Teaching Unit: ***Matter and Change***

Sub Topic: ***Properties of Matter***

Essential Understandings

Atomic theory and atomic structure

1. Evidence for the atomic theory
2. Atomic masses; determination by chemical and physical means
3. Atomic number and mass number; isotopes
4. Electron energy levels: atomic spectra, quantum numbers, atomic orbitals
5. Periodic relationships including, for example, atomic radii, ionization energies, electron affinities, oxidation states

Knowledge and Skills

The materials in our world exhibit a striking and seemingly infinite variety of properties, including different colors, textures, solubilities, and chemical reactivities. When we see that diamonds are transparent and hard, table salt is brittle and dissolves in water, gold conducts electricity and can be hammered into thin sheets, and nitroglycerin is explosive, we are making observations in the macroscopic world, the world of our everyday senses. In chemistry we seek to understand and explain these properties in the submicroscopic world, the world of atoms and molecules.

The diversity of chemical behavior results from only about 100 different elements and, thus, only 100 different kinds of atoms. In a sense, the atoms are like the 26 letters of the alphabet that join together in different combinations to form the immense number of words in our language. But how do the atoms combine with each other? What rules govern the ways in which they can combine? How do the properties of a substance relate to the kinds of atoms it contains? Indeed, what is an atom like, and what makes the atoms of one element different from those of another?

The microscopic view of matter forms the basis for understanding why elements and compounds react in the ways they do and why they exhibit specific physical and chemical properties. In this chapter we begin to explore the fascinating world of atoms and molecules. We will examine the basic structure of the atom and briefly discuss the formation of molecules and ions. We will also introduce the systematic procedures used to name compounds.

Teaching Unit: ***Scientific Measurement*** Sub Topic: ***Dimensional Analysis***

Essential Understandings

Knowledge and Skills

* Be familiar with the units of the metric system of measurement and the temperature scales.
* Be able to convert measurements, especially within the metric system, by using dimensional analysis.
* Determine the number of significant figures in a measurement and be able to express the results of a calculation with the proper number of significant figures.

Teaching Unit: ***Atomic Structure*** Sub Topic: ***Defining the Atom***

Essential Understandings

Knowledge and Skills

* Distinguish between physical and chemical properties and changes.
* Understand the difference between elements, compounds, and mixtures.
* Distinguish between protons, neutrons, and electrons, and be able to describe the composition of an atom of any particular element in terms of these subatomic particles.
* Describe the basic anatomy of an atom and the ratio of the diameter of the nucleus to that of the atom.
* Know the difference between an atom, an ion, and a molecule.
* Have a basic knowledge of the periodic table, which includes being able to predict whether an element is a metal or a nonmetal, and what will be the probable charge of its ion.
* Distinguish between empirical, molecular, and structural formulas.

Teaching Unit: ***Electrons in Atoms***

Sub Topic: ***Quantum Mechanical Model***

Essential Understandings

Knowledge and Skills

Models of the Atom - Rutherford, Bohr, Quantum Mechanical Model

Quantum Mechanics description if subatomic particles and wave theory

Electron arrangement in atoms

The relationship between Dalton's Atomic Theory and the laws of conservation of mass, definite proportions, and multiple proportions

Summarize Rutherford's experiment

The properties of protons, neutrons, and electrons - Definition of an atom

Isotopes

Atomic number and mass number

The identity of a nuclide, determine its number of protons, electrons, and neutrons

The dual wave-particle nature of light

DeBroglie's role in the development of the quantum model of the atom

Explain how the Heisenberg uncertainty principle the Schroedinger wave equation led to the idea of atomic orbitals

The four quantum numbers and describe their significance 21. Relate the number of sublevels and orbitals to the main energy level

The total number of electrons needed to fully occupy each main energy level

Aufbau Principle, Pauli Exclusion principle, Hund's Rule

Wavelength and frequency of light inversely proportional

Teaching Unit: ***The Periodic Table***

Sub Topic: ***Electron Configurations***

Essential Understandings

Explain the roles of Mendeleev and Moseley in the development of the periodic table

Describe the modern periodic table

Explain how the periodic law can be used to predict the physical and chemical properties of elements

Describe how the elements belonging to a group of the periodic table are interrelated in terms of atomic number

Describe the relationship between the electrons in sublevels and the length of each period of the periodic chart

Locate and name the four blocks of the periodic table

Discuss the relationship between group configurations and numbers

Define atomic and ionic radii, ionization energy, electron affinity, and electronegativity

Compare periodic trends of atomic and ionic radii, ionization energy, electron affinity, and electronegativity

Define valence electrons and state how many are present in atoms of each main group element

Compare the atomic and ionic radii, ionization energy, electron affinity, and electronegativity of the d-block elements and the main group elements

Knowledge and Skills

Teaching Unit: ***Ionic and Metallic Bonding***

Sub Topic: ***Ions - Monatomic and Polyatomic***

Essential Understandings

Types of chemical bonding

Ionic vs. covalent bonding

Formation of cations and anions

Valence Electrons of Metallic Atoms

Patterns of Metallic ion arrangement

Knowledge and Skills

Teaching Unit: ***Covalent Bonding***

Sub Topic: ***Bonding Theories in Molecules***

Essential Understandings	Knowledge and Skills
Formation of covalent bonds	
Characteristics of the covalent bond	
The octet rule	
Molecular polarity	
Dipole-dipole forces	
Van Der Walls Dispersion forces	
Hydrogen bonding	
Lewis structures: single, double, and triple covalent bonds	
Pure, polar, and non-polar covalent bonds	
Resonance structures	
Prediction of bond types based on electronegativity differences	
Comparison of ionic and covalent bonds	
Writing ionic compounds 12. Metallic bonds	
VESPR theory of molecular shape 14. Hybridization	

Teaching Unit: ***Chemical Names and Formulas***

Sub Topic: ***Laws for Naming Formulas***

Essential Understandings

Naming Anions and Cations

Writing formulas for ionic compounds

Writing formulas for covalent compounds

Naming and writing formulas for acids and bases

Common laws governing formulas and names

Knowledge and Skills

Teaching Unit: ***Chemical Quantities***

Sub Topic: ***The Mole, Quantitative Relationships***

Essential Understandings

Knowledge and Skills

Molar mass: definition and calculations

Percent Composition:definition and calculations

The law of multiple proportions

The mole concept: definition and calculations

Avogadro's number: definition and calculations

Empirical Formulas: definition and calculations

Empirical Weight: definition and calculations

Molecular Formulas: definition and calculations

Molecular Weight: definition and calculations

Indicators of chemical reactions

Characteristics of chemical equations and reactions

Synthesis reactions: recognition, completion, and balancing

Decomposition reactions: recognition, completion, and balancing

Single replacement reactions: recognition, completion, and balancing

Double replacement reactions: recognition, completion, and balancing

Combustion reactions: recognition, completion, and balancing

Stoichiometry: stepwise method of solution

Stoichiometry: calculations

Limiting reactants: definition and calculations

Percent yield: definition and calculations

Teaching Unit: ***Chemical Reactions*** Sub Topic: ***Reaction Types and Dynamics***

Essential Understandings

Be able to balance chemical equations.

Write balanced chemical equations from word descriptions.

Predict the products of reactions based on the types presented, including combustion of compounds of C, H, and O.

Complete and balance common chemical reactions.

Knowledge and Skills

Teaching Unit: ***Stoichiometry*** Sub Topic: ***Reaction Quantities and Predictions***

Essential Understandings

Knowledge and Skills

Teaching Unit: ***States of Matter*** Sub Topic: ***Phase Change Dynamics***

Essential Understandings

Distinguish between the physical and chemical properties of matter

Classify changes of matter as physical or chemical

Explain the gas, liquid, and solid states of matter in terms of particles

Distinguish between a mixture and a pure substance

Knowledge and Skills

Teaching Unit: ***Behavior of Gases***

Sub Topic: ***Gas Laws and Properties***

Essential Understandings

Kinetic molecular theory of gases

Properties of gases

Deviations of real gases from ideal gas behavior

Pressure - Units of pressure - Standard temperature and pressure

Boyle's Law: theory and calculations

The Kelvin temperature scale

Charles' Law: theory and calculations

Gay-Lussac's Law: theory and calculations

The combined law: theory and calculations

Dalton's Law of Partial Pressure: theory and calculations

Gases collected by water displacement: theory and calculations

The law of combining volumes

Avogadro's Law 16. Molar Volume: theory and calculations

The ideal gas law: theory and calculations

The ideal gas law constant

Molar mass or density determinations using the ideal gas law

Stoichiometry of gases

Volume-volume calculations - Volume-mass calculations - Mass-volume calculations

Graham's law of effusion: theory and calculations

Application of Graham's law of effusion

Knowledge and Skills

Teaching Unit: ***Water and Aqueous Systems*** Sub Topic: ***Water and it's Properties***

Essential Understandings

Knowledge and Skills

Teaching Unit: ***Solutions*** Sub Topic: ***Calculations and Colligative***

Essential Understandings

Knowledge and Skills

Solution Types

Conditions affecting solutions

Expressing concentration as molarity, molality, percent by mass, percent by volume

Colligative properties and calculations

Multi phase solutions

Teaching Unit: ***Thermochemistry*** Sub Topic: ***Calculating Heats of Reaction***

Essential Understandings

Knowledge and Skills

Distinguish between endothermic and exothermic reactions using the energy term in a reaction, H value, potential energy diagram or experimental data.

Concept of specific heat

Enthalpy changes for a reaction, calculating the heat of reaction by application of Hess's Law of Heat Summation

The size and direction of enthalpy and entropy changes to determine if a reaction is spontaneous

Entropy and Free Energy changes

Calorimetry

Calculate of the heat involved in a phase or temperature change for a given sample of matter

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Teaching Unit: ***Reaction Rates and Equilibrium***

Sub Topic: ***Equilibrium Constant and Entropy***

Essential Understandings

Knowledge and Skills

Define chemical equilibrium.

Write equilibrium constant expressions

Use values of K to predict the extent of a reaction.

Apply LeChâtelier's principle to systems at equilibrium.

Teaching Unit: ***Acids, Bases, & Salts***

Sub Topic: ***Calculating Acid & Base Strengths***

Essential Understandings

Knowledge and Skills

Draw the structure of the hydronium ion

Distinguish between strong and weak electrolytes.

List the five general properties of aqueous acids and bases.

Name common binary and ternary acids given their formulas.

Define acid and base according to Arrhenius's theory of ionization.

Explain the difference between strong and weak acids and bases.

Define and recognize Bronsted-Lowry acids and bases.

Define a Lewis acid and base.

Describe a conjugate acid and base system.

Describe and recognize an amphoteric compound.

Explain the process of neutralization.

Describe the self-ionization of water.

Define pH - Explain and use the pH scale

Calculate pH given the hydronium ion or hydroxide ion concentration.

Calculate the hydronium ion and hydroxide ion concentration given pH.

Describe how an acid-base indicator functions. - Describe what an acid-base titration is.

Calculate the molarity of a solution from titration data.

Explain strong acid – strong base titration systems.
Explain strong acid – weak base titration systems
Explain weak acid – strong base titration systems
Explain weak acid – weak base titration systems

Describe oxidation and reduction reactions and give common examples

Assign oxidation numbers in chemical reactions.

Teaching Unit: ***Oxidation -Reduction Reactions*** Sub Topic: ***Balancing Redox Reactions***

Essential Understandings

Oxidation and Reduction reactions

A bonded atom's oxidation number and the charge it would have if the bonding electrons were absorbed by the more electronegative element

Redox equations and oxidation numbers

Balancing equations with separate half reactions and comparison of electrons gained with electrons lost

Knowledge and Skills

Teaching Unit: ***Electrochemistry*** Sub Topic: ***Electrolytic Cell Functions***

Essential Understandings

Electrochemical Cells and the role of redox reactions

Half cells and cell potential

Determination of Standard Reduction Potential

Spontaneous/ non spontaneous reactions

Voltaic and electrolytic cells

Chemistry of electroplating

Knowledge and Skills

Teaching Unit: ***Hydrocarbon Compounds*** Sub Topic: ***Functional Groups, Reactions***

Essential Understandings

* Be able to write the correct name of an inorganic compound from its formula and vice versa.
* Define hydrocarbon, alkane, and alcohol and be able to write the name from the formula and vice versa for simple alkanes and alcohols.

Knowledge and Skills

Teaching Unit: ***Nuclear Chemistry*** Sub Topic: ***Fission and Fusion***

Essential Understandings

Knowledge and Skills

Teaching Unit: ***Honors Chemistry (AP)***

Essential Understandings

AP Chemistry reflects the average university expectations for the first year of college chemistry.

Students will understand the outcomes expected for a first year student in college chemistry.

1. Students are expected develop an understanding of the content in a typical first year college chemistry course. In addition to a review of the descriptive content of the topics covered, students will focus on the mathematical formulation of guiding principles as they relate to the topics studied. Quantitative analysis of topics require that students to solve multi step math problems. This will foster the development of analytical thinking.

2. Students will develop experimental skills and competencies. Students will become proficient in employing the scientific method to solve problems in the laboratory setting. These skills include; defining a problem, designing a controlled experiment, gathering and organizing data in spread sheets and graphically, interpreting data to draw conclusions, and error analysis. Experimentation not only reinforces content concepts covered in class but also fosters the development of problem solving and critical thinking skills. In addition, students will become competent using laboratory equipment safely including computer interface sensors for data collection in real time.

3. Students will develop teamwork skills. Through group problem solving sessions, laboratory teams, round table discussions, peer presentations and peer analysis of student work the students will come to see that learning is not a solitary process but the result of many minds working together to stimulate the growth of understanding of a body of knowledge in each mind. The teacher serves as a coach in this process.

Sub Topic:

Knowledge and Skills

Semester I
Chapter 1- Introduction, Measurement and Dimensional Analysis Dimensional analysis, uncertainty, significant digits, classification and properties of matter

Chapter 2 -Basic Atomic Structure and Chemical Nomenclature
Historical review of discovery of atomic structure, modern atomic structure, chemical nomenclature both inorganic and organic

Chapter 4 -Types of Chemical Reactions
Types of chemical reactions, balancing chemical equations, ionic and net ionic equations, oxidation numbers, use of Activity Series and solubility rules to predict if a reaction will occur

Chapter 3 –Stoichiometry
Molar conversions, calculation of empirical and molecular formula; Stoichiometric analysis of balanced equations, limiting reactants, theoretical and percent yield; solution concentration calculations involving molarity, percent mass and density of solutions

Chapter 5 -Introduction to Thermochemistry

Laws of Thermodynamics, Enthalpies of Reaction, Calorimetry, Enthalpies of Formation' Hess's Law calculations

Student Conducted Laboratories

1. Laboratory Orientation and Safety (week one, double lab period)
   Goals: Become familiar with safety equipment in the laboratory, location and safe use of lab equipment, interpreting MSDA sheets
   Laboratory Quiz

2. Graphical Analysis of Mass and Volume Relationships (week one double lab period)

   Goals: Measure mass and volume to significant digits, analyze a graphic display of data for regularity between variables and explain that regularity with an equation, distinguish between extensive and intensive properties, perform calculations to significant digits, identify unknowns by density, calculate and analyze percent error
   Informal Lab Report

3. Separation of a Mystery Mixture (week two, double lab period)
   Goals: Carry out fractional distillation and paper chromatography, collect data with computer interface temperature sensors, analyze computer-generated graphs of distillation to determine boiling points, identify unknown components of a mixture and calculate percent mass of each component

   Formal Lab Report
4. Comparison of Complete and Incomplete Combustion (week three, double lab period)

   Goals: Safe use of laboratory Bunsen burner, understanding of and ability to represent Complete and Incomplete Combustion with balanced chemical equations