Masconomet Regional High School Curriculum Guide

Course Title: Chemistry

Course Number: 3321

Department: Science

Grade Level and Phase 10, 11 or 12

Course Level: College Prep

Length of Course: One year

Course Description:

Students learn about the properties of matter and how these properties help to organize elements on the periodic table. Students develop a better understanding of the structure of the atom. Students develop an understanding of chemical reactions, including the involvement of energy and sub-atomic particles, to better understand the nature of chemical changes. Students learn about chemical reactions that occur around us everyday as they learn about chemical reactions such as oxidation-reduction, combustion, and decomposition. Students also gain a deeper understanding of acids and bases, rates of reactions, and factors that affect those rates. From calculating stoichiometry problems and molar concentrations, students learn about proportionality and strengthen their mathematical skills

Objectives:

- *Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.*
- *Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.*
- *Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.*
- *Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus), and Bohr (planetary model of atom), and understand how each discovery leads to modern theory.*
- *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.*
- *Interpret and apply the laws of conservation of mass, constant composition (definite proportions), and multiple proportions.*
- *Write the electron configurations for the first twenty elements of the periodic table.*
- *Identify the three main types of radioactive decay (alpha, beta, and gamma) and compare their properties (composition, mass, charge, and penetrating power).*
- *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).*
- *Compare and contrast nuclear fission and nuclear fusion.*
- *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.*
- *Use the periodic table to identify the three classes of elements: metals, nonmetals, and metalloids.*
- *Relate the position of an element on the periodic table to its electron configuration and compare its reactivity to the reactivity of other elements in the table.*
- *Identify trends on the periodic table (ionization energy, electronegativity, and relative sizes of atoms and ions).*

- *Explain how atoms combine to form compounds through both ionic and covalent bonding. Predict chemical formulas based on the number of valence electrons.*
- *Draw Lewis dot structures for simple molecules and ionic compounds.*
- *Use electronegativity to explain the difference between polar and nonpolar covalent bonds.*
- *Use valence-shell electron-pair repulsion theory (VSEPR) to predict the molecular geometry (linear, trigonal planar, and tetrahedral) of simple molecules.*
- *Identify how hydrogen bonding in water affects a variety of physical, chemical, and biological phenomena (e.g., surface tension, capillary action, density, boiling point).*
- *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.*
- *Balance chemical equations by applying the laws of conservation of mass and constant composition (definite proportions).*
- *Classify chemical reactions as synthesis (combination), decomposition, single displacement (replacement), double displacement, and combustion.*
- *Use the mole concept to determine number of particles and molar mass for elements and compounds.*
- *Determine percent compositions, empirical formulas, and molecular formulas.*
- *Calculate the mass-to-mass stoichiometry for a chemical reaction.*
- *Calculate percent yield in a chemical reaction.*
- *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). Use the combined gas law to determine changes in pressure, volume, and temperature.*
- *Perform calculations using the ideal gas law. Understand the molar volume at 273 K and 1 atmosphere (STP).*
- *Describe the process by which solutes dissolve in solvents.*
- *Calculate concentration in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.*
- *Identify and explain the factors that affect the rate of dissolving (e.g., temperature, concentration, surface area, pressure, mixing).*
- *Compare and contrast qualitatively the properties of solutions and pure solvents (colligative properties such as boiling point and freezing point).*
- *Identify the factors that affect the rate of a chemical reaction (temperature, mixing, concentration, particle size, surface area, catalyst).*
- *Predict the shift in equilibrium when a system is subjected to a stress (LeChatelier's principle) and identify the factors that can cause a shift in equilibrium (concentration, pressure, volume, temperature).*
- *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 donors and acceptors.*
- *Relate hydrogen ion concentrations to the pH scale and to acidic, basic, and neutral solutions. Compare and contrast the strengths of various common acids and bases (e.g., vinegar, baking soda, soap, citrus juice).*
- *Explain how a buffer works.*
- *Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction*

These objectives support the following **Academic Expectations from the Masconomet High School Mission Statement**:

1. Students will communicate effectively.

2. Students will use problem solving skills.
3. Students will use a variety of technological and informational resources to gather, analyze, and synthesize facts, results, ideas and concepts.
4. Students will participate in decision making and team building activities
5. Students will demonstrate and practice an understanding of the rights and responsibilities of citizenship.

Materials and Activities:

Text: Wilbraham, c. Anthony, Staley, D. Denis, Matta, S. Michael, Waterman, L. Edward,2005. *Chemistry*. Prentice Hall.

a. Students will complete problem sets assigned at the beginning of a unit. The problem sets will be based on the lectures, labs and text reading for each unit of study.
b. Students will demonstrate basic laboratory skills and safety protocols.
c. Students will record data and observations on lab sheets and communicate their findings in informal and formal lab reports.
d. Students will complete reading notes based on assigned test book readings before the unit assessment.
e. Students will complete tests or projects due at the end of each unit of study.

Scope and Sequence:

Unit 1Matter
Unit 2 Measurement
Unit 3 Atomic Theory
Unit 4 Bonding-Ionic Covalent
Unit 5 Naming Ionic and Molecular Compounds
Unit 6 The mole
Unit 7 Chemical Reactions
Unit 8 Stoichiometry
Unit 9 Quantum mechanics, periodic trends and bonding theories
Unit 10 States of Matter and Gas laws
Unit 11 Solutions
Unit 12Thermochemistry
Unit 13 Reaction Rates and Equilibrium
Unit 14 Acids and Bases
Unit 15 Oxidation-Reduction Reactions

Assessment:

Upon successful completion of this course students will be able to:

A. Explain and give examples of these foundational themes:
i. Chemistry is the study of matter and the changes it undergoes
ii. Chemical reactions occur in predictable patterns.
iii. Particles of every substance obey the Kinetic Theory of Matter.
iv. Fundamental gas laws explain changing conditions and static conditions for a sample of gas.
v. The mole is central to the quantitative analysis of matter and reactions.
vi. Chemical bonds occur in predictable patterns

B. Demonstrate knowledge and understanding of the topics listed in the course description through successful homework assignments, laboratory exercises and reports, and quizzes, tests and examinations.

C. Demonstrate basic laboratory skills through the contents of their laboratory reports.

D. Name and identify common ionic and organic substances.

E. Demonstrate increased appreciation in the everyday chemistry that takes place around them through increased involvement in recycling, hazardous waste handling, climate change, water treatment, toxic dumps and other environmental concerns