WOODSIDE PRIORY SCHOOL

COURSE OUTLINE – CHEMISTRY

Instructor: Mr. G. Tang **Phone:** (650) 851-6129 **Email:** gtang@prioryca.org
Office Hours: 7:45 AM – Start of 1st Class (Excepts Wednesdays); End of Last Class – 4:00 PM (Mondays, Thursdays, Fridays); B Block (both semesters) and E Block (Semester 1)

Required Text: Meyers, R. Thomas, Oldham, Keith B., Tocci, Salvatore. *Chemistry*, 2005-2006 (ISBN: 978-0-030-39107-1 or ISBN 0-030-39107-5)

Required Material: Scientific Calculator, Separate Bind (Composition) Notebook as Labs and Activities Log, 1½-inch 3-ring Binder, Dividers

Course Overview:
Chemistry is the study of matter and its changes. Through the study of chemistry, students are given an opportunity to explore and understand the natural world and to become aware of the profound influence of chemistry in their lives.

Chemistry, as with all sciences, is an experimental discipline requiring creativity and imagination. Methods of inquiry characterize its study. In Chemistry, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills.

Students are active learners and will assume increased responsibility for their learning as they work through the program. The study of chemistry is required to give students an understanding that encourages them to make appropriate applications of scientific concepts to their daily lives. Students are expected to participate actively in their own learning. An emphasis on the key concepts and principles of chemistry provides students with a more unified view of sciences and a greater awareness of the connections among them.

In this conceptual chemistry course, designed for liberal arts students, numerical problem-solving skills and memorization are not stressed. Instead, chemistry concepts are developed in a story-telling fashion with the frequent use if analogies and illustrations as well as simple activities both in and out of the laboratory settings to help students become better thinkers and reach their personal goals of self-discovery.

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 hand use natural resources judiciously to ensure quality of life for future generations.

Course Content and Tentative Timeline
When content taught is not in the textbook, alternate material and worksheets will be provided.

Unit 1: Chemistry as a Science

Chapter 1 The Science of Chemistry **1.5 week**

Lab Safety, Chemistry as a Scientific Discipline, States of Matter, Evidences of Chemical Change, Matter, Volume, Mass and Weight, Metric System, Unit Factors and Quantities, Physical and Chemical Properties, Density, Classification of Matter, Solutions, Elements and Compounds, Physical Change and Chemical Reactions

Chapter 2 Matter and Energy **1.5 weeks**

Energy and Work, Physical versus Chemical Change, Endothermic and Exothermic, Law of Conservation of Energy, Heat, Kinetic Energy, Temperature, Specific Heat, Scientific Method, Hypothesis, Theory, Scientific Law, Law of Conservation of Mass, Accuracy, Precision, Uncertainty, Significant Figures, Unit Analysis, Conversion of Complex Units

Unit 2: Atoms, Moles and the Periodic Table

Chapter 3 Atoms and Molecules **2.0 weeks**

Law of Definite Proportions and Law of Multiple Proportions, Models of the Atom (Dalton, Plum-Pudding, Nuclear, Bohr, Quantum), Structure of a Nuclear Atom (Electrons, Protons and Neutrons), Atomic Number and Mass Number, Isotope and Average Atomic Mass, Energy Level, Atomic Orbital, EM Spectrum, Ground State versus Excited State, Quantum Number, Pauli Exclusion Principle, Electron Configuration, Aufbau Principle, Hund's Rule, Mole, Molar Mass and Avagadro's Number

Chapter 4 The Periodic Table **2.0 weeks**

Periodic Table of Elements, Periodic Law, Valence Electrons, Groups and Periods, Metals and Nonmetals and their Properties, Metalloids or Semi-metals, Main or Representative Group Elements, Alkali and Alkaline Earth Metals, Halogen and Noble Gas, Groups and Periods, Transition Metals, Inner Transition Metals (Lanthanide and Actinide Series), Alloy, Trends in the Periodic Table (Electron Shielding, Ionization Energy, Atomic Radius and Electronegativity), Nuclear Reactions and Transmutations, Synthetic Elements, Cyclotron and Linear Accelerator

Unit 3: Ionic and Covalent Compounds

Chapter 5 Ions and Ionic Compounds **1.5 weeks**

Simple Ions, Octet Rule, Valence Electrons, Electron Configurations of Ions, Ionic Bonding and Ionic Compound, Energy of Ionic Compound Formation (Breaking and Forming Bonds and Lattice Energy), Unit Formula, Properties of Ionic Compounds, Nomenclature of Ionic Compounds, Polyatomic Ions,

Chapter 6 Covalent Compounds **2.0 weeks**

Covalent Bond, Molecular Orbital, Bond Length, Bond Energy, Non-polar and Polar Covalent Bonds, Lewis Structure, Unshared or Lone Pair, Single, Double and Triple Bonds, Resonance Structures, VSPER Theory and Molecule Geometry, Nomenclature of Molecular Compounds and Properties of Molecular Compounds, Acids and their Nomenclatures

Unit 4: The Mole, Chemical Equations and Reactions

Chapter 7 The Mole and Chemical Composition **1.0 week**

Mole, Avogadro's Number, Molar Mass, Average Atomic Mass, Mass-Mole-Molecules / Atoms Calculations

Chapter 8 Chemical Equations and Reactions **2.0 weeks**

Different Types of Chemical Reactions (Formation, Decomposition, Single and Double Replacements, Hydrocarbon Combustions, Precipitations, and Acid-Base Neutralizations), Chemical World Equations, Skeletal Chemical Equations, Coefficients, Balancing Chemical Equations and Predicting Products, Complete Ionic Equations, Spectator Ions and Net-Ionic Equations

Semester 1 Final Exam Review **1.0 week**

Students will review old unit tests, with the emphasis on the last 5 units of the course.

Unit 5: Stoichiometry

Chapter 9 Stoichiometry **3.0 weeks**

Mole Ratios, Gravimetric (Mass-Mass) and Density (Volume-Volume) Stoichiometry, Limiting Reactants, Percentage Yield, Actual Yield versus Theoretical Yield, Application of Stoichiometry

Unit 6: Energy in Chemical Change, States of Matter and Intermolecular Forces

Chapter 10 Causes of Change **2.0 weeks**

Heat, Enthalpy, Temperature, Endothermic and Exothermic Change, Heating Curve, Specific Heat and Specific Heat Capacity, Physical Kinetic Change ($\Delta H = C\Delta T = mc\Delta T$), Physical Potential Change ($\Delta H = m\Delta H_{\text{phase change}}$), Calorimetry, Molar Enthalpy of Formation (ΔH_f), Hess's Law – Adding Chemical Equations and their ΔH_{rxn}. ($\Delta H_{\text{rxn}} = \Delta H_{\text{products}} - \Delta H_{\text{reactants}}$)

Chapter 11 State of Matter and Intermolecular Forces **1.0 week**

States of Matter, Properties of Water (High Boiling and Melting Points, Density, High Specific Heat Capacity, Surface Tension), Changing States, Intermolecular Forces (London Dispersion Force, Dipole-Dipole and Hydrogen Bonds)

Unit 7: Gases and Solutions

Chapter 12 Gases **2.0 weeks**

Properties of Gases, Pressures and their units (atm and kPa), Temperature units (Celsius and Kelvin), Kinetic Molecular Theory, Gas Laws (Boyle's, Charles's, Guy-Lussac's and Avogadro's), Combined Gas Law, Ideal Gas Law, Gas Constant, Gas Stoichiometry

Chapter 13 Solutions **2.0 weeks**

Solution versus Suspension, Solute and Solvent, Colloid, Mixture Separation Techniques (Filtration and Distillation), Concentration and Molarity, Preparing a Standard Solution, Solution Stoichiometry, Factors Affecting Solubility of Gas and Solid Solutes, "Like-Dissolves Like", Solution Process (Dissociation and Hydration), Solubility of Ionic versus Molecular Compounds, Unsaturated, Saturated and Super-saturated Solutions, Nonelectrolytes versus Electrolytes, Acid Dissociation (Hydronium Ion preview), Qualitative Description of the Colligative Properties (Boiling Point Elevation and Freezing Point Depression), Surfactant, Soap versus Detergent

Unit 8: Acids and Bases, Redox and Electrochemistry

Chapter 15 Acids and Bases **2.0 weeks**

Acids and Bases and their Properties, Different Definitions of Acids and Bases (Arrenhius and Brønsted-Lowry), Hydronium Ion, Conjugate Acids and Bases, Strong Acids and Bases, Weak Acids and Bases, Amphoteric and Polyprotic Acids, Concentrations of Hydronium and Hydroxide Ions, Self-Ionization Constant of Water (K_w), Acidity, Basicity and pH, Neutralization and Titration, Acid-Base Salt.

Chapter 16 Oxidation, Reduction and Electrochemistry **2.0 weeks**

Reduction and Oxidation, Reduction-Oxidation Reactions, Redox Reagents, Half-reactions, Electrochemistry, Electrodes (Anode versus Cathode), Electron Flow, Voltage, Electrochemical Cells (Salt Bridge, Half-Cells), Galvanic Cells and Voltaic Cells, Application of Electrochemical Cells, Corrosion Cells (Sacrificial Metal), Prevention of Corrosion, Electrolytic Cell, Minimum Voltage

Unit 9: Reaction Rates and Nuclear Chemistry

Chapter 16 Reaction Rates **1.0 weeks**

Factors Affecting Reaction Rates (Concentration, Pressure, Temperature and Surface Area), Catalyst and Inhibitor, Ozone Layer Depletion

Chapter 18 Nuclear Chemistry **2.0 weeks**

Nucleons, Nuclide, Nuclear Strong Force, Mass Defect, Nuclear Binding Energy, Band of Stability, Nuclear Change, Radioactivity, Nuclear Decay (alpha, beta and gamma particles), Balancing Nuclear Equations, Fission versus Fusion, Nuclear Energy and Reactors

Semester 2 Final Exam Review **1.0 week**

Students will review old unit tests, with the emphasis on the last 5 units of the course.

Semester One (September to December)

Units	Weight
Unit 1: Chemistry as a Science	20%
Unit 2: Atoms, Moles and the Periodic Table	20%
Unit 3: Ionic and Covalent Compounds	20%
Unit 4: The Mole, Chemical Equations and Reactions	20%
Semester 1 Final Exam (December)	*20%*
Total Course Mark	**100%**

*The 1st Quarter Mark will consist of Units 1 and 2. The 2nd Quarter Mark will consist of Units 3 and 4.

Semester Two (January to June)

Units	Weight
Unit 5: Stoichiometry	16%
Unit 6: Energy in Chemical Change, States of Matter and Intermolecular Forces	16%
Unit 7: Gases and Solutions	16%
Unit 8: Acids and Bases, Redox and Electrochemistry	16%
Unit 9: Reaction Rates and Nuclear Chemistry	16%
Semester 2 Final Exam (Beginning of June)	*20%*
Total Course Mark	**100%**

**The 3rd Quarter Mark will consist of Units 5, 6 & 7. The 4th Quarter Mark will consist of Units 8 & 9.

Unit Components	Weight
Homework / Notebook	25%
Labs	30%
Quizzes	15%
Unit Test	30%
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.

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 about 9 to 11 labs within this course. They are crucial components of the Chemistry program. Students who have missed a lab period must arrange other times (before or after school) to perform the lab. Students must perform the lab on their own unless otherwise stated, and each should hand in their own 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.

Formal 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.
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.
7. **Analysis:** This section consists of any 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. **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. Most unit tests will be in the same style and format to the midterm and final exam.

Semester 1 Final Exam
The Semester 1 Final Exam will be held in December prior to the Christmas Break. It will cover the first 4 units of this course.

Semester 2 Final Exam
The Semester 2 Final Exam will be held at the beginning of June. Although all units will be tested, the last 5 units will be the focus of this final exam.

Academic Integrity
It is expected that students follow the rules regarding academic integrity as outlined in the Parents and Students Handbook.

"Students who are unclear about what constitute cheating or plagiarism should discuss it with a teacher or advisor. Infractions of the Academic Integrity guidelines are cumulative through a student's High School years at the Priory."

Homework and Lab Reports:
All homework must be the student's own work. It is cheating to:
- ***Submit work copied from any outside source (text or electronic) without proper footnotes or references. (If you are copying from a passage or obtain information from other textbooks or the Internet, you MUST state the sources either as footnotes or references in the bibliography.)***
- ***Submit work copied from a friend.***
- ***Give the work to a friend for copying.***
- ***Submit work overly reliant on outside assistance from a tutor, mentor or a parent.***

**** In labs and homework, collaborations are encouraged but only limited to discussion. All final work must be from the student's own words.***

Quizzes, Tests and Exams:
Students must adhere to the rules of classroom assessments such as quizzes, tests, and exams. It is cheating to:
- *Copy answers from another student's test.*
- *Consult any unauthorized notes during the test.*
- *Use or share any kind of electronic devices without specific and explicit permissions. (In most tests, calculators are allowed. However,* ***NO cell phones, communication devices or computers are allowed****.)*
- ***Solicit specific information about a test that the student has not yet taken from someone who has taken it. (This is always a problem. If someone asked you what's on the test, just state the chapters the test is covered.)***
- *Go back to a prior section or ahead to another section on a standardized test unless it is specifically allowed.*
- *Give answers to another student or knowingly assist another student to cheat.*

Students who compromise their academic integrity for violating the above rules will receive an automatic zero for the assignment or test. In addition, the incident will be reported to the Academic Dean for further considerations.