FAST-PACED CHEMISTRY COURSE OF STUDY

Textbook: Prentice Hall's *Chemistry* (2002 edition) by Wilbraham et al

DAY 1	**WHAT (skill goals, knowledge goals, concepts)**	**HOW (activities)**
morning	Introduction: The nature of scientific investigation, how scientists solve problems. Introduction to Chemistry: the study of matter -definition of matter, states of matter, changes of state. Classification of matter-pure and impure substances, heterogeneous and homogeneous. The properties of matter-physical and chemical	Cooperative puzzle solving, Demonstration of the scientific method. Running shoe demo. Questions Page (58-9) – 36,37,39,42,46,54,56
afternoon	Changes in matter-physical and chemical Indicators of chemical change. Law of Conservation of Mass.	Use of the Bunsen burner (questions - Page (46-55) – 9,10,14,18,19,24,32,34 Student Lab
evening	The use of mathematics in science - scientific notation, significant figures (rules), rounding off. Units used in measurement - length, volume, mass, density, time, temperature. Conversions within the metric system. Review problems Page (91-93) – 46,47,48,49,53,54,55	Activity to practice measurement - estimation, limits imposed by measuring devices, etc. (questions - Page 69 – 3,4 Page 79 – 23,24,25 Page 83 – 30, 31,32,33

DAY 2	**WHAT (skill goals, knowledge goals, concepts)**	**HOW (activities)**
morning	The history of atomic structure - the models of the atom proposed by Dalton, Thomson, Rutherford. The fundamental sub-atomic particles - protons, electrons, neutrons. Definitions of atomic number, mass number, isotopes, atomic mass. The Periodic Table - history of its development. Use of atomic number rather than atomic mass. Definitions of family groups, periods. Positions of metals, non-metals and metalloids	Black Box demo Page (111-113) – 15,16,17,18,19,20 Page (116-117) – 21,22,23,24 Page 122 – 50,65
afternoon	How atoms combine - simple introduction to the formation of molecules and ionic compounds. Definitions of anion and cation. (Relation of noble gases to chemical reactivity of metals and non-metals, formation of ions, ionic charges) Law of Definite proportions	Lab to find the % water in bluestone
evening	Chemical nomenclature - binary compounds - simple monovalent ions. Multivalent elements - use of prefixes, classical suffixes, Stock system. Polyatomic ions - nomenclature of ternary compounds. Nomenclature of acids.	Chemical "Boggle"

DAY 3	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Introduction of the mole in its three modes - as a counting number, as a mass and as a volume. Page (290-302) – 3,4,5,6,7,8,17,19,21,22 % composition of compounds. Page (306-307) 32,33,34,35 Empirical and molecular formula. Page (310-312) -36,37,38,39,45	Activity to illustrate moles of various materials. empirical formula of magnesium oxide
afternoon	Types of chemical reactions: combination, decomposition, single and double replacement, combustion. Page (327-329) – 3,4 ,5,6,10,11,12 Page (331-337) – 13,14,15,16,17,18,19,20,21	Demos: Zn/S combination, HgO decomposition, Aluminum and mercury chloride. Student lab to illustrate all types of reactions.
evening	Chemical equations - word equations, skeleton equations, balanced chemical equations. Solubility rules - ionic and "net ionic" equations	Page 344 -32,33,34,35

DAY 4	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Stoichiometry - chemical calculations Interpreting chemical equations in quantitative terms. Problem solving involving moles, mass and volume. Page 360 – 11,12,13,14,15,16,17,18 Page 366 - 24	Student lab - reaction of steel wool and copper II sulfate solution to verify mole ratio. Decomposition of a hydrated salt to identify it.
afternoon	Concept of limiting reagent Page (370-371) -25,26,27,28 % yield of a reaction Page (374-375) – 29,30,31,32	Demo of limiting reagent using magnesium and hydrochloric acid
evening	The States of matter (chapter 10) Kinetic molecular Theory - application to the three states of matter.	

DAY 5	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Gases and Gas behavior - dependence of volume on temperature pressure and amount of gas. The Gas Laws - graphical analysis of data to establish Boyle's Law (PV = k), Charles' Law (V/T = k) Gay-Lussac's Law (P/T = k) The combined Gas Law. Page (418-425) – 7,8,9,10,11,12,13,14,20,21,22,23,24	Demo to show how the volume of a gas can be changed. Student labs - to derive data for Boyle's and Charles' Laws.
afternoon	Avogadro's Law Dalton's Law of Partial Pressure Page 434 -31 32 , Page (439-441) – 61,62,63,76,83 Graham's Law of Diffusion	Problems involving all the gas laws. Student lab - to find the molar volume of hydrogen gas.
evening	The Ideal Gas Law (PV = nRT) derivation and use of the equation to solve problems Page 439 – 43,46,47,48,51,55,56,57,58	Student lab - to find the molar mass of butane gas.

DAY 6	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Modern Atomic Theory - review models of the atom (Dalton to Rutherford) Extension to the model to the Bohr atom. Drawing representations of atoms using the Bohr model. Limitations of the Bohr model - uncertainty, wave nature of matter, etc. Extension of model to quantum mechanical model based on probability. Introduction of atomic orbitals - principal energy levels, shapes of atomic orbitals (s, p, d and f)	Flame tests for various metallic ions to verify electron promotion, etc. Spectrum tubes to illustrate unique spectral "fingerprints" of some elements.
afternoon	The electron arrangement of atoms. Rules for filling orbitals - Aufbau principle, Pauli exclusion, Hund's rule. Exceptions to the rules	Page 135 – 8,9 Page 149 – 30,32,33,34,35,36,39
evening	The Periodic Table revisited - based on the electron arrangement of the atoms. Trends in the Periodic Table - atomic and ionic radius, Ionization Energy, electronegativity.	Page 181 – 27, 30, 35, 36, 37, 38, 39, 40,41,42,43,46

DAY 7	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Chemical Bonding - use of electron-dot diagrams Formation of ions - ionic bonding The properties of ionic compounds and their relationship to the strength of the bonds. (i.e. Melting points, solubility, electrical conductivity) Metallic bonding - the nature of the metallic bond and the factors affecting its strength. The relationship of bond strength to the properties of metals.	Student lab to examine the properties of substances in relation to their bonding.
afternoon	Covalent bonding - the nature of the covalent bond. Formation of single and multiple bonds. The coordinate covalent bond.	Model building exercises to demonstrate the bonding and shapes of covalent compounds
evening	The Shapes of molecules. Describing the shapes of molecules using VSEPR theory. Explanation of the shapes of molecules using hybrid atomic orbitals. Also explanation of multiple bonds. The polarity of molecules and extensions to intermolecular forces like dipole forces, hydrogen bonds and Van Der Waal's forces.	Page (220 – 239) – 7, 8, 9, 10, 11, 12, 26, 27, 28, 30, 31 Page 247 – 50, 54, 56, 64, 65, 67, 68, 69, 70

DAY 8	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Water - its importance and unique properties - high melting and boiling points, density, high heat capacity, surface tension, etc. Solutions - defined as homogeneous mixtures Solutes and solvents. Various types of solutions. The dissolving process. Hydration of ions. Electrolytes and non-electrolytes Water of hydration. Efflorescence and deliquescence. Practical uses.	Student experiments and demos to show the unique properties of water. The Acetone "race" Student experiment to illustrate the electrical conductivity of solutions. Demo of water absorption by ASAP
afternoon	Rates of dissolving - factors affecting the rate of dissolving. Quantitative aspects of solubility. Solubility curves. Saturated, unsaturated and supersaturated solutions. Solubility of gases.	Student activity to show the formation of a supersaturated solution. Page (499 – 501) – 47, 77, 82
evening	The concentration of Solutions. Expressed as % solution. Molarity of solutions. Colligative properties of solutions. Practical applications of elevated boiling points and depressed freezing points.	Page (481 – 486) – 8, 9, 10, 11, 12, 13, 14, 15, 19, 20, 21 Page 499 – 45, 46, 51, 52, 57 Page 501 – 89, 91

DAY 9	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Thermochemistry - endothermic and exothermic reactions. Changes of state - heats of fusion and vaporization. Calorimetry - measuring the heats of reaction Thermochemical equations	Demos to illustrate terms Student labs: Heat of fusion of Ice Heat of combustion of paraffin. Heat of solution of ammonium nitrate and sodium hydroxide Mathematical problems involving calorimetry
afternoon	Standard Heats of Formation Hess's Law. Finding heats of reaction. Relation of heat of reaction to stability Bond Energy and Heats of reaction Entropy and Free Energy. Reaction spontaneity.	Student lab to illustrate Hess's Law - Heat of neutralization. Page (510 – 532) – 4, 14, 15, 18, 19, 21, 22, 23, 24, 25, 26, 32, 33, 35, 37 Page (535 -537) – 56, 58, 59, 67, 71, 72, 74, 75, 85
evening	Nuclear Energy. Symbols of particles. Nuclear equations. Types of radioactive decay - alpha, beta and gamma. Half-life Types of nuclear reactions - transmutation, fission and fusion.	Page (806 -808) – 7, 8, 12, 13, 14 Page 822 – 47, 49, 50, 52, 58 Page 823 – 74 Page 825 – 2, 4, 5, 6, 7, 8

DAY 10	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Reaction Kinetics - the rates of reaction Definition of rate of reaction The measuring of reaction rates - initial rate, instantaneous rates, average rate. The factors affecting the rate of reaction - concentration, temperature and catalysis. Expand to include nature of reactants, surface area and pressure (for gases)	Demo to illustrate different reaction rates. Student lab: measuring the rate of the reaction between marble chips and hydrochloric acid. Graphical analysis. Student lab: factors affecting rate. Potassium permanganate and oxalic acid.
afternoon	Collision theory as an explanation for the factors affecting rate. Development of the Rate Law expression. Potential energy graphs to follow the progress of a reaction.	Iodine clock reaction to generate data to establish rate law expression.
evening	Reaction mechanisms. Introduction to equilibrium	Page (581 – 582) – 67, 68, 70, 79, 84, 86, 87 Water transfer lab. Graphical analysis.

DAY 11	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Equilibrium - Use results and graphs from water transfer lab to establish the conditions for a state of equilibrium to exist. Discuss - static equilibrium, - physical equilibrium in the (Liquid water - water vapor system) - chemical equilibrium using the hydrogen + iodine <===> hydrogen iodide reaction. Analysis of Haber process for ammonia to consider the concept of shifting an equilibrium. Le Chatelier's Principle. Application to the Haber process	Student lab for shifting an equilibrium. Reaction of Iron III ion with thiocyanate ion. Page 555 – 6 Page (581 -582) – 50, 51, 52, 73, 74, 75, 83, 84, 86 Demo the effect of changing temperature and pressure using the Nitrogen dioxide equilibrium.
afternoon	Introduction of the equilibrium constant. The form of the expression. Inclusion of concentrations of gases and aqueous ions.	Page (557 -558) – 7, 8, 9, 10 Student lab - equilibrium between chromate and dichromate ions in solution
evening	Solubility equilibrium, the solubility product constant. Significance of the magnitude of the constant. Using the constant to find molar concentrations and solubilities. Finding the constant using molar ionic concentrations. Predicting the formation of precipitates. The common ion effect.	Page 562 – 17, 18, 19, 20, 23, 24, 26, 27

DAY 12	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Acids and bases - physical and chemical properties, nomenclature. Evolution of the definition of acids and bases - Arrhenius, Bronsted-Lowry, Lewis. Using Bronsted-Lowry definition - conjugate acid-base pairs. The pH scale - definition of pH, the ion-product of water constant. Definition of pOH Strong and weak acids and bases. Definition of the acid dissociation constant.	Demo - red cabbage juice as acid-base indicator Page (596 – 610) – 9, 10, 11, 12, 13, 14, 15, 16, 20, 21, 23
afternoon	Reaction of acids and bases - neutralization Titration techniques - equipment needed - burets, pipets, etc. - choosing appropriate acid-base indicators.	. Student lab - %acetic acid in commercial vinegar Student lab - comparison of effectiveness of commercial antacids. Student lab - analysis of aspirin tablets for ASA
evening	Hydrolysis of salts - impact on indicator choice for titration. Buffer solutions - impact on living systems.	Demo - reaction of water with various salts Page (625 – 626) – 45, 48, 52, 53, 56, 65, 73, 74, 97, 98

DAY 13	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Oxidation and Reduction Definitions of redox from reactions with oxygen to loss and gain of electrons to changes in oxidation number. Assigning oxidation numbers. The balancing of redox equations: 1) by using oxidation number 2) by the half-cell method (in both acid and base solutions)	Demo to illustrate activity series. Extend to see these reactions as redox reactions. Page (649 – 654) – 19b, 20, 21, 25 Page (657 -659) – 35, 36, 40, 45, 65
afternoon	Redox Applications Electrochemical Cells - converting chemical energy into electrical energy. The Daniell Cell and extension to other electrochemical cells. Definition of cell potential. Electrolysis - converting electrical energy to chemical energy .	Demo of removing tarnish from silver Student lab to measure the cell potential of cells with various combinations of metal electrodes. Demo to illustrate the electrolysis of water and of brine (salt-water solution)
evening	Application of redox principles to batteries of various types, and to corrosion	Student presentations .

DAY 14	WHAT (skill goals, knowledge goals, concepts)	HOW (activities)
morning	Organic Chemistry - the chemistry of carbon Introduction - the scope and importance of organic chemistry. Classes of compounds - hydrocarbons - names, chemical formulas and structural formulas. - alkanes, alkenes, alkynes and cyclic hydrocarbons. Existence of isomers. Systematic nomenclature for hydrocarbons. Halogenated hydrocarbons. - benzene - a unique hydrocarbon. Resonance in the bonding of benzene. Simple reactions of hydrocarbons.	Student lab to prepare acetylene and study its properties.
afternoon	Organic compounds containing oxygen. - nomenclature and simple reactions of alcohols, ethers, aldehydes, ketones and esters. Polymers - different types and uses	. Demo to prepare a simple polymer.
evening	No evening class on Thursday of third week	

Day 15 – The last Friday – The Post-test is written in the morning session, the only class scheduled for the day.