Course No: S 760, 760B

Orange Unified School District

CHEMISTRY

Year Course

GRADE LEVEL: 10-12

PREREQUISITES: *B* or better grade in prior high school science course, completion of Algebra I and Geometry with *B* or better grade and concurrent enrollment in Algebra II. Recommended reading level at the 10th grade and above.

INTRODUCTION TO THE SUBJECT:
Chemistry is a college preparatory course that meets part of the University of California and CSU laboratory science entrance requirement. Chemistry is the study of properties that can be used to identify matter, and of techniques to measure those properties. Chemistry stresses the processes of science for obtaining and analyzing information. Laboratory activities and cooperative student activities are designed to give the student first hand experiences to support the theoretical concepts and principles. Measurement is stressed and mathematics is used to process and analyze measurements in order to answer questions about matter.

Core topics covered include: atomic and molecular structure, molecular bonds, chemical bonds, conservation of matter and stoichiometry, gases and their properties, acids and bases, solutions, chemical thermodynamics, reaction rates, chemical equilibrium, organic chemistry and biochemistry, nuclear processes, and investigation and experimentation.

TEXT: Zumdahl, Steven S., Susan L. Zumdahl, Donald J. DeCoste. *World of Chemistry*. © 2006. Houghton Mifflin Company.

COURSE OVERVIEW AND APPROXIMATE UNIT TIME ALLOTMENTS:

FIRST SEMESTER

ASSESSMENT BLUEPRINT:

Semester		Standard	# of Questions
1	1a	Relate periodic table position to atomic number and atomic mass	2
	1b	Use periodic table to identify metals, semimetals, non-metals, halogens	2
	1c	" to identify alkali metals, alkaline earth metals, electronegativity, …	5
	1d	" to determine number of electrons available for bonding	2
	1e	Nucleus of atom smaller than atom yet contains most of its mass	1
	2a	Sharing (covalent/metallic bonds) or exchanging (ionic bonds) electrons	4
	2b	Chemical bonds / large biological molecules are covalent	1
	2c	Salt crystals are repeating patterns of positive/negative ions (electrostatic)	1
	2e	Lewis dot structures	2
	3a	Describe chemical reactions by writing balanced equations	3
	3b	One mole set by defining one mole of carbon 12 atoms (mass of 12 grams)	1
	3c	One mole = 6.02×10^{23} particles	
	3d	Determine molar mass of molecules, convert mass to moles, # particles, volume of gas	4
	3e	Calculate mass of reactants and products	3
	11a	Protons & neutrons held together by nuclear forces	1
	1&E1b	Identify / communicate sources of unavoidable experimental error	1
	1&E1g	Usefulness / limitations of models / theories as representations of reality	1

I. Introduction — 0.5 week

Essential Learning: Students will follow safety rules.

Topic	Text Location	Standards
A. Class standards		
B. Lab write-up format		
C. Chemistry laboratory materials and equipment		I&E 1a, b, c, d, f, j, n
D. Safety in the chemistry laboratory		

II. Measurement and Calculations — 1.5 weeks

Essential Learning: Students will use the metric system and apply dimensional analysis in chemistry problems.

Topic	Text Location	Standards
A. Scientific method	1.5	I&E 1f, j, k
B. SI units and prefixes	5.2	
C. Percent error	Supplement	I&E 1c
D. Accuracy, precision, significant figures	5.5 & Supplement	I&E 1b, c
E. Scientific notation	5.1	I&E 1a
F. Dimensional analysis	5.6	I&E 1d
G. Temperature—Fahrenheit, Celsius, Kelvin	5.7	1f, 4e
H. Density	5.8	

III. Matter — 1 week

Essential Learning: Students will understand the states of matter are the fundamental components of chemistry.

Topic	Text Location	Standards
A. States of Matter	2.3	
B. Elements and compounds	2.2	1a, 1b, 1c, 1d
C. Mixtures	2.5	
D. Physical and chemical properties	2.4	

IV. Atomic Structure — 1.5 weeks

Essential Learnings: Students will identify the function of each subatomic particle. Students will understand the quantum mechanical model in a theory based on a progression of historical experiments and discoveries.

Topic	Text Location	Standards
A. Early models of the atom	3.3, 3.5, 11.1, 11.5	1i
B. Discovery of atomic structure	11.3, 11.4, 11.6	1h, 1i
C. Subatomic particles	3.5, 3.6	1e
D. Atomic numbers, atomic mass, isotopes, ions	3.7, 3.10	1a
E. Periodic Table	3.8	1b, 1c

V. Electron Configurations and Periodicity 2.5 weeks

Essential Learning: Students use the periodic table to describe the physical and chemical properties of elements.

Topic	Text Location	Standards
A. Electromagnetic waves and spectrum	11.2	1g, 1j
B. Quantum theory	11.6 – 11.8	1g, 1j
C. Progression of models of atoms	11.1, 11.5 – 11.8	1i
D. Electron configurations	11.9, 11.10	1c, 1f
E. Periodic trends	11.11	1e
F. Descriptive chemistry of the s-p-d-f- blocks	11.10	

VI. Bonding and Chemical Formulas 4 weeks

Essential Learning: Students understand the difference between ionic and covalent bonds both conceptually and visually (Lewis).

Topic	Text Location	Standards
A. Ionic bonding	12.1, 12.4, 12.5	1d, 2a, 2c
B. Covalent bonding	12.1 – 12.3	1d, 2b
C. Nomenclature (prerequisite for college chemistry)	4.1 – 4.6	
D. Lewis dot structures	12.6, 12.7	1d, 2e, 2f

VII. Chemical Equations 2 weeks

Essential Learning: Students balance chemical equations.

Topic	Text Location	Standards
A. Balancing chemical equations	7.2, 7.3	3a
B. Reaction types (prerequisite for college chemistry)	8.6, 8.7	

VIII. Mole Concept and Stoichiometry 3 weeks

Essential Learning: Students calculate quantities of reactants and products within chemical reactions (quantitative analysis).

Topic	Text Location	Standards
A. Mole	6.1 – 6.3	3b, 3c
B. Mole conversions (representative particles, mass, volume)	6.4 & Supplement	3d, 3e, 3f
C. Stoichiometric conversions	9.1 – 9.4	3e

IX. Semester Review & Final Exam 1 week

SECOND SEMESTER

ASSESSMENT BLUEPRINT:

Semester	Standard		# of Questions
2	2d	Atoms & molecules in liquids move in random pattern	2
	3d	Determine molar mass of molecules, convert mass to moles, # particles, volume of gas	1
	4a	Random motion of molecules and collisions with surface create pressure	1
	4b	Random motion of molecules explains diffusion of gases	1
	4c	Apply gas laws to pressure/temperature/volume of ideal gas or mixture	4
	4d	Values/meanings of standard temperature and pressure (STP)	1
	4e	Convert between Celsius and Kelvin	Within 4c
	4f	No temperature lower than 0 Kelvin	1
	5a	Observable properties of acids, bases, and salt solutions	3
	5b	Acids are hydrogen-ion-donating & bases are hydrogen-ion-accepting	1
	5c	Strong acids/bases fully dissociate & weak acids/bases partially dissociate	1
	5d	Use the pH scale to characterize acid and base solutions	2
	6a	Definitions of *solute* and *solvent*	1
	6b	Describe dissolving process at molecular level using random molecular	1
	6c	Temperature, pressure, surface area affect dissolving process	2
	6d	Calculate concentration of a solute (grams/liter, molarity, parts/million, %)	3
	7a	Describe temperature and heat flow in terms of motion of molecules/atoms	1
	7b	Chemical process release (exothermic)/absorb (endothermic) thermal energy	2
	7c	Energy released (condenses/freezes) & absorbed (evaporates/melts)	2
	7d	Heat flow/temperature change problems	2
	8a	Rate of reaction	1
	8b	Reactions rates factors, e.g., concentration, temperature, pressure	1
	8c	Role of catalyst	1
	9a	LeChatelier's principle	3
	9b	Equilibrium	2
	10a	Formation of polymers, e.g., proteins, nucleic acids, starch	1
	11b	Energy release larger in nuclear fusion/fission than in chemical reactions	1
	11c	Radioactivity of isotopes	Within 11d
	11d	Radioactive decay (alpha, beta, gamma) and change in nucleus	1
	11e	Alpha/beta/gamma radiation produce different amounts/kinds of damage	1

I. Thermochemistry (Energy) — 2 weeks

Essential Learning: Students describe heat changes both conceptually and quantitatively for chemical and physical changes.

Topic	Text Location	Standards
A. Kinetic energy	10.1	4a
B. Temperature v. Heat	10.2	7a
C. Thermochemical equations	Supplement	7d
D. Endo-/Exothermic reactions	10.3	7b
E. Potential energy diagrams	10.3	7b, 7c
F. Specific heat capacity and latent heat (concept / calculation)	10.5, 14.3	7d

II. Gases 2 weeks

Essential Learning: Students apply gas laws to relations between pressure, temperature, and volume of any amount of ideal gases.

Topic	Text Location	Standards
A. Gas properties and behavior	13.1, 13.3, 13.8, 13.9, 13.11	4a, 4b, 4c, 4e, 4f
1. Pressure		
2. Absolute zero		
3. Standard temperature and pressure (STP)		
B. Gas laws		4c, 4i
1. Boyle's	13.2	
2. Charles'	13.3	
3. Combined Gas Law	Supplement	
4. Dalton's Law of Partial Pressures	13.6	
5. Avogadro's Law	13.4	4h
C. Ideal Gas Law	13.5	4c, 4h
D. Gas Stoichiometry	13.11	3d

III. Liquids and Solids 1 week

Essential Learning: Students will understand the relationship of intermolecular forces and the states of matter.

Topic	Text Location	Standards
A. Changes of state	14.2, 14.3	7c
B. Intermolecular forces	14.1	2d, 2h
C. Heating and cooling curves	14.2	7b

IV. Solutions 2 weeks

Essential Learning: Students describe the dissolving process and calculate the concentration of a solution.

Topic	Text Location	Standards
A. Dissolving process	15.1	6a, 6b
B. Factors affecting the dissolving process	15.3	6c
C. Concentration		6d
1. Molarity	15.5	
2. Parts per million and grams per liter	Supplement	
3. Percent composition	15.4	

V. Acids and Bases 2 weeks

Essential Learning: Students identify and characterize acids and bases.

Topic	Text Location	Standards
A. Properties of acids and bases	8.4 & Supplement	5a, 5b
B. Defining acids and bases	8.4, 16.1	5b, 5e
C. Strength of acids and bases	16.2	5c
D. pH and hydrogen ion concentration	16.4, 16.5	5d, 5f

SPRING BREAK

VI. Chemical Equilibrium 0.5 week

Essential Learning: Students predict the effect of changes in concentration, temperature, and pressure (volume) using Le Chatelier's principle.

Topic	Text Location	Standards
A. Reversible reactions	17.4, 17.5	9b
B. Characteristics of equilibrium		
C. Equilibrium Constant Expression (conceptual/no calculation)	17.6	9c
D. Le Chatelier's Principle	17.8	9a

VII. Reaction rates 0.5 week

Essential Learning: Students know the factors that affect the reaction rate.

Topic	Text Location	Standards
A. Concentration	17.1	8a
B. Temperature	17.1	8b
C. Catalyst	17.2	8c
D. Nature of reactants	Top p. 543	8b

VIII. California Standards Test (CST)

<u>Teachers are encouraged to insert Standard 11 prior to CST as appropriate for their classrooms.</u>

IX. Nuclear Reactions 1 week

Essential Learning: Students analyze nuclear processes in which the atomic nucleus changes.

Topic	Text Location	Standards
A. Fission versus fusion	19.7 – 19.9	11b, 1f
B. Radioactive decay	19.1	11c, 11d, 11e
C. Half life	10.3	11f
D. Practical applications of radioactivity	19.4 – 19.6	I&E 1m

<u>Teachers are encouraged to incorporate Standard 10 into appropriate topics prior to the CST.</u>

X. Organic Chemistry 2 weeks

Essential Learning: Students know the structure and function of common organic molecules.

Topic	Text Location	Standards
A. Hydrocarbons	20.1 – 20.4	10b, 10d
B. Polymers	20.16	10a, 10b
C. Six functional groups	20.10	10e
D. Carbohydrates, lipids, proteins, and nucleic acids	21.1 – 21.9	10c, 10d, 10f

XI. Teacher Selected Topics 4 weeks

XII. Semester Review & Final Exam 1 week

DATE OF CURRENT CONTENT REVISION: February 2011

DATE OF BOARD APPROVAL: August 2006

CALIFORNIA CONTENT STANDARDS: CHEMISTRY	# of Items	%
Atomic and Molecular Structure	**6**	**10.0%**
1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:		
a. *Students know* how to relate the position of an element in the periodic table to its atomic number and atomic mass.	1	
b. *Students know* how to use the periodic table to identify metals, semimetals, non-metals, and halogens.	1	
c. *Students know* how to use the periodic table to identify alkali metals, alkaline earth metals and transition metals, trends in ionization energy, electronegativity, and the relative sizes of ions and atoms.	2	
d. *Students know* how to use the periodic table to determine the number of electrons available for bonding.	1	
e. *Students know* the nucleus of the atom is much smaller than the atom yet contains most of its mass.	1	
f. **Students know* how to use the periodic table to identify the lanthanide, actinide, and transactinide elements and know that the transuranium elements were synthesized and identified in laboratory experiments through the use of nuclear accelerators.	NA*	
g.**Students know* how to relate the position of an element in the periodic table to its quantum electron configuration and to its reactivity with other elements in the table.	NA*	
h.**Students know* the experimental basis for Thomson's discovery of the electron, Rutherford's nuclear atom, Millikan's oil drop experiment, and Einstein's explanation of the photoelectric effect.	NA*	
i.* *Students know* the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom.	NA*	
j.* *Students know* that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E = hv$).	NA*	
Chemical Bonds	**7**	**11.7%**
2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:		
a. *Students know* atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.	2	
b. Students know chemical bonds between atoms in molecules such as H2, CH4, NH3, H2CCH2, N2, Cl2 and many large biological molecules are covalent.	1	
c. Students know salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.	1	

d. Students know the atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.	1	
e. Students know how to draw Lewis dot structures.	2	
f. *Students know how to predict the shape of simple molecules and their polarity from Lewis dot structures.	NA*	
g.*Students know how electronegativity and ionization energy relate to bond formation.	NA*	
h.*Students know how to identify solids and liquids held together by Van der Waals forces or hydrogen bonding and relate these forces to volatility and boiling/melting point temperatures.	NA*	
Conservation of Matter and Stoichiometry	**10**	**16.7%**
3. The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants. As a basis for understanding this concept:		
a. Students know how to describe chemical reactions by writing balanced equations.	2	
b. Students know the quantity one mole is set by defining one mole of carbon 12 atoms to have a mass of exactly 12 grams.	1	
c. Students know one mole equals 6.02 x 1023 particles (atoms or molecules).	1	
d. Students know how to determine the molar mass of a molecule from its chemical formula and a table of atomic masses and how to convert the mass of a molecular substance to moles, number of particles, or volume of gas at standard temperature and pressure.	3	
e. Students know how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants or products and the relevant atomic masses.	3	
f.* Students know how to calculate percent yield in a chemical reaction.	NA*	
g.* Students know how to identify reactions that involve oxidation and reduction and how to balance oxidation-reduction reactions.	NA*	
Gases and Their Properties	**6**	**10.0%**
4. The kinetic molecular theory describes the motion of atoms and molecules and explains the properties of gases. As a basis for understanding this concept:		
a. Students know the random motion of molecules and their collisions with a surface create the observable pressure on that surface.	1	
b. Students know the random motion of molecules explains the diffusion of gases.	1	
c. Students know how to apply the gas laws to relations between the pressure, temperature, and volume of any amount of an ideal gas or any mixture of ideal gases.	2	
d. Students know the values and meanings of standard temperature and pressure (STP).	1	
e. Students know how to convert between the Celsius and Kelvin temperature scales.	1/2***	
f. Students know there is no temperature lower than 0 Kelvin.	1/2***	
g.*Students know the kinetic theory of gases relates the absolute temperature of a gas to the average kinetic energy of its molecules or atoms.	NA*	
h.*Students know how to solve problems by using the ideal gas law in the form PV = nRT.	NA*	
i.* Students know how to apply Dalton's law of partial pressures to describe the composition of gases and Graham's law to predict diffusion of gases.	NA*	

Acids and Bases	**5**	**8.3%**
5. Acids, bases, and salts are three classes of compounds that form ions in water solutions. As a basis for understanding this concept:		
a. Students know the observable properties of acids, bases, and salt solutions.	2	
b. Students know acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.	1	
c. Students know strong acids and bases fully dissociate and weak acids and bases partially dissociate.	1	
d. Students know how to use the pH scale to characterize acid and base solutions.	1	
e.*Students know the Arrhenius, Brønsted-Lowry, and Lewis acid-base definitions.	NA*	
f.* Students know how to calculate pH from the hydrogen-ion concentration.	NA*	
g.*Students know buffers stabilize pH in acid-base reactions.	NA*	
Solutions	**3**	**5.0%**
6. Solutions are homogenous mixtures of two or more substances. As a basis for understanding this concept:		
a. Students know the definitions of solute and solvent.	1	
b. Students know how to describe the dissolving process at the molecular level by using the concept of random molecular motion.	1	
c. Students know temperature, pressure, and surface area affect the dissolving process.	1/2***	
d. Students know how to calculate the concentration of a solute in terms of grams per liter, molarity, parts per million, and percent composition.	1/2***	
e.*Students know the relationship between the molality of a solute in a solution and the solution's depressed freezing point or elevated boiling point.	NA*	
f. *Students know how molecules in a solution are separated or purified by the methods of chromatography and distillation.	NA*	
Chemical Thermodynamics	**5**	**8.3%**
7. Energy is exchanged or transformed in all chemical reactions and physical changes of matter. As a basis for understanding this concept:		
a. *Students know* how to describe temperature and heat flow in terms of the motion of molecules (or atoms).	1	
b. *Students know* chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.	1	
c. *Students know* energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.	1	
d. *Students know* how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.	2	
e.**Students know* how to apply Hess's law to calculate enthalpy change in a reaction.	NA*	
f. **Students know* how to use the Gibbs free energy equation to determine whether a reaction would be spontaneous.	NA*	
Reaction Rates	**4**	**6.7%**
8. Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules. As a basis for understanding this concept:		
a. *Students know* the rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.	1	
b. *Students know* how reaction rates depend on such factors as concentration, temperature, and pressure.	1 or 2**	
c. *Students know* the role a catalyst plays in increasing the reaction rate.	1 or 2**	

d.*Students know the definition and role of activation energy in a chemical reaction.	NA*	

Chemical Equilibrium	**4**	**6.7%**
9. Chemical equilibrium is a dynamic process at the molecular level. As a basis for understanding this concept:		
a. Students know how to use LeChatelier's principle to predict the effect of changes in concentration, temperature, and pressure.	3	
b. Students know equilibrium is established when forward and reverse reaction rates are equal.	1	
c.*Students know how to write and calculate an equilibrium constant expression for a reaction.	NA*	
Organic Chemistry and Biochemistry	**2**	**3.3%**
10. The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:		
a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.	1	
b. Students know the bonding characteristics of carbon that result in the formation of a large variety of structures ranging from simple hydrocarbons to complex polymers and biological molecules.	1/2***	
c. Students know amino acids are the building blocks of proteins.	1/2***	
d.*Students know the system for naming the ten simplest linear hydrocarbons and isomers that contain single bonds, simple hydrocarbons with double and triple bonds, and simple molecules that contain a benzene ring.	NA*	
e.*Students know how to identify the functional groups that form the basis of alcohols, ketones, ethers, amines, esters, aldehydes, and organic acids.	NA*	
f. *Students know the R-group structure of amino acids and know how they combine to form the polypeptide backbone structure of proteins.	NA*	
Nuclear Processes	**2**	**3.3%**
11. Nuclear processes are those in which an atomic nucleus changes, including radioactive decay of naturally occurring and human-made isotopes, nuclear fission, and nuclear fusion. As a basis for understanding this concept:		
a. *Students know* protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.	2/5***	
b. Students know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions. The change in mass (calculated by E=mc2) is small but significant in nuclear reactions.	2/5***	
c. Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.	2/5***	
d. Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.	2/5***	
e. Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.	2/5***	
f. *Students know how to calculate the amount of a radioactive substance remaining after an integral number of half lives have passed.	NA*	
g.*Students know protons and neutrons have substructures and consist of particles called quarks.	NA*	

Investigation and Experimentation	6	10.0%
1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:		
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.		
b. Identify and communicate sources of unavoidable experimental error.		
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.		
d. Formulate explanations by using logic and evidence.		
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.		
f. Distinguish between hypothesis and theory as scientific terms.		
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.		
h. Read and interpret topographic and geologic maps.		
i. Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).		
j. Recognize the issues of statistical variability and the need for controlled tests.		
k. Recognize the cumulative nature of scientific evidence.		
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.		
m. Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.		
n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).		
TOTAL	**60**	**100%**