquids and solids

1. Liquids and solids from the kinetic-molecular viewpoint

2. Phase diagrams of one-component systems

3. Changes of state, including critical points and triple points

4. Structure of solids; lattice energies

C. Solutions

1. Types of solutions and factors affecting solubility

2. Methods of expressing concentration (use of normalities is not tested)

3. Raoult’s law and colligative properties (nonvolatile solutes); osmosis

4. Nonideal behavior (qualitative aspects)

**III. Reactions**

A. Reaction types

1. Acid-base reactions; concepts of Arrhenius, Bronsted-Lowry and Lewis; coordination complexes; amphoterism

(Enduring Understanding 3.A and 3.B)

2. Precipitation reactions(Enduring Understanding 3.A and 3.B)

3. Oxidation-reduction reactions(Enduring Understanding 3.A and 3.B)

a. Oxidation number

b. The role of the electron in oxidation-reduction

c. Electrochemistry: electrolytic and galvanic cells; Faraday’s laws; standard half-cell potentials; Nernst

equation; prediction of the direction of redox reactions

B. Stoichiometry

1. Ionic and molecular species present in chemical systems: net ionic equations

2. Balancing of equations, including those for redox reactions (Enduring Understanding 1.E)

3. Mass and volume relations with emphasis on the mole concept, including empirical formulas and limiting reactants

(Enduring Understanding 1.E)

C. Equilibrium

1. Concept of dynamic equilibrium, physical and chemical; Le Chatelier’s principle; equilibrium constants

(Enduring Understanding 6.Aand 6.B)

2. Quantitative treatment

a. Equilibrium constants for gaseous reactions: *Kp, Kc*

b. Equilibrium constants for reactions in solution

(1) Constants for acids and bases; pK; pH

(2) Solubility product constants; their application to precipitation; dissolution of slightly soluble compounds

(Enduring Understanding 6.C)

(3) Common ion effect; buffers; hydrolysis (Enduring Understanding 6.C)

D. Kinetics

1. Concept of rate of reaction (Enduring Understanding 4.A and 4.B)

2. Use of experimental data and graphical analysis to determine reactant order, rate constants and reaction rate laws

3. Effect of temperature change on rates

4. Energy of activation; the role of catalysts (Enduring Understanding 4.D)

5. The relationship between the rate-determining step and a mechanism (Enduring Understanding 4.C)

E. Thermodynamics

1. State functions

2. First law: change in enthalpy; heat of formation; heat of reaction; Hess’s law; heats of vaporization/fusion; calorimetry

(Enduring Understanding 5.B, 5.C, and 5.D)

3. Second law: entropy; free energy of formation; free energy of reaction; dependence of change in free energy on

enthalpy and entropy changes( Enduring Understanding 5.D and 5.E)

4. Relationship of change in free energy to equilibrium constants and electrode potentials

(Enduring Understanding 6.D)

**IV. Descriptive Chemistry**

Knowledge of specific facts of chemistry is essential for an understanding of principles and concepts. These descriptive facts, including the chemistry involved in environmental and societal issues, should not be isolated from the principles being studied but should be taught throughout the course to illustrate and illuminate the principles. The following areas should be covered:

1. Chemical reactivity and products of chemical reactions

2. Relationships in the periodic table: horizontal, vertical and diagonal with examples from alkali metals, alkaline earth

metals, halogens, and the first series of transition elements

3. Introduction to organic chemistry: hydrocarbons and functional groups (structure, nomenclature, chemical properties)

**V. Laboratory**

The differences between college chemistry and the usual secondary school chemistry course are especially evident in the laboratory work. The AP Chemistry Exam includes some questions based on experiences and skills students acquire in the laboratory:

• making observations of chemical reactions and substances

• recording data

• calculating and interpreting results based on the quantitative data obtained

• communicating effectively the results of experimental work

**Students will spend a minimum of 25% of class time in lab.**

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| **Major Course Projects and Assignments** |

**Assignments – These activities are performed outside of the laboratory environment and will assess the**

**“big Ideas” developed for accredited AP Chemistry courses.**

On every unit, students will:

1. read the chapter for each unit thoroughly, take notes on the reading, and use the notes to complete a reading quiz.

2. complete a homework assignment of questions selected from the textbook chapter, so as to be comprehensive for that chapter,

and then discuss that work within a small group of fellow students.

3. complete a practice test that contains questions from the textbook test bank, such that the practice test comprehensively

assesses the unit content. Students compare their work with each other and with a “key” during discussion.

4. complete a test that comprehensively assesses the unit content.

The following is a summary of all units that will be taught during the year.

**Fundamentals of Chemistry**

*Topics:* Lab Safety, How to read an MSDS, Scientific Method, Math Review, Units of Measurement, Uncertainty in Measurement, Significant Figures & Calculations, Dimensional Analysis, Temperature, Density, How to Write a Lab Report

**The Atom**

*Topics:* Atomic History, Parts of the Atom, Ions and Isotopes, Molecules, and Ions, Nomenclature

**Stoichiometry**

*Topics:* Atomic Masses, The Mole, Molar Mass, Mole Calculations (Avogadro’s Number), Percent Composition, Empirical/Molecular Formulas, Equations, Stoichiometry

**Types of Chemical Reactions and Solution Stoichiometry**

*Topics:* Solvation, Electrolytes, Reaction Types, Precipitation Reactions, Stoichiometry of PPT Rxns,Acids-Bases, ReDox Rxns

**Gases**

*Topics:* Ideal/Combined Gas Laws, Gas Stoichiometry, Daltons Law, Kinetic Molecular Theory, Effusion/Diffusion, Real Gases

**Thermochemistry**

Topics: Units of Energy, Endothermic/Exothermic, Enthalpy, Calorimetry, Hess’s Law, Enthalpy of Formation

**Atomic Structure, Periodicity, and Bonding**

*Topics:* Bohr Model, QM Model, Orbitals, Periodic Table and Trends, Types of Bonds, Electronegativity, Lewis Structures, Polarity, Resonance, VSEPR shapes, Hybrid and Molecular Orbitals, Bond Order, Photoelectron Spectroscopy

**Liquids and Solids**

*Topics:* IMFs, Liquids, Metals, Molecular and Ionic Solids, Vapor Pressure, Changes of State, Phase Diagrams

**Properties of Solutions**

Topics: Energy and Solvation, Factors Affecting Solubility and Rate of Formation, Colligative Properties, Colloids

**Unit 7: Gases and Kinetic Molecular Theory (Chapter 5)**

*Topics:* Gas Laws, Dalton’s Law, Gas Density, Real/Ideal Gases, KMT, Ideal Gas Law, Effusion/Diffusion and Gas Stoichiometry

**Reaction Spontaneity**

Topics: Units of Energy, Enthalpy, Calorimetry, Hess’s Law, Enthalpy of Formation, Reaction Spontaneity, Entropy, Gibbs Free Energy

**Kinetics and Equilibrium**

Topics: Factors Affecting Reaction Rates, Rate Law Problems, Reaction Order, Reaction Mechanisms, Catalysts, Concept of Equilibrium, Equilibrium Constant; How to Solve Problems with Kc, Kp, Heterogeneous Equilibria, LeChatelier’s Principle

**Acids and Bases and Their Equilibria**

*Topics:* Acid/Base Definitions, Strength, pH Calculations for Stronf/Weak, Polyprotics, Solving Acid-Base Equilibria, Acidic-Basic Salts and Oxides, Effect of Molecular Structure on Acidity, Common Ion Effect, Buffers, Titrations,

**Solubility and Complex Ion Equilibria**

*Topics:* Solubility Product Constant, Precipitation, Qualitative Analysis, Complex Ions

**Spontaneity, Entropy, and Free Energy**

*Topics:* Entropy, Gibb’s Free Energy, Temperature Effects, Pressure Effects, Work

**Electrochemistry**

*Topics:* Oxidation/Reduction, Galvanic Cells and SRPs, Work and Free Energy, Concentration Effects, Batteries, Corrosion, Electrolysis

**Nuclear Chemistry**

*Topics:* Stability and Decay, Kinetics, Half-Life

**Transition Metals and Coordination Chemistry**

*Topics:* Transition Metals, The First Row, Coordination Compounds, Bonding in Complex Ions, Crustal Field Model

**Organic and Biological Chemistry**

*Topics:* Alkanes, Alkenes-Alkynes, Aromatics, Derivatives, Polymers, Optical Rotation, Natural Polymers

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| **Assessment and Grading Plan** |

Your AP Chemistry grade will be based on the following: tests; projects, quizzes and labs; and classwork and homework.

Tests = 50% Quizzes/Labs/Projects = 30% Homework/Classwork = 20%

Make-up work and. Late work: Make-up work is available to students as per county policy.

Students have two days for each day absent to make up work.

**Late work will earn less credit. (30% penalty - 1 day, 60% penalty - 2 days, After 2 days the penalty will be at the teacher’s discretion. Please talk to me about extenuating circumstances!)**