

Course Outline

College Chemistry I

Course Description:

CH 110. College Chemistry I. Five credit hours. Prerequisite: High school chemistry or CH 105 and two units of high school algebra or MA 120 or departmental consent. Three single/recitation periods and two, two hour labs per week. A study of chemical principles and their application. Offered fall and spring semesters

Real World Relevance:

The impact of chemistry in everyday life is phenomenal. The ability to see chemistry in action on the micro (molecular) and macro scale is necessary to develop a fuller knowledge and understanding of the world around us. Chemistry will enrich the students appreciation of the world and help them better understand the studies of science and the scientific methods.

Required Materials:

Change, R. (2003) *General Chemistry: The Essential Concepts* (3rd ed.). New York: McGraw-Hill, ISBN 0-07-241067-1

Laboratory Notebook:

Laboratory Manual: Available on CD-ROM

Spain, James and Peters, Harold. 2000-CD. *Chem Skill Builder 2000*

Learning Outcomes:

The intention is for the student to be able to analyze scientific materials in various forms demonstrating:

- An understanding of the scientific method.
- An ability to read, communicate and understand scientific materials.
- A knowledge of basic math skills.
- An ability to apply scientific reasoning to real world problems.

Learning PACT Skills:

Through the students' involvement in this course, they will develop and document achievement of the following skills:

Primary skills for this course:

- Critical thinking
Through a variety of methods, conceptual, mathematical, graphical, experimental, and written form demonstrate scientific reasoning.

Secondary skills for this course:

- Writing
Through a variety of writing experiences
- Speaking
Through a variety of speaking experiences
- Computer literacy
Through the production of written assignments and graphing using computer technology
- Internet use
Through the use of internet resources for research
- Teamwork
Through involvement in group tasks
- Ethical conduct
Through the students' ethical fulfillment of required activities and assignments

Assessment Tasks:

These learning outcomes will be demonstrated by:

1. Write laboratory reports, including purpose, procedural, observations, and analysis of the experiment using scientific reasoning.
2. Present an oral presentation of an assigned chemical in the laboratory from the MSDS sheets.
3. Final assessment of the course using the ACS standardized exam.
4. Various work will be collected at the end of the semester in a portfolio..

Course Content:

Recurring concepts that run throughout the course

Scientific method

Scientific reasoning

Issues

The balance between the conceptual and mathematical models

The cumulative nature of science and the world

The cumulative influence of scientific discoveries and the subsequent application of the discoveries

The balance between "wet" lab chemistry and computer interfacing, collection and analysis of data

Concepts that must be understood to address the issues:

Mathematics

Visual/conceptual

Scientific Methods

Scientific Reasoning

Modeling

Scientific writing

Scientific principles

MLA writing format

Word processing

Excel spreadsheet

Graphing

Characteristics and impact of science in the world around them

Content Specific Skills

By the end of the course, the student will have demonstrated the ability to:

A. Lecture:

1. Explain the design and significance of experiments that led to the adoption of modern atomic theory.
2. Recognize and interpret isotopic notation; understanding the relationship between average atomic masses and isotopic masses.
3. Relate atomic mass to composition in terms of subatomic particles.
4. Relate spectroscopic observations of atoms to quantum mechanical theories.
5. Explain the distinction between classical and wave mechanics.
6. Describe the radial and angular dependence of solutions to the Schrodinger equation for hydrogenic atoms (s, p, d orbitals).
7. Using the Aufbau principle, write the electron configuration of many electron atoms.
8. Relate the names to formulas for simple ionic and molecular compounds.
9. Draw Lewis Dot Structures for atoms, simple ionic and molecular compounds.
10. Describe the characteristics of ionic and covalent bonding.
11. Be able to predict the shape of simple molecules and ions using VSEPR Theory.
12. Explain how electronegativity differences relate to bond polarity.
13. Determine bond orders and relate them to relative bond strength.
14. Relate MO concepts to structural, energetic, spectroscopic, and magnetic properties of molecules.
15. Explain how the mole concept relates bulk chemical phenomena to atomic/molecular phenomena.
16. Perform calculations that employ relationships involving masses, formula units, and the mole concept.
17. Determine empirical and molecular formula for appropriate data.
18. Demonstrate your ability to balance chemical equations.
19. Write net ionic equations based on solubility rules.
20. Determine limiting reagents from stoichiometric data.
21. Calculate theoretical yield from stoichiometric data.
22. Employ stoichiometric reasoning in calculations of
 - a. Solution properties such as molarity.
 - b. Reaction enthalpies
 - c. Properties of gases.
23. Describe, define, and use the following concepts based on principles of energetics.
 - a. Heat capacity
 - b. Calorimetry
 - c. Heat/Work/Energy
 - d. Enthalpy/Standard States
 - e. Hess's Law
 - f. Heat of Formation
 - g. Phase Changes/Energy
24. Describe and apply the following concepts of the common state of matter.
 - a. General Properties of Gases.

- b. Gas Laws
 - c. Kinetic Molecular Theory
 - d. General Properties of Liquids
 - e. Intermolecular Forces.
 - f. General Solubility Principles/Rules
 - g. General Properties of Solids
25. Describe the general properties of solids, liquids, and gases, using Kinetic Molecular Theory.
 26. Calculate the concentration of a solution.
 27. Describe and apply the general properties of:
 - a. Solutions
 - b. Solution Preparation
 28. Determine oxidation states and assign oxidation numbers.
 29. Balance Redox reactions and determine oxidation/reduction reagent.
 30. Describe and group elements according to the Periodic Trends.
 31. Balance and classify the types of chemical reactions.

B. Laboratory

1. Working in the laboratory in accordance with good laboratory practices.
 - a. Dress in an appropriate manner as to promote safety in the laboratory, wearing a lab coat and goggles when anyone is working with chemicals in the laboratory.
 - b. Follow written directions accurately.
 - c. Work safely and effectively, using equipment and chemicals carefully and correctly.
 - d. Demonstrate use of required safety and common laboratory techniques.
 - e. Dispose of waste products in a proper manner.
2. Gather and record qualitative and quantitative data accurately.
 - a. Acquire data using balances and volumetric glassware.
 - b. Make and record visual observations.
 - c. Use computers, when appropriate, as data acquisition tools.
 - d. List or describe experimental assumptions made and any deviations from the written experimental procedures.
3. Handle and evaluate data in logical, productive, and meaningful ways.
 - a. Create notebooks and laboratory reports that are clear, understandable, and accurately represent the data collected.
 - b. Display computer data in a spreadsheet or graphically, as appropriate.
 - c. Correlate observations with chemical or physical processes.
 - d. Carry out suitable calculations with quantitative data, recognizing when data and calculations are within a reasonable range.
 - e. Use observations of experimental data to present relevant conclusions pertaining to the experimental procedure.
4. Correlate laboratory work with principal topics in College Chemistry I lecture.

Topical Outline of Concepts:

Unit 1: Fundamental Concepts

- Definitions
- Origin of Modern Chemistry
- Scientific Method

- Chemical Problem Solving
- Measurements
- Significant Figures.

Unit 2: The Components of Matter

- Elements, Compounds, and Mixtures
- Atomic View of Matter
- Dalton's Atomic Theory
- Nuclear Atomic Model
- Atomic Theory
- Bonding
- Formulas, names and masses
- Mixtures: Classification and separations.

Unit 3: Chemical Stoichiometry

- The mole
- Determining the Formula of an Unknown Compound
- Writing and Balancing Chemical Equations
- Calculating amounts of reactant and product
- Fundamentals of Solution stoichiometry.

Unit 4: Chemical Equations and Reactions

- Water as a solvent
- Precipitation's reactions and acid-base reactions
- Oxidations-Reduction reactions
- Predicting Products in Precipitation, Acid-base and Redox reactions
- Reversible reactions.

Unit 5: The Gaseous State and Kinetic Molecular Theory

- Physical States of Matter
- Gas pressure and its measurements
- Applications of the Ideal Gas Law
- Ideal gas law and reaction stoichiometry
- Kinetic-molecular theory
- Real gases.

Unit 6: Thermochemistry

- Form of Energy and their interconversions
- Enthalpy
- Calorimetry
- Stoichiometry of thermochemical equations
- Hess's law
- Standard heats of reactions.

Unit 7: The Quantum Theory and Atomic Structure

- The nature of light
- Atomic spectra
- The wave-particle theory
- Spectrophotometry

- The quantum-mechanical model of the atom.

Unit 8: Electronic Configuration and the Periodic Table

- Development of the periodic table
- Characteristics of many-electron atoms
- The quantum-mechanical model and the periodic table
- Trends in some key periodic atomic properties
- The connection between atomic structure and chemical reactivity.

Unit 9: Chemical Bonding: General Concepts

- Atomic properties and chemical bonding
- Ionic bonding
- Covalent bonding
- Electronegativity and bond polarity
- Metallic bonding.

Unit 10: Molecular Structure, Valence Bond Theory, and Hybridization

- Depicting molecules and ions with Lewis structures
- Valence shell electron pair repulsion theory and molecular shape
- Molecular shape and molecular polarity.

Unit 11: Molecular Orbitals

- Valence bond theory and orbital hybridization
- The mode of orbital overlap and the types of covalent bonds
- Molecular orbitals theory.

Unit 12: Intermolecular Forces, Liquids and Solids

- Physical states and changes
- Quantitative aspects of phase changes
- Types of intermolecular forces
- Properties of the liquid state
- Water
- The solid state
- Advanced materials.

Learning Activities:

Independent and collaborative learning activities will be assigned within and outside the classroom and laboratory to achieve the intended course outcomes. Classroom discussion, lecture, and textbook reading assignments will also contribute to the learning process.

Grade Determination:

Grade determination may include tests, projects, quizzes, homework, written assignments and laboratory experiments. Other methods may be used at the discretion of the instructor. A departmental final will be administered at the end of the semester.