Chemistry

2007 - 2008

Brief Description of Course

AP Chemistry meets every other day on the A/B block schedule for 82 minutes. Class is exended to 120 minutes one class period a week for laboratory purposes. Some labs take more than one lab period to complete, in which case two extended class periods in a week are required. A minumum of an extra 45 minutes a day outside of class is expected for students to keep up on reading and assignements. Laboratory work is crucial to understanding chemistry. During the school year, students will perform a minimum of 24 laboratory excercises in an effort to mirror the laboratory responsibilities of a college course. This minimum includes the 22 recommended laboratory topics, plus a refresher in lab equipment and one lab on using statistical software for graphing and data analysis. In all of the lab work, students are expected to maniupulate the scientific equipment in the lab to obtain the results. Student collected data and observations, along with associated mathematical calculations, are used to reinforce concepts in the course. As such the laboratory goals are: 1. to enable students to think analytically and to identify researchable problems 2. to enable students to formulate appropriate conclusions, based on experimental evidence, and to provide evidence of their finding reliability and validity 3. to provide an opportunity for students to manipulate experimental data, and evaluate data during the experiment and afterwards 4. to enable students to design and test their own laboratory procedure sets for certain lab work, and evaluate their own planning 5. to provide students with the opportunity to do technical writing in communicating their results and conclusions 6. to allow students the opportunity to evaluate sources of experimental error, examin how that error affects results, and make suggestions for improving results 7. to allow students the opportunity to make suggestions on further areas of study that could build upon or enhance the laboratory work they have completed Students perform all labs in pairs or small groups to ensure the safety of all in the lab, and are required to keep a soft bound lab notebook throughout the year as evidence of laboratory completion. Once per quarter, students are expected to formally present one set of their laboratory findings to the class. Laboratory activies are based on the Flinn Scientific labs recommended to meet the suggested lab components.

Unit Information

Unit Name or Timeframe:
Unit 1 Dimensional Analysis and Significant Figures (review concepts) 1 week (primarily done over the summer)

Content and/or Skills Taught:
- appropriate use of the rules for significant figures in calculations and data recording
- performing basic chemistry calculations to a correct number of significant figures
- analyzing unfamiliar equations in terms of dimensions and what measurements might be requrired to obtain values
- applying the scientific method to chemistry laboratory work

Major Assignments and/or Assessments:
Lab - Lab Safety Review and Equipment Practical
Reveiw of saftey techniques and procedures, equipment identification, uses, cleaning, and storage

Unit Name or Timeframe:
Unit 2 Atomic Theory and Nomenclature (review concepts) 1 week (primarily done over the summer)

Content and/or Skills Taught:
- atomic theory as it has developed from early civilizations to modern times, including contributions from the Greeks, alchemists, Lavoisier, Dalton, Thomson, Rutherford,and Bohr.
- modern view of atomic structure
- formula writing and naming for common monatomic and polyatomic anions and cations
- formula writing and naming for ionic compounds, binary molecular compounds, and acids (using both Stock system and prefixes where appropriate)

Major Assignments and/or Assessments:
Lab - Graphing and Data analysis software (Graphical Analysis and Excel in AP chemistry)
Review of computer use in graphing and data analysis, including, but not limited to best fit lines, interpolation, and extrapolation
Lab - Formula Determination for a hydrate (recommended #2)

Unit Name or Timeframe:
Unit 3 Stoichiometry (3 weeks) (Some summer review work)

Content and/or Skills Taught:
- calculating atomic masses for nuclides
- calculating average atomic masses based on abundance
- performing calculations relating to the number of atoms in a sample, moles of a substance,and molar mass of substances
- performing percent composition calculations
- calculationg empirical and molecular formulas from percent composition data and given molar masses
- balancing chemical equations
- reaction prediction (products) for basic types of chemical equations (synthesis, decomposistion, double replacement, single replacement, combustion)
- perform calculations relating to molarity, molality, and mole fractions
- perform calculations relating to solution dilution (molarities)
- solve problems involving solution stoichiometry
- solubility rules and precipitation reactions
- predict products in acid base reactions and perform calculations involving acid-base titrations
- assign oxidation numbers to elements in elements, ions, and compounds
- identify species that are oxidized/reduced and the responsible agents for the reduction/oxidation
- identify and balance redox reactions (including acidic and basic solutions)
- performing basic stoichiometric calculations from balanced chemical equations, including limiting reagent and percent yield problems

Major Assignments and/or Assessments:
Lab - Empirical Formula of Silver Oxide (recommended #1)
Lab - Oxidation/Reduction Titrations (recommended #8)

Unit Name or Timeframe:
Unit 4 Gases (2 weeks)

Content and/or Skills Taught:
- pressure units and conversions
- using barometers and manometers to measure gas pressure
- Boyle's, Charles', Avogadro's,and Gay-Lussac's Laws
- Ideal Gas Law and it's derivation
- conditions for gases to approximate Ideal behavior/deviate from Ideal behavior (including types of gases that come close to Ideal)
- calculations involving van der Waals Equation for gases
- perform gas stoichiometry problems at STP and nonstandard conditions
- apply Dalton's Law of Partial Pressures to a mixture of gases
- perform calcuations using mole fractions
- solve problems involving gas collection over water
- Kinetic Molecular Theory for Gases
- perform calculations relating to temperature and the root means square velocities of gas particles
- apply Graham's Law of Effusion

Major Assignments and/or Assessments:
Lab - Determining the Stoichiometry of Chemical Reactions (recommended #9)
Lab - Molar Volume of a Gas (recommended #5)

Unit Name or Timeframe:
Unit 5 Thermochemistry (2 weeks)

Content and/or Skills Taught:
- understand how potential energy, kinetic energy, and work are related
- understand what is meant by a state function or property
- apply the first law of thermodyanmics to a system
- perform calculations relating to specific heat and molar heat capacity
- identify exothermic and endothermic reactions (delta H)
- perform calculations using Hess's Law

Major Assignments and/or Assessments:
Lab - Determination of Molar Mass of gases and volatile liquids (Dumas method)(recommended #3)
Lab - Enthalpy of reactions and Hess's Law (recommended #13)

Unit Name or Timeframe:
Unit 6 Atomic Structure and Periodicity (2 weeks)

Content and/or Skills Taught:
- electromagnetic spectrum and frequency, wavelength, energy relations
- Bohr model and calculations based on the hydrogen atom
- uncertainty principle and probability distribution
- Quantum Numbers, orbital shapes, and energies
- Aufbau Principle, Pauli Exclusion Principle, and Hund's Rule
- electron configuration notation, orbital notation, dot notation
- common exceptions to Aufbau
- Mendeleev and his contributions to the Periodic Table
- Trends in the peridodic table; atomic radius, electronegativity, ionization energy, electron affinity, ionic radius

Major Assignments and/or Assessments:
Lab - Separation and Qualitative Analysis of Cations and Anions (recommended #14)

Unit Name or Timeframe:
Unit 7 Bonding (2 weeks)

Content and/or Skills Taught:
- bond type by electronegativity differences
- bond polarity and dipole moments
- lattice energy calculations
- percent ionic character
- covalent bond energies and delta H values for reactions
- Lewis Strucutures and exceptions to the octet rule
- Resonance
- Molecular Structure; VSEPR and hybridization of orbitals
- sigma and pi bonds
- bond order, bond length, and bond energies
- paramagnetism and diamagnetism

Major Assignments and/or Assessments:
Lab - Gravimetric Determination of a Metallic Carbonate (recommended #16)

Unit Name or Timeframe:
Unit 8 Liquids, Solids, and Solutions (2 weeks)

Content and/or Skills Taught:
- Intermolecular Forces (Dipole-dipole, London Dispersion, hydrogen bonding)
- Kinetic molecular connections to solids and liquids
- Structural models for liquids and solids
- Structure and bonding in metals
- calculations involving molarity, molality,and percent by mass for solutions
- heats of solution
- factors affecting solubility (including Henry's Law)
- Vapor Pressure of solutions
- colligative properties of solutions (boiling point elevation, freezing point depression, vapor pressure lowering)
- Osmotic pressure and molar mass calculations
- colligative properties for electrolyte solutions (van't Hoff factor)
- suspensions and colloids

Major Assignments and/or Assessments:
Lab - Molar mass by freezing point depression (recommended #4)
Lab - Liquid chromatography (recommended #18)

Unit Name or Timeframe:
Unit 9 Kinetics (2 weeks)

Content and/or Skills Taught:
- calculating reaction rates for reactions
- writing rate laws for reactions; differential and integrated
- graphical representations for rate laws (zeroth, first, second order)
- Reaction mechanisms, including identifying rate determining step

- Chemical kinetics; collision theory, activated complex, activation energy and reaction diagrams
- catalyzed and uncatalyzed reactions and activation energy

Major Assignments and/or Assessments:
Lab - Kinetics of a reaction (reaction rate and order)(recommended #12)

Unit Name or Timeframe:
Unit 10 Chemical Equilibrium (2 weeks)

Content and/or Skills Taught:
- chemical and physical equilibrium
- dynamimc equilibrium
- Le Chatelier's Principle and how changes in conditions affect equilibrium (specifically pressure and temperature)
- writing expressions for equilibrium constants and solving equilibrium problems involving the constants in terms of concentratin and pressure
- ICE tables
- reaction quotients and the extent of a reaction

Major Assignments and/or Assessments:
Lab - Ka of a weak acid (recommended #10)

Unit Name or Timeframe:
Unit 11 Acids/Bases and Equilibrium (3 weeks)

Content and/or Skills Taught:
- Arrhenius, Bronsted-Lowry, and Lewis definitions of acids and bases
- conjugate acid/base pairs and relative strengths of acids/bases
- Dissociation constants for acids/bases Ka and Kb
- amphoteric substances
- calculations involving pH, pOH, and Kw
- pH of strong/weak acids/bases and percent dissociation
- acid/base properties of salt solutions
- structural effect of acids on strenght
- acid/base properties of oxides
- common ion effect
- buffered solutions, pH, and the Henderson-Hasselbalch equation
- titration of acids/bases and titration curves for various strength acids/bases
- Acid/Base indicators and choosing appropriate indicators for titrations
- endpoint and equivalence point
- solve problems relating to Ksp and solubility of substances
- predicting precipitation and using selective precipitation to separate substances
- complex ions and solubility

Major Assignments and/or Assessments:
Lab - Acid-Base Titrations (standardization of NaOH and titration of a weak acid)recommended #6 and #7)
Lab - Acid-Base Indicators (recommended #11)

Unit Name or Timeframe:
Unit 12 Spontaneity, Free energy, and Entropy (2 weeks)

Content and/or Skills Taught:
- spontaneity and entropy relationship
- 2nd law of thermodyamics
- temperature effects on spontaneity and determining delta S surroundings
- free energy and spontaneity
- solve problems involving the calculation of delta S for a reaction
- relating delta H, delta G, and delta S
- pressure relations to free energy
- delta G and spontaneity and equilibrium

Major Assignments and/or Assessments:
Lab - Buffered Solutions (recommended #19)
Lab - Determination of Keq for FeSCN+2 (spectrophotometric analylsis) (recommended #17)

Unit Name or Timeframe:
Unit 13 Electrochemistry (2 weeks)

Content and/or Skills Taught:
- oxidation and reduction half-cells and equations
- electrochemical cells (voltaic)
- standard reduction potentials
- cells and cell notations
- free energy and spontaneity relation to cell potential
- concentration effects on cell potential (Nernst Equation)
- electrolysis (water and mixtures of ions
- Faraday's Law and electrolysis

Major Assignments and/or Assessments:
Lab - Electochemical Cells (recommended #21)
Lab - An activity series (recommended #20)

Unit Name or Timeframe:
Unit 14 Nuclear Chemistry (1 week)

Content and/or Skills Taught:
- nuclear stability and radioactive decay
- types of radiation (alpha, beta, gamma, positron emission, electron capture)
- writing nuclear equations
- half-life and radioactive decay (including decay rate)
- fission and fusion
- nuclear binding energy

Major Assignments and/or Assessments:
Lab - Introduction to radioactivity and half-life

Unit Name or Timeframe:
Unit 15 Transition metals and coordination chemistry (1 week)

Content and/or Skills Taught:
- common oxidation states of transition metal and colors
- coordination compounds, coordination numbers, and ligands
- naming coordination compounds
- structural and stereoisomerism

Major Assignments and/or Assessments:
Lab - Synthesis and analysis of a coordination compound (recommended #15)

Unit Name or Timeframe:
Unit 16 Organic Chemistry (1 Week)

Content and/or Skills Taught:
- alkanes, alkenes, alkynes
- nomenclature for hydrocarbons
- common reactions for alkanes, alkenes, and alkynes
- cyclic alkanes
- functional groups for hydrocarbon dervivatives (alcohols, esthers, ethers, aldehydes, ketones, organic acids, amine, halohydrocarbons)
- nomanclature for derivatives
- reactions with derivatives

Major Assignments and/or Assessments:
Lab - Synthesis, isolation, and purification of an esther (recommended #22)

Textbooks

Title: Chemistry

Publisher: Mcdougal Littell/Houghton Mifflin

Published Date: 01 January, 2003

Author: Steven S. Zumdahl

Second Author: Susan A. Zumdahl

Description:

Other Course Materials

Material Type: Other

Description:
The Ultimate Equations Handbook - Hague and Smith, Flinn Scientific
Laboratory Experiments for Advanced Placement Chemistry - Vonderbrink, Flinn Scientific
Flinn Scientific AP Chemistry Labs