WOODSIDE PRIORY SCHOOL

COURSE OUTLINE – AP CHEMISTRY

Instructor: Mr. G. Tang **Phone:** (650) 851-6129

Office Hours: 8:00 AM – Start of 1st Class (Excepts Wednesdays) **Email:** gtang@woodsidepriory.com
End of Last Class – 4:00 PM (Except Mondays); B and G Blocks

Required Text: Zumdahl, Steven S., Zumdahl, Susan A. *Chemistry*. 6th Ed. Houghton Mifflin Company, 2003

Supporting Websites: www.doctortang.com and www.adriandingleschemistrypages.com

Required Material: TI-83 Plus or TI-84 Plus Graphing Calculator, Separate Bind Notebook as Lab Notebook, 1½-inch 3-ring Binder, Dividers

Special Class: Besides the assigned block in the schedule (210 minutes per week), **AP Chemistry students are to meet Fridays (2:15 – 3:00 PM) during the assigned AP Tutorial Session.** This is to ensure we will cover the entire curriculum (including all lab work) by the AP Exam Weeks.

Course Overview:
The AP Chemistry course is designed to be the equivalent of the general chemistry course taken during the first college year. Students in this course should attain a depth of understanding of fundamentals and a reasonable competence in dealing with chemical problems. This course should contribute to the development of the students' abilities to think clearly and to express their ideas, orally and in writing, with clarity and logic.

AP Chemistry differs from the regular high school chemistry course in two ways. Qualitatively, AP Chemistry uses a college textbook, covers advanced topics, emphasizes more on chemical calculations and the mathematical formation of principals, and demands higher level of laboratory work done by students. Quantitatively, AP Chemistry involves an increase number of topics covered, requires students to spend significantly more time outside of their regular class schedules, and the nature and variety of experiments done in the laboratory.

Science, Technology and Society (STS)
In addition to scientific knowledge, *students will be expected to demonstrate* an understanding of the processes by which scientific knowledge is developed, and of the interrelationships among science, technology and society, including:

- The central role of evidence in the accumulation of knowledge, and the ways proposed theories may be supported, modified or refuted.
- The inability of science to provide complete answers to all questions.
- The functioning of processes or products based on scientific principles.
- The ways in which science advances technology and technology advances science.
- The use of technology to solve practical problems.
- The limitations of scientific knowledge and technology.
- The influence of the needs, interests and financial support of society on scientific and technological research.
- The ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

AP Examination:
All students who registered in the AP Chemistry class are required to write the AP Chemistry Exam. The AP Exam is administered each year in May. Questions for the exam are developed by the AP Chemistry Development Committee, which includes both high school teachers and college professors. The multiple-choice questions are field-tested in colleges, and data from these tests are used to assemble an AP Chemistry Exam with questions of an appropriate range and balance of difficulty. **The 2008 AP Chemistry Exam is in the morning of May 13th, Tuesday.**

There are two sections in the AP Chemistry Exam:

Section I: Multiple Choice
This section is 90 minutes long, contains 75 multiple-choice questions with broad coverage of topics. Calculators are not allowed in this section and it constitutes 50% of the final score.

Section II: Free-Response
This section is 95 minutes long, consists of two parts, and constitutes 50% of the final grade. One of the questions in this section is based on laboratory experience.

Part A
(55 minutes) There will be three comprehensive problems. Calculator is permitted.

Part B
(40 minutes) It consists of one question requiring the writing of balanced chemical equations, and two essay questions. Calculator is not permitted.

Course Content and Tentative Timeline:

Unit 1: Basic Chemistry

Chapter 1: Chemical Foundations **1.0 week**
SI and Metric Units, Scientific Notations, Dimensional Analysis, Uncertainty, Significant Figures, Temperature, Density, Classification of Matter

Chapter 2: Atoms, Molecules, and Ions **1.5 weeks**
Atomic Theories, Atomic Masses, Mass Numbers, Metals and Non-metals, Groups and Periods in the Periodic Table of Elements, Review of Formula Writing, Nomenclatures of ionic, molecular compounds and acids

Chapters 3 & 4: Stoichiometry **2.5 weeks**
Mole Concepts, Atomic Weights, Predicting Products of Chemical Equations, Classifying and Balancing Equations, Net-ionic Equations, Solubility Table, Empirical Formulas and Molecular Formulas, Percent Composition, Percent Yield, Molarity, Solution Preparation, Dilution, Limiting Reagents, Gravimetric and Solution Stoichiometry and their Application in Laboratory Settings

Unit 2: Chemical Bonding and Organic Chemistry

Chapter 7: Atomic Structure and Periodicity **2.0 weeks**
Electromagnetic Radiation, Atomic Spectra, Bohr Atom, Quantum Model and Number, Atomic Orbital, Electron Configurations, Orbital Shapes and Energies, Electron Spin and the Pauli Principle, Flame Tests for Metals, Periodic Table, Periodic Law and Trends in Atomic, Physical and Chemical Properties

Chapters 8 & 9: Chemical Bonding **3.0 weeks**
Electronegativity, Bond Polarity and Dipole Moments of Molecules, Ionic Bonding and Lattice Energies, Electron Configurations and Sizes of Ions, Lewis Structure, Characters of Bonds, Covalent Model, Single, Double and Triple Covalent Bonds, Sigma and Pi Bonds, Octet Rule and Exceptions, Resonance, VSEPR Model, Hybridization of Orbitals, Bonding and Physical Properties

Chapter 22: Organic and Biological Molecules **1.0 week**
Nomenclatures and Structural Formulas of Alkanes, Alkenes, Alkynes, Aromatics, Cyclic Alkanes, Structural, Geometric and Conformational Isomers, Stereoisomers, Halogens Substituents, and other Functional Groups, Various Organic Reactions including Addition, Elimination, Substitution, Combustion, Cracking, Reforming and Esterification, Polymers

Unit 3: States of Matter

Chapter 5: Gases **2.0 weeks**
Pressure, Boyle, Charles and Avogadro Gas Laws, Ideal Gas Law, van der Waal's Equation, Avogadro's Law, STP and SATP, Dalton's Law, Graham's Law, Henry's Law, Kinetic Molecular Theory of Gases, Effusion and Diffusion, Real Gases, Gas Stoichiometry

Chapter 10: Liquids and Solids **1.5 weeks**
Kinetic Molecular Theory of Liquids and Solids, Dipole-dipole Interactions, Hydrogen Bonding, London Forces, Liquid State, Types of Solids, Metallic Bonding, Network Solids, Vapor Pressure, Change of State, Phase Diagrams and One-Component Systems, Clausius-Clapeyron Equation

Chapter 11: Properties of Solutions **2.0 weeks**
Electrolytes and Non-electrolytes, Molarity, Molality, Mole Fraction, Factors of Solubility, Qualitative Analysis of Ions, Vapour Pressures of Solutions, Colligative Properties, Raoult's Law and Deviations from Ideality, Henry's Law, Freezing Point Depression, Boiling Point Elevation, Osmotic Pressure and van't Hoff Factors

Unit 4: Thermochemistry and Nuclear Chemistry

Chapter 6: Thermochemistry **2.0 weeks**
State Functions, Enthalpy, Calories and Specific Heats, Thermochemical Equations and First Law of Thermodynamics, Heats of Formation, Bond Energies, Potential Energy Diagrams, Heats of Reactions, Hess's Law, Calorimetry

Chapter 16: Spontaneity, Entropy, and Free Energy **2.5 weeks**
Spontaneous Process and Entropy, Entropy and the Second Law of Thermodynamics, Temperature and Spontaneity, Free Energy, Dependence of Change in Free Energy on Enthalpy and Entropy Changes

Chapter 18: The Nucleus: A Chemist's View **1.0 week**
Isotopes, Radioactive Decay, Nuclear Transformations, Nuclear Equations, Half-lives, Nuclear Particle Emission, Fission and Fusion, Nuclear Energy Production

Unit 5: Chemical Kinetics and Equilibria

Chapter 12: Chemical Kinetics **2.5 weeks**
Reaction Rates, Rate Law Expressions, Rate Order of Reactions, Rate Constant, Integrated Rate Laws and Graphical Determinations, Half-Life, Temperature and Reaction Rates, Reaction Mechanisms, Catalysts and Rate-Determining Steps, Activation Energy Calculation, Beer-Lambert Law

Chapter 13: Chemical Equilibrium **2.0 weeks**
Laws of Mass Action, Equilibrium Expressions, Equilibrium Constants (K_P and K_C) and Concentrations, Le Châtelier's Principle, Solving Quantitative Equilibrium Problems, Free Energy on Pressure and Equilibrium

Unit 6: Acids and Bases and Aqueous Equilibria

Chapters 14 & 15: Acids and Bases and Applications of Aqueous Equilibria **2.5 weeks**

Arrhenius, Brønstead-Lowry and Lewis Definitions, Strong and Weak Acids and Bases, pH and pOH, K_a and K_b Expressions, K_w, Degree of Ionization / Dissociations, Polyprotic and Amphiprotic Acids and Bases, Writing Complete and Net-Ionic Neutralization Reactions, Titrations and pH Curves, Indicators, Equivalent Points and Endpoints, Buffer Solutions and Capacities, pK_a, Salt Hydrolysis, Common Ion Effect, Precipitation Reactions, Solubility Equilibria, Solubility Product, Complex Ions Equilibria, Coordination Complexes and their Geometries

Unit 7: Reduction, Oxidation and Electrochemistry

Chapter 17: Electrochemistry **1.5 weeks**

Writing and Balancing Oxidation and Reduction Half Reactions Using Oxidation Number in Acid / Base Environments, Electron Transport, Strengths of Redox Reagents, Activity Series, Chemical Reactivity and Products of Chemical Reactions (Net-ionic Equations Revisit), Redox Titration, Standard and Net Electric Potentials, Electrochemical (Voltaic / Galvanic) Cells, Electrolytic Cells, Faraday's Laws, Nernst Equation

AP Exam Review **1.0 – 1.5 weeks**

Students will review old AP Exams, with the emphasis on writing complete and net ionic equations, Solubility Rules, Solving Stoichiometry, Equilibria, Thermochemistry, Kinetics, and Redox Problems.

Course Evaluation:

Semester One (September to January)

Units	Weight
Unit 1: Basic Chemistry	21%
Unit 2: Chemical Bonding and Organic Chemistry	34%
Unit 3: States of Matter	25%
Semester 1 Final Exam (December)	*20%*
Total Course Mark	**100%**

*The 1st Quarter Mark will consist of Unit 1. The 2nd Quarter Mark will consist of Units 2 and 3.

Semester Two (January to May)

Units	Weight
Unit 4: Thermochemistry and Nuclear Chemistry	29%
Unit 5: Chemical Kinetics and Equilibria	23%
Unit 6: Acids and Bases and Aqueous Equilibria	15%
Unit 7: Reduction, Oxidation and Electrochemistry	13%
AP Exam Review (End of April)	*20%*
Total Course Mark	**100%**

*The 3rd Quarter Mark will consist of Units 4 and 5. The 4th Quarter Mark will consist of Units 6 and 7.

Unit Components	Weight
Homework	10%
Labs	30%
Quizzes	10%
Unit Test	50%
Total Unit Mark	**100%**

Unit Preparation
At the beginning of each unit, a detailed timeline of readings and problems are given out to students. This is to allow students the opportunity to better manage their studying schedule. It is highly recommended that students do the assigned reading from the text to prepare for the next class. AP Chemistry is a fast paced course and this is exactly what is required in universities.

Homework
Homework will be assigned every class. All answers of assigned problems are in the back of the textbook. Students are encouraged to ask problems they do not understand in the next class. Homework check will be conducted regularly. It is important that students do the assigned problems to self-evaluate their understanding of the material taught.

Notebook
An organized notebook is a key to success in any course. Students are to keep their current chapter's work in a 1½-inch 3-ring binder. It should have several dividers. The chapter outline will be placed at the beginning, follow by class notes with all answers to the examples filled out. Then, a section of homework follows, and finally chapter quizzes that has been handed back. This chapter notebook is turned in during the chapter test. After each chapter test, students are to put all material of that chapter in a central binder at home. The new chapter will now be house in the emptied binder to be carried to and from class.

Labs
Labs will be conducted in each unit. *All Safety Procedure MUST be followed at ALL times*. Proper lab techniques will be introduced. It is required that students are to read up on the lab procedure prior the lab period.

There are 14 labs within this course (see below). A lot of these labs will require two-class periods or utilizing the weekly AP Chemistry Tutorial Session. They are crucial components of the AP Chemistry program. Students who have missed a lab period must arrange other times (before or after school) to perform the lab. For each lab, students are require to make observations of chemical reactions and substance, record data, calculate and interpret results based on quantitative date obtained, and communicate effectively the results of experimental work. For some labs, students are to perform them on their own. Other labs will require groups of two students, or combining results of the entire class. However, each student should write up and hand in his or her individual lab report. Students should have a separate bind notebook as their lab notebook. The entire notebook should be handed in for evaluation every time a lab report is due.

Note: If students wish to type up their lab reports, a three-ring binder can be used to collect all reports graded. In such case, a *Title Page* indicated the title of the lab; student's name; class and instructor must be included with the report when it is due. Proper word processing techniques, such as subscripts, superscripts, arrows, double arrows, and math equations should be used. Because of the amount of mathematical calculations involved in these labs, students are strongly encouraged to write up their lab reports instead. ***It is highly recommended that students keep all their labs for college evaluation if they want to receive college credits for taking AP Chem****istry*

AP Chemistry Labs

Lab #1: Measuring Techniques and Diagnostic Tests for Gases	Unit 1
Lab #2: Solution Preparations	Unit 1
Lab #3: Gravimetric and Solution Stoichiometry	Unit 1
Lab #4: Quantitative Spectroscopy of the Hydrogen Emission Spectrum	Unit 2
Lab #5: Chemical Models	Unit 2
Lab #6: Enthalpy of Vapourization of Water	Unit 3
Lab #7: Molar Heat of Solvation and Molar Heat of Fusion	Unit 4
Lab #8: Molar Heat of Combustion	Unit 4
Lab #9: Chemical Kinetics	Unit 5
Lab #11: Weak Acid and Strong Base Titration	Unit 5
Lab #10: Chemical Equilibrium Constant	Unit 6
Lab #12: Qualitative Analysis of Cations and Anions	Unit 6
Lab #13: Electrochemical Cells	Unit 7
Lab #14: Organic Chemistry: Esterification (Post AP Exam)	Unit 2

Lab Report Format

1. **Title and Date:** A Short Description of the experiment
2. **Objective:** Describe the Background and the Purpose of the experiment. What is it that we are expected to learn and accomplish from this experiment?
3. **Hypothesis:** An Educated Guess of the result of the experiment. Predict any observations. This is also the section where you will answer any prelab questions. Example: Products Prediction, Concentrations of Solution …etc.
4. **Materials:** A Detailed List of all Equipment and Amounts of Chemicals Used. The list can be found in the lab itself.
5. **Procedure:** Even though the procedure is provided in the lab, students should not merely copy the steps. The procedure is to be paraphrased into your lab report. All universities and colleges are against any form of plagiarism. All quotes and materials must be properly referenced.
6. **Observations:** All relevant Quantitative Data must be recorded. The measurements that need to be taken should have been conveyed in the objective, hypothesis and procedure. All Qualitative Data must be recorded as well. All observations must be recorded in pen and initialed by the teacher before students leave the lab.
7. **Analysis:** This section consists of all Calculations and Graphs from the Experimental Data. All calculations must include proper units and all parts of any graphs are properly labeled. Any Inferences from the Qualitative Data should also be included.
8. **Evaluation:** When there are both theoretical and experimental results, percentage yield or percentage error must be calculated. This value must be explained and accounted for (What were the kinds of errors made in the lab?). Suggestions to improve the lab procedure must also be provided.

$$\%\ \text{Yield} = \frac{\text{Experimental}}{\text{Theoretical}} \times 100\% \qquad \%\ \text{Error} = \frac{\left|\text{Theoretical} - \text{Experimental}\right|}{\text{Theoretical}} \times 100\%$$

9. **Conclusion:** Finally, comment on whether your have met the objective and what have you learned from this lab.

The first five sections (title to procedure) and the list of measurements needed for the observation must be completed prior to any lab periods. This is to ensure students have read and understood the lab before hand.

Quizzes
A quiz is given at the end of each chapter or in the middle of a chapter. They serve as interim assessment on material taught. Students are encouraged to study and learn from the mistakes in these quizzes to better prepare of the unit test.

Unit Test
There will be a unit test given at the end of each unit. These are comprehensive tests that will cover all components taught (including labs performed) within a unit **and possibly prior units**. Most unit tests will be in the same style and format as previous AP exams. Therefore, students are continuously practicing for the "big one" in May.

Semester 1 Final Exam
The Semester 1 Final Exam will be in December. It will cover the Units 1, 2 and 3.

AP Exam Review
The review consists of two exams (a take-home and an in-class). Both will be very similar to the real exams.