

# Chemistry I

Course Code: 441 and 442

**LEVEL:** 1 and 2

**CREDITS:** 5

**GRADE:** 10,11,12

**Recommendation:** 441 :352 (B- or better; or department head recommendation)

442 : 352(C or better; or department head recommendation)

**BASIC TEXT:** Prentice Hall Chemistry  
PRENTICE HALL, 2008

**REQUIRED MATERIALS:** notebook, pen/pencils, and scientific calculator

## **COURSE DESCRIPTION:**

This course with emphasizes the fundamental principles of chemistry including concepts of energy, structure of matter, interactions of matter, states of matter, and stoichiometry. It is a blend of mathematical principles applied to chemical concepts developed through experimentation. Laboratory investigation is an integral part of this course.

## **MISSION RELATED GOALS:**

- Foster communication
- Foster problem solving
- Academic excellence
- Intellectual curiosity
- Respect rights of others
- Self-confidence

## **GENERAL PERFORMANCE OBJECTIVES:**

The students will be able to:

- Improve study and organizational skills.
- Practice good laboratory safety habits; and identify, utilize, and locate safety and laboratory equipment.
- Be educated citizens and consumers who can make conscious decisions because of a general understanding of the positive and negative effects chemicals and different forms of energy have on our lives.
- Develop basic laboratory skills and techniques.
- Learn to organize and analyze experimental data through practicing problem solving techniques.
- Proficient in the Massachusetts core learning standards for chemistry.

**STATE STANDARDS:**

**Boldface type indicates core standards for full-year courses.**

Massachusetts Science Curriculum Framework Learning Standard Strands for this Course are listed in brackets.

(1.1-1.4)

- 1. Identify and explain some of the physical properties that are used to classify matter, e.g., density, melting point.**
- 2. Explain the difference between mixtures and pure substance.**
- 3. Describe the four states of matter (solid, liquid, gas, plasma) in terms of energy, particle motion, and phase transitions.**
- 4. Distinguish between chemical and physical changes.**

(2.1-2.11)

5. Trace the development of atomic theory and the structure of the atom from the ancient Greeks to the present (Dalton, Thompson, Rutherford, and modern theory).
- 6. Interpret Dalton's atomic theory in terms of the Laws of Conservation of Mass, Constant Composition, and Multiple Proportions.**
- 7. Identify the major components of the nuclear atom (protons, neutrons, and electrons) and explain how they interact.**
8. Understand that matter has properties of both particles and waves.
9. Using Bohr's model of the atom interpret changes (emission/absorption) in electron energies in the hydrogen atom corresponding to emission transitions between quantum levels.
10. Describe the electromagnetic spectrum in terms of wavelength and energy; identify regions of the electromagnetic spectrum.
11. Write the electron configurations for elements in the first three rows of the periodic table.
12. Describe alpha, beta, and gamma particles; discuss the properties of alpha, beta, and gamma radiation; and write balanced nuclear reactions.
- 13. Compare nuclear fission and nuclear fusion and mass defect.**
- 14. Describe the process of radioactive decay as the spontaneous breakdown of certain unstable elements (radioactive) into new elements (radioactive or not) through the spontaneous emission by the nucleus of alpha or beta particles. Explain the difference between stable and unstable isotopes.**
15. Explain the concept of half-life of a radioactive element, e.g, explain why the half-life of C14 has made carbon dating a powerful tool in determining the age of very old objects.

(3.1 – 3.4)

- 16. Explain the relationship of an element's position on the periodic table to its atomic number and mass.**
- 17. Use the periodic table to identify metals, nonmetals, metalloids, families (groups), periods, valence electrons, and reactivity with other elements in the table.**

**18. Relate the position of an element on the periodic table to its electron configuration.**

**19. Identify trends on the periodic table (ionization energy, electronegativity, electron affinity, and relative size of atoms and ions.)**

(4.1 – 4.7)

**20. Explain how atoms combine to form compounds through both ionic and covalent bonding.**

**21. Draw Lewis dot structure for simple molecules.**

22. Relate electronegativity and ionization energy to the type of bonding an element is likely to undergo.

23. Predict the geometry of simple molecules and their polarity (VSEPR theory).

24. Identify the types of intermolecular forces present based on molecular geometry and polarity.

**25. Predict chemical formulas based on the number of valence electrons.**

**26. Name and write formulas for simple ionic and molecular compounds, including those that contain common polyatomic ions.**

(5.1-5.6)

**27. Balance chemical equations by applying the law of conservation of mass.**

**28. Recognize synthesis, decomposition, single displacement, double displacement, and neutralization reactions.**

**29. Understand the mole concept in terms of number of particles, mass, and gaseous volume.**

30. Determine molar mass, percent composition, empirical formulas, and molecular formulas.

31. Calculate mass-mass, mass-volume, volume-volume, and limiting reactant problems for chemical reactions.

32. Calculate percent yield in a chemical reaction.

(6.1-6.6)

**33. Using the kinetic molecular theory, explain the relationship between pressure and volume (Boyle's law), volume and temperature (Charles' Law), and the number of particles in a gas sample (Avogadro's hypothesis).**

**34. Explain the relationship between temperature and average kinetic energy.**

35. Perform calculations using the ideal gas law.

36. Describe the conditions under which a real gas deviates from ideal behavior.

37. Interpret Dalton's empirical Law of Partial Pressures and use it to calculate partial pressures and total pressures.

38. Use the combined gas law to determine changes in pressure, volume, or temperature.

(7.1 – 7.7)

**39. Describe the process by which solutes dissolve in solvents.**

**40. Identify and explain the factors that affect the rate of dissolving (temperature, concentration, and mixing).**

41. Calculate the concentration in terms of molarity, molality, and percent by mass.

42. Use a solubility curve to determine saturation values at different temperatures.
43. Calculate the freezing point depression and boiling point elevation of a solution.
44. Write net ionic equations for precipitation reactions in aqueous solutions.
45. Practice laboratory safety rules.
46. Students will be proficient in general laboratory skills, and will identify and utilize laboratory equipment.

## **UNITS AND THEMES COVERED AND ESTIMATED TIME LINE/COURSE OUTLINE**

Massachusetts Science Curriculum Framework Learning Standard Strands for this Course are listed in brackets.

- I. The Nature of Chemistry** (1.1, 2.1-2.4, 3.1-3.4) *3 weeks*
  - A. Define chemistry and the scientific method
  - B. Safety in Laboratory and Laboratory equipment
  - C. Units of measurements, uncertainty in measurements, working with numbers, and problem solving
  - D. Energy and Matter: energy, temperature, matter, elements, compounds, and mixtures
  
- II. The Structure of Matter** (4.1 – 4.3, 5.1 – 5.3, 6.1-6.4) *4 weeks*
  - A. Atomic structure: early models of the atom, discovering atomic structure, modern atomic theory, and changes in the nucleus.
  - B. Electron configurations: radiant energy, quantum theory, modern theory, and electron configurations.
  - C. Periodic Table: Developing, Reading and Periodic trends.
  - D. Groups of Elements: reactive metals, transition metals, inner transition, nonmetals, and hydrogen.
  
- III. Interactions of Matter** (8.1- 8.4, 9.1- 9.4, 11.1 – 11.2) *4 weeks*
  - A. Chemical Formulas and bonding: ionic and molecular, and naming chemical compounds
  - B. Molecular shapes and polarity
  - C. Chemical reactions and equations: classifying chemical reactions and writing/balancing equations.
  
- IV. Stoichiometry** (10.1-10.3) *2 weeks*
  - A. The mole: chemical measurements, mole conversions, and empirical/molecular formulas.
  - B. Mathematics of chemical equations: stoichiometry, limiting reactants and percent yield.
  
- V. States of Matter** (14.1- 14.4) *3 weeks*
  - A. Gases: model to explain gas behavior, measuring gases, gas laws, ideal gas law, and how gasses work.

- B. Liquids and Solids: condensed states of matter, properties of liquids, nature of solids, and changes of state.

**VI. Chemical Equilibrium (16.1- 16.4) 2 weeks**

- A. The Nature of Solutions
- B. Concentration of Solutions
- C. The Formation of Solutions
- D. Colligative Properties

**SUGGESTED INSTRUCTIONAL STRATEGIES**

- Inquiry lab investigation
- Role plays
- Cooperative learning
- Creating models

**USE OF TECHNOLOGY/TOOLS**

1. Uses of computers with Internet access and integrated software packages.
2. Use of computer based simulation labs.
3. Use of scientific calculator.
4. View video/DVD selections.
5. Use of a SMART Board
6. Use of laboratory equipment.

**ASSESSMENT TECHNIQUES**

1. Students will take free-response performance tests.
2. Students will participate in classroom discussions and demonstrate problem solving on the board, and homework/seatwork assignments.
3. Students will work in cooperative situations and report their results both orally and in written form.
4. Students will exercise critical thinking and organizational skills through inquiry and experimentation based laboratory activities.
5. Use of rubrics to assess laboratory investigations.