

SC0213 JUNIOR HONORS CHEMISTRY

This course is designed for the strong science student who is interested in obtaining a thorough background in the field of chemistry. In addition to learning concepts and laboratory skills, this course will expand the theoretical and technical aspects of chemistry to a level that is both exciting and demanding.

Level: H

Credits: 1.25

Course Length: Full Year

Prerequisite: Students should have a passing grade in Honors Biology and Algebra I.

Course Type: Required

I. Learning Standards/Objectives:

Properties of Matter- Students will learn to:

1. Identify and explain physical properties (such as density, melting point, boiling point, conductivity, and malleability) and chemical properties (such as the ability to form new substances). Distinguish between chemical and physical changes.
2. Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.
3. Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.
4. Determine the correct number of significant figures.
5. Determine percent error from experimental and accepted values.
6. Use appropriate metric/standard international (SI) units of measurement for mass (kg); length (m); and time (s).
7. Use Celsius and Kelvin scales.

Atomic Structure and Nuclear Chemistry, Students will learn to:

8. Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom) and understand how these discoveries lead to the modern theory.
9. Describe Rutherford's "gold foil" experiment that led to the discovery of the nuclear atom. Identify the major components (protons, neutrons, and electrons) of the nuclear atom and explain how they interact.
10. Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.
 - a. Write the electron configurations for the first twenty elements of the periodic table.

- b. Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).
- c. Describe the process of radioactive decay by using nuclear equations and explain the concept of half-life for an isotope, for example, C-14 is a powerful tool in determining the age of objects.
- d. Compare and contrast nuclear fission and nuclear fusion.

Periodicity, Students will learn to:

11. Explain the relationship of an element's position on the periodic table to its atomic number. Identify families (groups) and periods on the periodic table.
12. Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.
13. Relate the position of an element on the periodic table to its electron configuration and compare its reactivity with other elements in the table.
14. Identify trends on the periodic table (ionization energy, electronegativity, and relative size of atoms and ions).

Chemical Bonding, Students will learn to:

15. Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.
16. Draw Lewis dot structures for simple molecules and ionic compounds.
17. Use electronegativity to explain the difference between polar and nonpolar covalent bonds.
18. Use valence-shell electron-pair repulsion theory (VSEPR) to predict the electron geometry (linear, trigonal planar, and tetrahedral) of simple molecules.
19. Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (such as, surface tension, capillary action, density, and boiling point).
20. Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain the polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.

Chemical Reactions and Stoichiometry, Students will learn to:

21. Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions)
22. Classify chemical reactions as synthesis (combination), decomposition, single displacement, double displacement, and combustion.
23. Use the mole concept to determine the number of particles and the molar mass of elements and compounds.
24. Determine percent compositions, empirical formulas, and molecular formulas.
25. Calculate the mass-to-mass stoichiometry for a chemical reaction.
26. Calculate percent yield in a chemical reaction.

States of Matter, Kinetic Molecular Theory, and Thermochemistry, Students will learn to:

27. Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's law), volume and temperature (Charles's law), pressure and temperature (Gay-Lussac's law), and the number of particles in a gas sample (Avogadro's hypothesis).
28. Use the combined gas law to determine changes in pressure, volume, and temperature.
29. Perform calculations using the ideal gas law. Understand the molar volume at 273K and 1 atmosphere (STP).
30. Using the kinetic molecular theory, describe and contrast the properties of gases, liquids, and solids. Explain, at the molecular level, the behavior of matter as it undergoes phase transitions.

Describe the law of conservation of energy. Explain the difference between an endothermic process and an exothermic process.

Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (entropy).

Solutions, Rates of Reaction, and Equilibrium, Students will learn to:

31. Describe the process by which solutes dissolve in solvents.
32. Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.
33. Identify and explain the factors that affect the rate of dissolving, such as, temperature, concentration, surface area, pressure, and mixing.
34. Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).
35. Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, and catalyst).
36. Predict the shift in equilibrium when the system is subjected to a stress (LeChatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).

Acids and Bases and Oxidation-Reduction Reactions, Students will learn to:

37. Define the Arrhenius theory of acids and bases in terms of the presence of hydronium and hydroxide ions in water and the Bronsted-Lowry theory of acids and bases in terms of proton donor and acceptor.
38. Relate hydrogen ion concentrations to the pH scale, and to acidic, basic, and neutral solutions. Compare and contrast the strength of various common acids and bases such as vinegar, baking soda, soap, and citrus juice.
39. Explain how a buffer works.
40. Describe oxidation and reduction reactions and give some every day examples, such as, fuel burning, corrosion. Assign oxidation numbers in a reaction.

II. Learning Experiences:

In this course, students will be granted the opportunity to:

1. Engage in activities that allow them to adapt chemistry to their everyday surroundings.
2. Listen, outline, investigate, appreciate, recognize, learn, observe and demonstrate chemistry in the real world.
3. Participate and work collectively with partners to demonstrate skills learned

III. Course Outline:

1. Matter and Measurements
2. Periodic Table and Atomic Structure
3. Molecular Mass and the Mole
4. Stoichiometry
5. Reactions in aqueous solutions
6. Gases
7. Electronic Structure
8. Covalent Bonding
9. Thermochemistry
10. Rate of reactions
11. Gaseous Equilibrium
12. Aqueous equilibrium
13. Electrochemistry

IV. Course Materials:

The Following lists the texts and resources used. Teachers will implement supplementary materials that they believe will enrich the curriculum and extend student learning.

Text: Chemistry: Zumdahl, sixth edition, 2003

Lab Manual: Experimental Chemistry: James F. Hall, sixth edition, 2003.

Current periodicals and literature in relation to chemistry

Computer:

- a. Internet
- b. Microsoft Word
- c. Microsoft Excel

V. Formative Assessments:

1. Vocabulary Exercises, Chapter Quizzes
2. Unit Worksheets
3. Collins Type I writings for each unit
4. Text Book Questions for each unit
5. Collins Type IV writing - Research Paper
6. Collins Type II writings for current Chemistry periodicals
7. In - Class Unit Tests
8. Take Home Unit Tests
9. Collins Type III writing - Laboratory Reports

VI. Summative Assessments:

1. Mid – Term Examination (January of Junior year)
2. Final Examination (June of Junior year)