**Syllabus for AP Chemistry**

I)      Text Book: <u>Chemistry the Central Science</u> 6$^{th}$ and 10$^{th}$ editions. Brown, LeMay, Bursten

II)      Laboratory Manuals:      <u>Chemistry the Central Science</u> 6$^{th}$ and 10$^{th}$ editions. Nelson, Kemp
     <u>Advanced Chemistry with Vernier</u>. Jack Randall

III)      Students will attend five (5) forty – two (42) minute classes a week. In addition, they will meet one other time for forty – two   minutes to complete laboratory activities.

IV)      **Course Outline**: The classroom portion of the course will emphasize chemical calculations and the mathematical formulation of principles. In addition concepts of chemical reactivity and equation writing will be stressed. Homework will include problem sets from the textbook and old advanced placement exam questions. Powerpoint presentations and homework assignments will be posted online.

     a. **The following tests will be give:**

| | | |
|---|---|---|
| i. Ch. 1 & 2 | ii. Ch. 3 & 4. | iii. Ch 6 & 7 |
| iv. Ch. 8 & 9 | v. Ch 10 & 11 | vi. Ch. 13 |
| vii. Mid-Term | viii. Ch. 21 | ix. Ch. 5 |
| x. Ch. 14 | xi. Ch. 15. | xii. Ch. 16 & 17 |
| xiii. Ch. 19 | xiv. Ch. 20 | xv. Ch. 26 |

     b. **Chapter 1:  Introduction to Basic Concepts – Review – Summer Work** (2 class periods)

     c. **Chapter 2: Atoms, Molecules and Ions – Summer Work** & (2 class periods)
         i.   Atomic Theory of Matter
         ii.   Discovery of Atomic Structure
         iii.   Modern View of Atomic Structure
         iv.   Periodic Table
         v.   Molecules and Ions
         vi.   Nomenclature of Inorganic Compounds

     d. **Chapter 3: Stoichiometry: Calculations with Chemical Formulas & Equations** (6 class periods)
         i.   Chemical Equations
         ii.   Patterns of Chemical Reactivity
         iii.   Atomic and Molecular Weights
         iv.   The Mole
         v.   Empirical Formulas from Analyses
         vi.   Quantitative Information from Balanced Equations
         vii.   Limiting Reactants

     e. **Chapter 4: Aqueous Reactions and Solution Stoichiometry** (5 class periods)

    i. Solution Composition
   ii. Electrolytes
   iii. Acids, Bases & Salts
   iv. Ionic Equations
   v. Metathesis Reactions
   vi. Reactions of Metals
   vii. Solution Stoichiometry

**f. Chapter 6 – Electronic Structure of Atoms** (6 class periods)
    i. Wave Nature of Light
   ii. Quantum Effects and Photons
   iii. Bohr's Model of the Hydrogen Atom
   iv. Dual Nature of Electrons
   v. Quantum Mechanics & Atomic Orbitals
   vi. Representations of Orbitals
   vii. Orbitals in Many Electron Atoms
   viii. Electron Configuration
   ix. Electron Configuration & Periodic Table

**g. Chapter 7: Periodic Properties of the Elements** (5 class periods)
    i. Development of the Periodic Table
   ii. Electron Shells in Atoms
   iii. Sizes of Atoms
   iv. Ionization Energy
   v. Electron Affinity
   vi. Metals, Non – Metals & Metalloids
   vii. Group Trends: The Active Metals
   viii. Group Trends: Selected Non – Metals

**h. Chapter 8: Basic Concepts of Chemical Bonding** (5 class periods)
    i. Lewis Symbols & Octet Rule
   ii. Ionic Bonding
   iii. Sizes of Ions
   iv. Covalent Bonding
   v. Bond Polarity & Electronegativity
   vi. Drawing Lewis Structures
   vii. Resonance Structures
   viii. Exceptions to the Octet Rule
   ix. Strength of Covalent Bonds
   x. Oxidation Numbers

**i. Chapter 9: Molecular Geometry & Bonding Theories** (6 class periods)
    i. Molecular Geometries
   ii. Polarity of Molecules
   iii. Covalent Bonding & Orbital Overlap
   iv. Hybrid Orbitals
   v. Multiple Bonds
   vi. Molecular Orbitals

      vii.   Second Period Diatomic Molecules

**j.  Chapter 11: Intermolecular Forces, Liquids & Solids** (5 class periods)
   - i. Kinetic – Molecular Description of Liquids & Solids
   - ii. Intermolecular Forces
   - iii. Properties of Liquids: Viscosity & Surface Tension
   - iv. Changes of State
   - v. Vapor Pressure
   - vi. Phase Diagrams
   - vii. Structures of Solids
   - viii. Bonding in Solids

**k.  Chapter 10: Gases** (6 class periods)
   - i. Characteristics of Gases
   - ii. Pressure
   - iii. The Gas Laws
   - iv. The Ideal – Gas Law
   - v. Molar Mass & Gas Densities
   - vi. Gas Mixtures & Partial Pressures
   - vii. Volumes of Gases in Chemical Reactions
   - viii. Kinetic – Molecular Theory
   - ix. Molecular Effusion and Diffusion
   - x. Deviations from Ideal Behavior

**l.  Chapter 13: Properties of Solutions** (6 class periods)
   - i. The Solution Process
   - ii. Ways of Expressing Concentration
   - iii. Saturated Solutions & Solubility
   - iv. Factors Affecting Solubility
   - v. Colligative Properties
   - vi. Colloids

**m. Chapter 21: Nuclear Chemistry** (6 class periods)
   - i. Radioactivity
   - ii. Patterns of Nuclear Stability
   - iii. Nuclear Transmutations
   - iv. Rates of Radioactive Decay
   - v. Detection of Radioactivity
   - vi. Energy changes in Nuclear Reactions
   - vii. Nuclear Fission
   - viii. Nuclear Fusion
   - ix. Biological Effects of Radiation

**n.  Chapter 5: Energy Relationships in Chemistry: Thermochemistry** (5 class periods)
   - i. The Nature of Energy
   - ii. The First Law of Thermodynamics
   - iii. Heat and Enthalpy Changes
   - iv. Enthalpies of Reaction
   - v. Calorimetry
   - vi. Hess's Law

      vii. Enthalpies of Formation
     viii. Foods and Fuels
- **o. Chapter 14: Chemical Kinetics** (9 class periods)
       i. Reaction Rates
      ii. The Dependence of Rate on Concentration
     iii. Change of Concentration with Time
      iv. Temperature & Rate
       v. Reaction Mechanisms
      vi. Catalysis
- **p. Chapter 15: Chemical Equilibrium** (7 class periods)
       i. The Concept of Equilibrium
      ii. The Equilibrium Constant
     iii. Heterogeneous Equilibria
      iv. Calculating Equilibrium Constants
       v. Applications of Equilibrium Constants
      vi. Factors Affecting Equilibrium: LeChatelier's Principle
- **q. Chapter 16: Acid – Base Equilibria** (10 class periods)
       i. The Dissociation of Water
      ii. Bronsted – Lowry Acids & Bases
     iii. The pH Scale
      iv. Strong Acids & Bases
       v. Weak Acids
      vi. Weak Bases
     vii. Relation between $K_a$ and $K_b$
    viii. Acid – Base Properties of Salt Solutions
      ix. Acid – Base Behavior & Chemical Structure
       x. Lewis Acids & Bases
- **r. Chapter 17: Additional Aspects of Aqueous Equilibria** (8 class periods)
       i. The Common – Ion Effect
      ii. Acid – Base Titrations
     iii. Buffered Solutions
      iv. Solubility Equilibria
       v. Criteria for Precipitation of Dissolution
      vi. Qualitative Analyses for Metallic Elements
- **s. Chapter 19: Chemical Thermodynamics** (6 class periods)
       i. Spontaneous Processes
      ii. Spontaneity, Enthalpy & Entropy
     iii. A Molecular Interpretation of Entropy
      iv. Calculation of Entropy Changes
       v. Gibbs Free Energy
      vi. Free Energy & Temperature
     vii. Free Energy & the Equilibrium Constant
- **t. Chapter 20: Electrochemistry** (8 class periods)
       i. Oxidation – Reduction Reactions
      ii. Balancing Oxidation – Reduction Equations
     iii. Voltaic Cells

      iv. Cell EMF

      v. Spontaneity of REDOX Reactions

      vi. Effect of Concentration on Cell EMF

      vii. Commercial Voltaic Cells

      viii. Electrolysis

      ix. Quantitative Aspects of Electrolysis

      x. Corrosion

**u. Chapter 26: The Chemistry of Life: Organic and Biological Chemistry** (6 class periods)

      i. Alkanes

      ii. Unsaturated Hydrocarbons

      iii. Hydrocarbon Derivatives

      iv. Introduction to Biochemistry

      v. Proteins

      vi. Carbohydrates

      vii. Nucleic Acids

**v. If There is Time: One or More of the Following Chapters will be covered**

      i. Chapter 12: Modern Materials

      ii. Chapter 18: Chemistry of the Environment

      iii. Chapter 22: Chemistry of Hydrogen, Oxygen, Nitrogen & Carbon

      iv. Chapter 23: Chemistry of other Nonmetallic Elements

      v. Chapter 24: Metals & Metallurgy

      vi. Chapter 25: Chemistry of Coordination Compounds

**V) Laboratory Component**

a. The following laboratory activities are from **Advanced Chemistry with Vernier**. These laboratory activities are all hands on. Students will work in groups of two or three. Each student is required to keep a laboratory notebook and complete a laboratory report which includes an abstract, presentation of data, calculations and a conclusion.

      *i. The Determination of a Chemical Formula*

        a. Determine the chemical formula of a copper chloride compound

      *ii. The Determination of the Percent Water in a Compound*

        a. Determine the water of hydration and chemical formula

      *iii. The Molar Mass of a Volatile Liquid*

        a. Use the ideal gas law to determine the molar mass

      *iv. Using Freezing – Point Depression to Find Molecular Weight*

        a. Measure the freezing point depression of lauric acid and determine the molecular mass of benzoic acid.

      *v. The Molar Volume of a Gas*

        a. Measure the gas production of a chemical reaction and determine the molar volume of the gas.

      *vi. Exploring Properties of Gases*

a. To conduct student determined experiments to illustrate the gas laws.

   vii. *The Rate and Order of a Chemical Reaction*
a. Determine the order and rate law expression for the reaction between KI and $FeCl_3$

  viii. *Standardizing a Solution of Sodium Hydroxide*
a. To make and standardize a NaOH solution using KHP

    ix. *Acid – Base Titration*
a. Determine the equivalence point for the titration of a strong base with a strong acid and a weak acid and calculate the concentrations.

     x. *An Oxidation – Reduction Titration: The reaction of $Fe^{2+}$ and $Ce^{4+}$*
a. Measure potential change of the reaction and determine the concentration of $Fe^{2+}$ ions.

    xi. *Determining the Mole Ratios in a Chemical Reaction*
a. Measure the enthalpy change of a series of reactions and determine the stoichiometry.

   xii. *The Determination of an Equilibrium Constant*
a. Determine the molar concentrations by measuring absorbance and calculate the equilibrium constant value.

  xiii. *Investigating Indicators*
a. Select the proper indicator to use with a titration of a weak acid or base based on observations and measurements.

  xiv. *The Decomposition of Hydrogen Peroxide*
a. Calculate the rate constant, rate law and activation energy for the reaction.

   xv. *Determining the Enthalpy of a Chemical Reaction*
a. Use Hess's Law to determine the enthalpy change of the reaction between $NH_3(aq)$ and $HCl(aq)$.

  xvi. *Separation and Qualitative Analysis of Cations*
a. Prepare and analyze a solution containing 10 cations. Analyze an unknown selection of cations.

 xvii. *Separation and Qualitative Analysis of Anions*
a. Prepare and analyze a solution containing 6 anions. Analyze an unknown selection of anions.

xviii. *The Synthesis and Analysis of Alum*
a. Synthesis a sample of Alum and compare the products properties to Alum's.

  xix. *Conductimetric Titration and Gravimetric Determination of a Precipitate*
a. Determine the equivalence point for the reaction of sulfuric acid and barium hydroxide by measuring conductivity and calculate the molar concentration of barium hydroxide.

   xx. *Determining the Concentration of a Solution: Beer's Law*
a. Determine the molar concentration of CuSO4 by measuring absorbance and creating a Beer's Law graph.

xxi. *Liquid Chromatography*
a. Complete the necessary measurements and calculations to evaluate the components of a mixture separated by liquid chromatography

xxii. *Buffers*
a. Prepare and test an acid buffer system. Calculate the buffer capacity.

xxiii. *Electorchemistry: Voltaic Cells*
a. Prepare a Cu – Pb voltaic cell and use the Nernst equation to calculate the $K_{sp}$ of $PbI_2$.

xxiv. *Electroplating*
a. Calculate the amount of energy need to plate copper onto a brass surface.

xxv. *The Synthesis and Analysis of Aspirin*
a. Synthesize a sample of acetylsalicylic acid, calculate percent yield, melting temperature and conduct a colorimetric analysis.

## AP Chemistry – Summer Work

1. Read Chapters 1 and 2 in the textbook.

2. Go to the following website:

   http://www.sciencegeek.net/APchemistry/APtaters/directory.shtml

Click on the activites and do them. Turn in a copy of the answers.

### Chapter 1: Chemical Foundations

- Chapter 1 Review Questions
- Lab Apparatus Review
- Significant Figures Exercises
- Scientific Notation

### Chapter 2: Atoms, Molecules and Ions

- Monatomic Ions Concentration Game
- Polyatomic Ions Concentration Game
- Chapter 2 Review Questions
- Writing Compound Formulas
- Convert Compound Names to Formulas
- Naming Compounds from Their Formulas
- The Stock System

3. Take the practice Tests

4. Memorize the Chemistry Pledge