

Students will be able to: PROPERTIES OF MATTER

- 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 states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.

Students will be able to: ATOMIC STRUCTURE

- Recognize discoveries from Dalton (atomic theory), Thomson (the electron), Rutherford (the nucleus) and Bohr (planetary model of the 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 first twenty elements of the periodic table.

Students will be able to: NUCLEAR CHEMISTRY

- 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.
- Compare and contrast nuclear fission and nuclear fusion.

Students will be able to: PERIODICITY

- 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)

Students will be able to: CHEMICAL BONDING

- 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 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. (*surface tension, capillary action, density, boiling point*)
- Name and write the chemical formulas for simple ionic and molecular compounds, including those that contain polyatomic ions: ammonium, carbonate, hydroxide, nitrate, phosphate, and sulfate.

Students will be able to: CHEMICAL REACTIONS

- Balance chemical equations by applying the law of conservation of mass and constant composition (*definite proportions*).
- Classify chemical reactions as synthesis (*combination*), decomposition, single displacement (*replacement*), double displacement, and combustion.

Students will be able to: MOLES AND STOICHIOMETRY

- 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-mass stoichiometry for a chemical reaction.
- Calculate the percentage yield in a chemical reaction.

Students will be able to: STATES OF MATTER AND KINETIC THEORY

- Using the kinetic molecular theory, explain the behavior of gases and the relationship between pressure and volume (Boyle's Law), volume and temperature (Charles' 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).
- 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.
- Recognize that there is a natural tendency for systems to move in a direction of disorder or randomness (*entropy*).

Students will be able to: THERMOCHEMISTRY

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

Students will be able to:

SOLUTIONS

- Describe the process by which solutes dissolve in solvents.
- Calculate concentrations in terms of molarity. Use molarity to perform solution dilution and solution stoichiometry.
- Identify and explain the factors that affect the rate of dissolving. (*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*)

Students will be able to:

REACTION RATES AND EQUILIBRIUM

- 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 (*LeChâtelier's Principle*) and identify the factors that can cause a shift in equilibrium. (*concentration, pressure, volume, temperature*)

Students will be able to:

ACIDS AND BASES

- Define Arrhenius' theory of acids and bases in terms of the presence of hydronium and hydroxide ions, 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. (*vinegar, baking soda, soap, citrus juice*)
- Explain how a buffer works.

Students will be able to:

OXIDATION-REDUCTION REACTIONS

- Describe oxidation and reduction reactions and give some everyday examples, such as fuel burning and corrosion. Assign oxidation numbers in a reaction.