Wilson Area School District
Planned Course Guide

Title of planned course: AP Chemistry

Subject Area: Science

Grade Level: 10 - 12

Course Description: AP Chemistry is a Collegeboard sponsored course that is the equivalent of two semesters of college level chemistry. The curriculum of the course will follow the required curriculum set forth by the Collegeboard which includes Atomic Structure, Bonding, Reactions, Equilibrium and Kinetics, and Thermodynamics and Electrochemistry. The course is rigorous and will require significant time at home working problems and mastering concepts. This is our most challenging chemistry course and is offered for advanced students who are interested in a career in the sciences or wish to take it as part of a challenging college-bound track. It is highly advised that the students take our Advanced Science Studies class with this class so the student may participate in all of the required laboratory experiments.

Time/Credit for this Course: One Full Academic Year / 1.3 Credits

Curriculum Writing Committee: Paul Stewart

Wilson Area School District
Planned Course Materials

Course Title: AP Chemistry

Supplemental Books:

- Princeton Review - Cracking the AP Chemistry Exam

Teacher Resources:

- Edpuzzle
- Kami
- Collegeboard classroom
- PHET virtual laboratory
- Journal of Chemical Education
- Document Camera

Curriculum Map

August:
- Atomic Structure
- Historical basis for atomic theory

September:
- Atomic Structure
- Early experiments into the atom
- Role of light in ascertaining electronic arrangement and verification of quantum theory
- PES and Mass Spectroscopy
- Electron configurations and Periodic Trends
- Formula writing and polyatomic ions

October:
- Introduction to chemical bonding
- Why do bonds form?
- Intra vs Intermolecular forces
- Lattice energy and properties of ionic substances
- Comparisons of ionic, network, molecular, and metallic materials
- Polarity of bonds

November:
- Lewis structures and VSEPR theory
- Asymmetry and polarity of molecules
- Resonance and hybridization
- Bond order

December:
- Phase changes
- Physical vs Chemical Changes
- Physical States of Matter

January:
- Reactions
- Stoichiometry, limiting reactants, mole ratios, percent yields
- Types of chemical reactions - Redox, precipitation, and Acid/Base
- Balancing chemical equations

February:
- Kinetics and Reaction rates
- Equilibrium - what is it and use of ice tables
- Calculation of Q and shifting equilibria

March:
- Thermodynamics
- Enthalpy, Entropy, and Gibbs Free Energy
- How to calculate dH, dS, or dG
- Reaction Favorability

April:

- Application of equilibrium to acid/base reactions
- Ka, Kb, pKa, pKb, pOH, pH
- Buffering
- Different types of titrations
- Review

May:

- Exam

Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Atomic Theory

Time frame: 3 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Describe the origins of atomic theory citing experimental evidence and modeling
- Describe the evolution of our understanding of the atom from early theories to our present day quantum model

Core Activities: Students will complete/participate in the following:

- Calculate the wavelength of hydrogen spectral lines and relate this energy emission to Bohr model of atom
- Evaluate flame tests to test for presence of a particular element and relate this emission to the electronic structure of an atom.
- Carry out investigations designed to demonstrate the difference between a physical and chemical change. Activities Outside the Laboratory: (Cr3a,c)
- Analyze actual PES charts to determine electron structure with an atom.
- Determine the relative abundance of an isotope using coin manipulatives.
- Analyze mass spectral data to determine isotopic abundance and to identify elements. (Cr4)

Instructional Methods:

- Direct instruction using notes and key terms
- Cooperative learning during student work time
- Group discussion
- Teacher modeling and visual aids
- Independent student work

Materials & Resources:

- Textbook
- Teacher generated assignments
- MyAP Classroom

Assessments:

- Teacher generated tests and quizzes
- Homework/assignments
- Student participation
- Questioning during direct instruction

Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Periodic Table and Trends

Time frame: 1 Week

Essential content/objectives: At end of the unit, students will be able to:

- Determine why the periodic table is arranged the way it is
- Describe how the position of an element on the table relates to its atomic structure, electronic structure, ionization energy, electronegativity, metallic character, and size

Core Activities: Students will complete/participate in the following:

- Position mystery elements on the periodic table based on their relative size, ionization energy, etc.
- Using actual data, graph ionization vs. atomic number and explain trends.

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Mole Concept, Reactions, and Stoichiometry

Time frame: 3 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Understand the significance of the mole concept and it's usage
- Use the mole concept mathematically to determine % composition, empirical and molecular formulas, and to determine unit amounts of substances
- Balance reactions and use stoichiometrical principles to determine relative amounts of reactants and products that react or are produced, theoretical yield, and determine a limiting reactant

Core Activities: Students will complete/participate in the following:

- AP Laboratory Investigation Three - Precipitate out a hard water ion and determine its concentration based on gravimetric measurement of precipitate.
- AP Laboratory Investigation Seven - Demonstrate the principle of atom economy via basic decomposition reactions. They will also use their results to establish the law of definite composition. In an extension, they will determine the empirical formula of a hydrated crystal. - Determine the empirical formula of a metal oxide - Determine the % yield of formation of copper(II) hydroxide precipitate
- Observe examples of REDOX, acid/base, and precipitation reactions.
- Utilizing an eduweb lab simulation, students have the opportunity to manipulate various factors that influence a redox titration.

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Bonding

Time frame: 4 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Describe why atoms form bonds, how these bonds relate to the overall properties of a molecule and how molecules interact via intermolecular forces
- Determine a substance's properties by analyzing its constituent elements, type of bonding, and overall structure.

Core Activities: Students will complete/participate in the following:

- AP Chemistry Laboratory Experience Five - Separation of a mixture using chromatography. Students will design and conduct an experiment designed to separate 3 substances in a mixture using bonding principles.
- AP Chemistry Laboratory Experience Six - Identification of materials using properties of these materials that reveal their structure. Students will propose a set of experiments designed to test the properties than use clues to identify material.
- Make drawings of a series of molecules and from those drawings predict geometry, hybridization, and polarity

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: States of Matter and Gases

Time frame: 2 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Understand particulate theory of matter, the kinetic molecular theory of matter and how these are used to describe the various states of matter and changes therein

Core Activities: Students will complete/participate in the following:

- Determination of the molar volume of a gas
- Determination of the molar mass of a gas via vapor density
- Examine stoichiometry of a gaseous reaction by collection of oxygen gas from thermal decomposition of metal chlorate
- Use eduweb lab simulation site, students will heat and cool an unknown and analyze the heating and cooling curves
- Use online simulation to examine the relationships between pressure, temperature, volume, moles, average kinetic energy, and speed of a gas

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Solutions

Time frame: 3 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Understand the difference between pure substances and mixtures, different types of mixtures, properties of solutions, and separation methods
- Apply the use of molarity to a variety of situations and apply a priori knowledge of colligative properties

Core Activities: Students will complete/participate in the following:

- AP Laboratory Investigation One:
  - Use of spectrophotometer to determine relationship between concentration and absorbance
  - Create standard curve, find molar absorptivity, and determine concentration
- AP Laboratory Investigation Two:
  - Use of spectrophotometer to determine proper wavelength to determine concentration of metal ions
  - Use standard curve to find concentration of metal ion based on absorbance and it's mass percent in an alloy. *Students first do literature search to determine absorbances of metal ions
- AP Laboratory Investigation Nine:
  - Use properties such as reactivity, solubility, and polarity to separate a mixture
  - Design a methodology to accomplish this and prepare an official report
- Examine a demonstration size model of DNA or an alpha helix, and use their fingers to identify which atoms / base pairs are particularly involved in hydrogen bonding within the molecule, causing the helical structure
- Discuss how the increased UV light because of ozone depletion can cause chemical reactions and thus mutations and disruption of hydrogen bonding

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Thermochemistry

Time frame: 3 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Describe the role of energy transfer in physical and chemical processes
- Use various methods to deduce enthalpy, entropy, and free energy changes both qualitatively and quantitatively and relate this to reaction favorability

Core Activities: Students will complete/participate in the following:

- AP Chemistry Laboratory Experience Twelve - Design their own exothermic reaction to produce a set amount of heat using a set amount of materials. The design will reflect the real world application of hand warmers and deepen their knowledge of calorimetry, exothermic and endothermic reactions, entropic effects, and favorability.
- Orally present findings to the class complete with their report and scientific poster
- Determine specific heat of metal: Determine heat of combustion of paraffin/and or butane
- Complete Hess's law puzzle where students create a series of steps to produce a final reaction and match with appropriate enthalpy change
- Complete the reaction favorability simulation where they analyze different variables and make a prediction

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Kinetics

Time frame: 2 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Examine the factors that govern the rates of reactions, predict reaction order and apply this to rate, and relate kinetics of reaction to energy profile of reaction.

Core Activities: Students will complete/participate in the following:

- AP Chemistry Laboratory Ten
  - Test various factors to examine their impact on the rate of a reaction
  - Determine the order with respect to each reactant
- AP Chemistry Laboratory Investigation Eleven - Determine their own Beer's law absorbance plot for crystal violet, then examine the rate of its reaction with sodium hydroxide to determine the rate order
- Using a web based simulation, students will study the elementary steps of a mechanism and how it relates to reaction rate and collision theory

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Equilibrium

Time frame: 3 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Understand what equilibrium means for chemical and physical processes, how it can be used to relate to favorability, and why processes reach equilibrium
- Use equilibrium constant to calculate equilibrium concentrations of vice versa and use Q and other qualitative changes to see which way a reaction will respond to a stress via Le-Chatelier's principle. In particular, these concepts will be applied to gaseous and solubility equilibria

Core Activities: Students will complete/participate in the following:

- AP Chemistry Laboratory Activity Thirteen
    - Explore Le-Chatelier's principle by adding reagents to shift an acid/base and complex ion equilibrium
    - Formation of reactant or product will be determined via color.
- Selectively precipitate a series of metal ions Activities
- In an online inquiry activity, students will manipulate variables to create stresses and look for responses by reaction in favor of new equilibrium

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Acids and Bases

Time frame: 4 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Understand the definition and chemistry of acids and bases and relate this to titrations, buffers, and equilibrium concepts

Core Activities: Students will complete/participate in the following:

- AP Laboratory Investigation Four
  - Determine the concentration of acid present in fruit juices and soda by using a titration with a strong base
  - Create titration curve and design the apparatus necessary for experiment.
- AP Laboratory Investigation Fourteen
  - Design an experiment that will determine concentration of solutions using titration
  - Analyze different titration curves for strong acid/weak base, strong acid/strong base, and weak acid/strong base titrations
  - Determine pKb or pKa of a base or acid respectively
- AP Laboratory Investigation Fifteen - Test a variety of household materials for buffering activity and identify the active buffering agent by determining the pKa from 27 titration curve
- AP Laboratory Investigation Sixteen - Design a buffer designed to buffer at a particular pH by researching pKa values of acid and calculating the appropriate amount of the acid and conjugate base needed
- Interpret titration curves and deduce species involved
- Build acids of various strengths and provide rationale for each

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Curriculum Scope & Sequence

Planned Course: AP Chemistry

Unit: Electrochemistry

Time frame: 3 weeks

Essential content/objectives: At end of the unit, students will be able to:

- Understand the concept of oxidation and reduction and how this impacts chemical processes
- Balance REDOX reactions, write half-reactions, predict favorability or reaction, design galvanic and electrolytic cells, determine voltage and understand its relation to free energy and favorability

Core Activities: Students will complete/participate in the following:

- AP Chemistry Laboratory Eight - Use a REDOX titration to first standardize a solution followed by using it to determine the % of hydrogen peroxide in a store bought bottle
- Simulate the impact on voltage as a galvanic cell runs by manipulating concentrations of ions, conductivity and contents of salt bridge, etc.

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