MiraCosta College

CHEM 100 - INTRODUCTORY CHEMISTRY

Units Lecture	3.00	**Units Lab**	1.00	**Units Total**	4.00
Total Hrs Lecture	49.50	**Total Hrs Lab**	49.50	**Total Course Hrs**	99.00

COURSE DESCRIPTION

This introductory course for non-chemistry majors teaches students the language, materials, mathematics, and principles of chemistry. It covers properties of matter, atomic theory, use of the periodic table of the elements, naming of compounds, formulas and equations, metric measurement, physical states of matter, chemistry of solutions, acids and bases, and organic and nuclear chemistry. UC CREDIT LIMITATION: Credit for CHEM 100 or 108. No credit for CHEM 100 if taken after CHEM 108 or CHEM 110.

ENROLLMENT RESTRICTIONS

PREREQUISITES	*COREQUISITES*	*ADVISORIES*
		MATH 830 or 830B with a "C" or better or qualification through the Math Competency Exam or approved equivalent.

OUTLINE OF COURSE CONTENT

The course will address the following topics:

I. Scientific thinking
A. Scientific method
B. Scientific terms: laws and theories
C. Measurements
1. Units and scientific notation
2. Significant figures in calculations
3. Prefix conversions
4. Dimensional analysis: problem-solving
5. Density determination and conversion.

II. Energy and matter
A. Kinetic, potential, and law of conservation of energy
B. Temperature and heat
C. Specific heat capacity determination
D. Energy content determination in food
E. Matter classifications
F. Physical and chemical properties of matter
G. Physical and chemical changes in matter.

III. Atoms and elements
A. Periodic table
1. Elements, symbols
2. Classifications
a. Metals, non-metals, and metalloids
b. Groups.
3. Atomic numbers
a. Isotopes
b. Atomic mass determination using percent abundances.
4. Periodic trends
a. Reactivity
b. Ionization energy
c. Electron affinities
d. Electronegativity.
B. Historical development of the atom

1. Electron discovery
2. Discovery of the nucleus
3. Bohr's model of the atom.
C. Modern model of the atom
1. Electron configurations and diagrams
2. Stability trends.

IV. Compounds and bonding
A. Ionic compounds
1. Ionic bond model
2. Nomenclature of ionic compounds, including polyatomic ions.
B. Covalent compounds
1. Covalent bond model
2. Bond polarity
3. Lewis structures: octet and duplet rules
4. Valence Shell Electron Pair Repulsion Theory: predicting molecular shapes and polarity.

V. Chemical reactions and stoichiometry
A. Classifying reactions
B. Mole concept for quantity determination
1. Molar mass determination
2. Mole relationships in balanced reactions.
C. Mass calculations for reactions
1. Theoretical and percent yield determination
2. Limiting reactant identification.
D. Energy changes in chemical reactions.

VI. Gases
A. Properties of gases, determining pressure
B. Gas laws
1. Boyle's and Charles's
2. Avogadro's, Combined, and Ideal
3. Dalton's law of partial pressures.

VII. Aqueous chemistry
A. Solutions and solubility
B. Electrolytes
C. Concentration calculations
D. Acid/base reactions
1. Properties of acids and bases
2. Determining the pH of a solution
3. Acid-base neutralization reactions
4. Buffers: resisting changes in pH.

VIII. Chemical equilibrium
A. Rates of reactions and equilibrium
B. Le Chatelier's principle.

IX. Nuclear chemistry
A. Natural radiation
B. Nuclear reactions
C. Half-life of radioisotopes
D. Fusion and fission.

Lab: All experiments performed in the laboratory portion of the class are designed to complement and support topics presented in lecture. Timing is such that students perform the experiment after the topic has been introduced and developed in lecture so that students are familiar with the subject. During the first 15-20 minutes of the experiment, theory and specifics are addressed. The specific contents of the laboratory are included below:

I. Introduction to the laboratory environment 
A. Laboratory safety 
B. Scientific inquiry: formulating and testing a hypothesis.

II. Measurements in the laboratory: density determination and significant figures

III. Energy and matter
A. Measuring the specific heat capacity of a metal
B. Substances and mixtures: separating a mixture into its components.

IV. Atoms and elements
A. Atomic emission spectroscopy
B. The periodic table: an investigation into elements and their chemistry.

V. Compounds and bonding: molecular models and covalent bonding.

VI. Chemical reactions and stoichiometry
A. Chemical reactions and equations
B. Theoretical and percent yield of tris (2,4-pentandianato) iron (III).

VII. Gas laws

VIII. Aqueous chemistry and chemical equilibrium
A. Solutions and solubility
B. Le Chatelier's principle
C. Acids and bases.

PERFORMANCE OBJECTIVES

Upon successful completion of this course, students will be able to do the following:

1). Assess the validity of claims of commercial products by applying the scientific method to evaluate the body of scientifically validated evidence or lack thereof
2). Compare the values of equivalent measurements in English and metric units by dimensional analysis conversions and rules for significant figures in calculations
3). Differentiate between the concepts of heat and temperature and use this knowledge to predict the quantity of energy released or absorbed in a chemical process or in the energy content of food
4). Classify matter as pure elements, compounds, homogeneous mixtures, or heterogeneous mixtures based on knowledge of the periodic table, bonding, and phase identification
5). Compare and contrast the solid, liquid, and gas phases of matter, in the context of density, packing of particles, freedom of particle movement, volume, and shape for all three phases
6). Organize the order and interpret relevant experimental setup and results of significant historical events, such as the discovery of the electron, discovery of the nucleus, and Bohr's model of the atom, in the evolution of the model of the atom
7). Analyze and predict chemical and physical properties of elements on the periodic table based on concepts of atomic structure, electron configurations, and periodic properties, such as ionization energy, atomic radii, and electron affinity
8). Describe and evaluate the impact nuclear reactions have on science and society
9). Select between covalent and ionic bonding for a particular chemical species; then correctly name the compound and either construct a Lewis structure for a covalent molecule using valence shell electron pair repulsion theory or diagram a representative ionic unit
10). Analyze given quantities of substances and chemical names in order to set up a balanced equation and then, using the concepts of molar mass and stoichiometry, to derive the theoretical and percent yields
11). Interpret and explain the qualitative significance of Boyle's, Charles's, Dalton's, and the Ideal gas laws; then apply that

knowledge quantitatively to predict the pressure, volume, number of moles, or temperature when parameters for a gas are changed
12). Calculate the mass percent and molarity concentrations for an aqueous solution
13). Apply Le Chatelier's principle to a reaction at equilibrium in order to predict the direction of change
14). Measure and compare the pH of different chemical solutions and household products
15). Safely and effectively operate laboratory equipment (e.g., burets, pipets, balances, volumetric flasks, Bunsen burners, hot plates, Spec 20) using proper techniques for handling chemicals and equipment
16). Analyze and interpret data through graphical means to draw conclusions that support or refute scientific hypotheses.

READING ASSIGNMENTS

Reading assignments will be consistent with, but not limited by, the following types and examples:

1). Read assigned sections of the course textbook with emphasis on relevant terminology and symbolic representation, molecular-level and macroscopic-level illustrations that explain the theory, causal factors that support the theory, and samples of worked problems
2). Read assigned scientific articles found in science journals, news magazines, or reliable Internet sites to expand understanding in lecture or laboratory arenas and/or for specific projects
3). Read assigned sections of course textbook for the laboratory with emphasis on safety and illustrations for proper handling techniques of chemicals
4). Read and deconstruct assigned course laboratory experiments for understanding and reconstructing detailed instructions into the lab notebook.

WRITING ASSIGNMENTS

Writing assignments will be consistent with, but not limited by, the following types and examples:

1). Complete comprehensive and frequent homework assignments from the text that include cause and effect arguments, explanations and descriptions, illustrations, and considerable mathematical computations, analysis, and graphing
2). Take extensive notes including writing short essays that develop and defend concepts in scientific theory, in addition to organization and pattern development for problem-solving and mathematical computations
3). Document data and observation entries in the lab notebook as consistent with laboratory experiments and activities
4). Tabulate data, prepare graphical and statistical analyses, organize results, assimilate information, and synthesize arguments that support or refute scientific hypotheses as part of the laboratory experience.

OUTSIDE-OF-CLASS ASSIGNMENTS (READING/WRITING/OTHER)

Outside-of-class assignments will be consistent with, but not limited by, the following types and examples:

1). Conclude extensive reading assignments from the course textbook and from supplemental reading sources, such as scientific journals, news magazines, or Internet sites
2). Conclude extensive writing assignments from textbook related homework, research papers, or reflective papers
3). Complete calculations and other quantitative and qualitative problem-solving assignments from the textbook
4). Complete calculations and other quantitative and qualitative problem-solving assignments from lab activities
5). Study and assimilate content learned in lecture and laboratory along with supporting materials, such as study guides, handouts, practice tests, and questions, in preparation for tests
6). Read and assimilate detailed instructions for laboratory activities; parse experimental procedure and rewrite using original wording into the laboratory notebook before actual experiment is performed
7). Organize qualitative and quantitative data, describe conditions and techniques, analyze results, and draw conclusions to formulate the comprehensive lab report.

STUDENT LEARNING OUTCOMES

	Learning Outcome	*Mode of Assessment*
1.	Students will analyze and interpret the periodic table to predict and explain an element's physical and chemical properties, based on the concepts of atomic structure, electron configurations and periodic properties.	1. Written essay question on exam, including cause and effect reasoning. Students will be given a periodic table, and instructed to compare particular property or properties of two or more elements.
2.	Students will construct the Lewis structure of a given molecule or polyatomic ion that obeys the octet rule, and use the Lewis structure to predict the number and types of bonds (single, double or triple) it has, and its	2. Diagram and interpretation problem on exam. Students will be given a periodic table and the molecular formula of a particular chemical species, and instructed to draw its Lewis structure. They will also be directed to analyze

geometry, based on the principles of covalent bonding and valence shell electron pair repulsion theory.	this species' Lewis structure in order to determine its molecular shape, and to identify each bond as single, double or triple.
3. Students will analyze a given chemical reaction, including the amounts of reactants, to write its balanced equation and to calculate the theoretical yield of the products, based on the concepts of molar mass and stoichiometry.	3. Written problem where students must write and balance the chemical reaction equation in symbol form, based on a written description of the reaction. Students will also construct and perform a calculation to determine the theoretical yield of a product.

METHODS OF INSTRUCTION

Instructional methodologies will be consistent with, but not limited by, the following types or examples:

1). Lecture - traditional and interactive one-on-one tutorial in class during problem-solving sessions supplemented with one or more of the following: PowerPoint slides, overhead transparencies, hand-drawn illustrations on the board, handouts
2). Group discussion and analysis of problems
3). Think pair-share methodology
4). Collaborative exercises
5). Laboratory - traditional lecture, group discussion, collaborative activities, individual instruction.

METHODS OF EVALUATION

Evaluation methodologies will be consistent with, but not limited by, the following types or examples:

1). Exams or tests including multiple choice, fill-in-the-blank, calculations, scientific reasoning, problem-solving, description and illustration, application, and explanation of concepts and phenomena covered in the content outline
2). Projects (such as individual and/or group research or reflection papers and/or presentations)
3). Written homework, including calculations, scientific reasoning, problem-solving, description and illustration, application, and explanation of concepts and phenomena covered in content outline
4). Quizzes
5). Lab notebook preparation
6). Lab reports.

REQUIRED TEXTBOOKS

Examples of typical textbooks for this course include the following:

1). Timberlake, Karen. General, Organic, and Biological Chemistry: Structures of Life. 3rd ed., Prentice Hall, 2010. ISBN: 978-0136054542
2). Seager, Spencer L., and Michael R. Slabaugh. Chemistry for Today: General, Organic, and Biochemistry. 6th ed., Brooks/Cole, 2008. ISBN: 978-0495112754
3). Hein, Morris, et al. Introduction to General, Organic, and Biochemistry. 9th ed., Wiley, 2009. ISBN: 978-0470129258
4). Stanitski, Griswold, et al. Laboratory Handbook for General Chemistry. 3rd ed., Thomson, Brooks/Cole, 2007. ISBN: 978-0495018902

OTHER REQUIRED INSTRUCTIONAL MATERIALS

1). Safety goggles
2). Scientific non-graphing calculator
3). Chemical resistant gloves.

COURSE REPEATABILITY

Total Completions Allowed:	***In Combination With:***
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