

Course Overview



Chemistry Curriculum

Scranton School District

Scranton, PA

Date

Course Name: Chemistry	Grade: 11 or 12
Prerequisites: Biology	
Course Description:	

Course Overview

Phenomenon / Topic	Standards / Assessment Anchors
Behaviors of the elements and the Periodic Table	3.2.9-12.A Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
Qualitative analysis of unknowns	<p>3.2.9-12.B Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p> <p>3.2.9-12.N Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</p> <p>3.2.9-12.V Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model and that for some situations one model is more useful than the other.</p> <p>3.2.9-12.W Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.</p>
Gravimetric analysis of compounds	3.2.9-12.C Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Types of chemical reactions	3.2.9-12.C Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
Thermodynamics	<p>3.2.9-12.D Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p> <p>3.2.9-12.O Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.</p> <p>3.2.9-12.P Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).</p> <p>3.2.9-12.R Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).</p>
Stoichiometry	<p>3.2.9-12.C Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</p> <p>3.2.9-12.G Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</p>
Dynamic Equilibrium	3.2.9-12.F Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
Reaction Rates	3.2.9-12.E Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
Acid-base chemistry	3.2.9-12.F Refine the design of a chemical system by specifying a change in conditions

	that would produce increased amounts of products at equilibrium.
Nuclear chemistry	3.2.9-12.H Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

Quarter 1 Details

Quarter 1
Detailed Breakdown By Topic

Phenomenon / Topic	Essential Knowledge & Skills	Vocabulary	Resources & Activities
<p>Forensic science:</p> <p>What is the mystery powder?</p> <p>Behavior and properties of substances.</p>	<p>Safety and lab techniques</p> <p>Using analytical techniques, students can determine what unknown substances are based on a predetermined list of unknowns.</p> <p>Substances with different bonds and geometries exhibit vastly different behavior that can be predicted.</p> <p>Demonstrate safe and accurate use of lab equipment, following appropriate lab procedures and protocols.</p> <p>Use qualitative and quantitative methods to analyze and identify unknown substances based on density, solubility, pH, and reactivity.</p> <p>Compare physical and chemical properties of substances to determine bond type (ionic, covalent, metallic) and molecular geometry.</p> <p>Predict properties of substances using intermolecular forces, polarity, and bonding patterns.</p> <p>Analyze experimental data to draw evidence-based conclusions regarding unknown compounds.</p> <p>Apply scientific reasoning and critical thinking to explain how bonding and structure influence observable macroscopic properties.</p> <p>Honors will add in complex molecular structures and detailed intermolecular forces.</p>	<p>Density</p> <p>Polarity</p> <p>Acid/Base</p> <p>Intermolecular forces</p> <p>Physical</p> <p>Polarity</p> <p>Specific heat</p>	<p>Flinn scientific Qualitative analysis of 11 unknowns Flinn Scientific Item #: AP4855</p> <p>Density of unknowns lab* Flinn Scientific Item #: AP6058</p> <p>Properties of ionic vs. covalent compounds lab Flinn Scientific Item #: AP7691</p> <p>Specific Heat lab Flinn Scientific Item #: AP7566</p>
<p>Why do the elements produce light of varying colors?</p> <p>How does a neon light work?</p>	<p>Based on the Bohr model and Quantum model of the atom, determine how electron configuration can predict the color of light emitted.</p> <p>Develop and Using Models: Modify the periodic table to add important information concerning electron configuration.</p> <p>Explain the relationship between energy, electron movement, and light emission using the Bohr and quantum models of the atom.</p> <p>Describe how electrons absorb and release energy as they transition between energy</p>	<p>Ionization energy</p> <p>Periodic trends</p> <p>Orbital diagrams</p> <p>Electron configuration</p> <p>Orbital sublevels</p> <p>Valence magnetism</p>	<p>Flame tests lab: Various ionic salts Bunsen burners Spectra tubes Plasma ball Flinn Scientific Item #: AP1716</p>

	<p>levels.</p> <p>Use flame tests and spectroscopy to determine the identity of elements based on their emission spectra.</p> <p>Interpret electron configurations, orbital diagrams, and valence electron patterns to predict reactivity and spectral output.</p> <p>Develop and refine models (e.g., atomic models, periodic table annotations) to represent subatomic interactions and atomic structure.</p> <p>Analyze and interpret patterns in spectral data to explain how electron behavior differs across elements.</p> <p>Honors will add in electron configuration for atoms larger than 30. Coulomb's Law will also be examined</p>			<p>F E - F V C</p>
<p>Why do elements on the periodic table have properties that change in predictable ways?</p>	<p>Students will be able to compare and contrast the properties of elements based on group and column</p> <p>Use the periodic table as a tool to predict and explain patterns in properties such as ionization energy, atomic radius, and electronegativity.</p> <p>Identify trends across periods and groups and relate these to the arrangement of electrons and energy levels.</p> <p>Explain the Law of Periodicity and how it reflects recurring patterns in chemical behavior.</p> <p>Compare chemical and physical properties of representative groups (e.g., alkali metals, halogens, noble gases).</p> <p>Construct models and data charts to visualize periodic trends and make predictions about unknown elements.</p> <p>Analyze historical models of the periodic table (e.g., Mendeleev's) and revise them to incorporate modern electron configuration insights.</p> <p>Honors will add in an experimental design of a rust/reaction inhibitor to determine its effectiveness.</p>	<p>Ionization energy Electronegativity Atomic radius Law of periodicity octet</p>	<p>Mendeleev Lab Flinn Scientific Item #: AP6289</p> <p>3D periodic table activity</p> <p>Determine the radius of an atom activity</p>	<p>F a i v g N t - C U S I F F F - F V C</p>

Quarter 2 Details

Quarter 2
Detailed Breakdown By Topic

Phenomenon / Topic	Essential Knowledge & Skills	Vocabulary	Resources & Activities	
<p>What is the formula for this compound? What is its name?</p>	<p>Students perform various experiments to produce products and determine the empirical formulas of these products.</p> <p>Use observational and experimental data to determine the empirical and molecular formulas of unknown substances.</p> <p>Apply the law of conservation of mass and the mole concept to determine molar ratios in compounds.</p> <p>Use IUPAC rules to name and write formulas for ionic and molecular compounds.</p> <p>Draw Lewis structures to represent covalent bonding and molecular geometry, applying the octet rule.</p> <p>Relate bonding types (ionic, covalent, metallic) to properties such as conductivity, solubility, and melting point.</p> <p>Use percent composition and hydrates to determine the formula of a compound.</p> <p>Honors will consider percent composition</p>	<p>Reactants Products Empirical mole Nomenclature Lewis structure Octet</p>	<p>Nomenclature</p> <p>Analysis of various Hydrates lab</p> <p>Calculate and determine the empirical formula for a hydrated crystal. Flinn Scientific Item #: AP7032</p> <p>Perform a chemical reaction to determine the formula of a compound.</p>	<p>For ass info hav wor</p> <p>Ma tea Tim Gra Ass Sho Ind</p> <p>Pro Des Des Per Vid Cre</p>
<p>What are the different types of chemical reactions seen in everyday life?</p>	<p>Students will be able to distinguish different types of chemical reactions based on the changes that reactants undergo.</p> <p>Identify and classify chemical reactions: synthesis, decomposition, single replacement, double replacement, and combustion.</p> <p>Predict products of chemical reactions based on reactant types and reactivity series.</p> <p>Explain chemical changes by tracking the rearrangement of atoms and conservation of mass.</p> <p>Use evidence (e.g., color change, gas formation, precipitate) to differentiate physical and chemical changes.</p> <p>Analyze how redox reactions are involved in corrosion, combustion, and biological processes.</p> <p>Design and interpret data from precipitation and gas formation reactions.</p> <p>Honors will look at caloric content</p>	<p>Synthesis decomposition single displacement (replacement) double displacement oxidation and reduction precipitate</p>	<p>Magnesium oxide synthesis lab</p> <p>Silver nitrate and hydrochloric acid precipitate lab</p> <p>Precipitation reactions Flinn Scientific Item #: AP4862</p>	<p>For ass info hav wor</p> <p>Ma tea Tim Gra Ass Sho Ind</p> <p>Pro Des Des Per Vid Cre</p>
<p>Chemical/Physical reaction enthalpy:</p>	<p>Students will perform experiments on physical and chemical reactions and the energy and heat transfers associated with both.</p>	<p>Phase changes Bond energies</p>	<p>Experiments measuring melting point, boiling point.</p>	<p>For ass info</p>

<p>How does an ice pack / hot pack produce energy?</p>	<p>Differentiate between physical and chemical changes in terms of energy transfer and molecular interactions.</p> <p>Use calorimetry data to calculate heat absorbed or released in endothermic and exothermic processes.</p> <p>Explain specific heat capacity and its role in determining temperature changes in substances.</p> <p>Analyze phase changes and bond energy changes to determine total enthalpy change.</p> <p>Apply the principles of energy conservation and enthalpy to real-life engineering challenges such as designing a hand warmer or cold pack.</p> <p>Use experimental data and calculations to evaluate the efficiency of thermal systems.</p> <p>Honors will add calculations for enthalpy and Gibbs free energy</p>	<p>Equilibrium Calorimetry Endothermic Exothermic Specific heat capacity</p>	<p>Designing a hand warmer Flinn Scientific AP#7654</p> <p>Heat of fusion of a fatty acid (lauric acid)</p> <p>Heat of reaction: calcium oxide and water</p>	<p>hav wor Ma tea Tim Gra Ass Sho Ind Pro Des Des Per Vid Cre</p>
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Quarter 3 Details

Quarter 3
Detailed Breakdown By Topic

Phenomenon / Topic	Essential Knowledge & Skills	Vocabulary	Resources & Activities
<p>Stoichiometry:</p> <p>How much product is produced for different chemical reactions?</p>	<p>Using mathematics and computation to determine theoretical and percent yield for a variety of chemical reactions in the solid, liquid and gas phase.</p> <p>Use the Law of Conservation of Mass to balance chemical equations and relate moles of reactants to products.</p> <p>Apply molar mass and mole-to-mole ratios to convert between grams, moles, particles, and volume (for gases at STP).</p> <p>Calculate theoretical yield and percent yield using experimental and calculated data.</p> <p>Justify stoichiometric calculations with dimensional analysis and proportional reasoning.</p> <p>Predict and analyze reaction outcomes by comparing experimental results with theoretical predictions.</p> <p>Interpret stoichiometric ratios using particle diagrams and balanced chemical equations.</p> <p>Honors will add ideal gas law</p>	<p>Law of conservation of mass Molar mass Balancing equations</p>	<p>Copper and silver nitrate or a comparable experiment to determine the amount of a product produced using stoichiometry Flinn Scientific Item #: AP6363</p>
<p>What determines the amount of product that is created by a chemical reaction?</p>	<p>Using mathematics to predict the outcome of chemical reactions and which reactant is limiting and in excess.</p> <p>Identify and analyze limiting and excess reactants using mole ratios and chemical reaction data.</p> <p>Determine theoretical yield and percent yield in reactions with limiting reactants.</p> <p>Relate molarity and solution concentration to the amount of reactants and products in a chemical reaction. Design investigations to explore how the amount of a reactant affects the yield of a product.</p> <p>Evaluate experimental procedures for accuracy in predicting yields and identifying limiting reagents.</p> <p>Apply stoichiometry in real-world contexts such as pharmaceuticals, energy systems, or manufacturing.</p> <p>Honors will add in electrochemistry reactions</p>	<p>Limiting/excess reactants Law of conservation of mass Theoretical yield Molarity</p>	<p>Target Stoichiometry lab Flinn Item #: AP8483</p> <p>Limiting reagent lab Flinn Item #: AP4678</p>
<p>Dynamic equilibrium:</p> <p>How do variable changes in chemical reactions affect the products</p>	<p>Students will examine specific reactions where the variables can be manipulated to produce different amounts of products.</p> <p>Explain the concept of chemical equilibrium as a dynamic process where forward and reverse reactions occur at equal rates.</p>	<p>Phase changes Le Chatelier's principle Temperature Pressure concentration</p>	<p>Several demonstrations: Cobalt chloride Ferric thiocyanate Starch iodine reaction Copper ammonia complex Application of Le Chatelier's Principle</p>

<p>and reactants of chemical reactions?</p>	<p>Use Le Chatelier's Principle to predict how changes in concentration, temperature, and pressure affect the position of equilibrium.</p> <p>Conduct experiments and analyze visual indicators of shifts in equilibrium systems (e.g., color change in reversible reactions).</p> <p>Develop and interpret models to demonstrate how equilibrium responds to environmental changes.</p> <p>Evaluate how systems adjust to restore equilibrium and apply this understanding to real-world systems like atmospheric balance, industrial reactions, or physiological processes.</p> <p>Use quantitative reasoning and graphical data to explain equilibrium shifts.</p> <p>Honors will examine gas stoichiometry and solution stoichiometry</p>		<p>Flinn Scientific Item #: AP7659</p>	<p>t - C U S I P P P - P V C</p>
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Quarter 4 Details

Quarter 4
Detailed Breakdown By Topic

Phenomenon / Topic	Essential Knowledge & Skills	Vocabulary	Resources & Activities
<p>What speeds up or slows down a chemical reaction?</p>	<p>Students will refine the design of a chemical system by changing conditions to produce different results.</p> <p>Explain the Collision Theory and how it relates to the rate of chemical reactions.</p> <p>Analyze the effect of temperature, surface area, concentration, and catalysts on reaction rates.</p> <p>Design and conduct investigations to collect rate data and graph reaction kinetics.</p> <p>Interpret rate vs. time graphs and use evidence to justify how different variables influence the speed of reactions.</p> <p>Evaluate chemical system designs and propose modifications to optimize reaction conditions (e.g., industrial synthesis or food preservation).</p> <p>Apply scientific reasoning to predict how altering conditions will affect the rate of a reaction in lab and real-world scenarios.</p>	<p>Collision theory Temperature Concentration Reaction kinetics Surface area</p>	<p>Iodine clock reaction lab</p> <p>Rate of decomposition of calcium carbonate</p> <p>Flinn Scientific Item#: AP7648</p>
<p>What classifies a chemical as an acid or a base and what is its behavior?</p>	<p>Students will examine a variety of materials to observe their acid and basic nature and reactions to produce them and reactions between them.</p> <p>Distinguish between acids and bases using their physical and chemical properties and the pH scale.</p> <p>Use indicators and pH meters to test and classify common substances.</p> <p>Explore acid-base reactions (neutralization) and relate them to real-world applications (e.g., digestion, antacids, buffers).</p> <p>Perform titrations and interpret data to calculate concentrations of unknown solutions.</p> <p>Model acid-base equilibria and explain the role of buffers in maintaining pH stability.</p> <p>Analyze how acid-base chemistry impacts environmental and biological systems (e.g., acid rain, blood pH).</p> <p>Honors will add several acid/base titration types.</p>	<p>pH Acid-base equilibrium Buffers Indicators</p>	<p>Acid-base titrations - Classic Lab Kit Flinn Scientific Item# AP9083</p> <p>Sodium hydroxide pellets vinegar aspirin</p>
<p>Nuclear reactions: What happens in nuclear power</p>	<p>Students develop models to demonstrate nuclei composition changes resulting in alpha, beta, and gamma decay. Real-life applications of carbon dating</p>	<p>Alpha particle Beta particle Gamma particle Fission</p>	<p>Chain reaction simulation Nuclear power plant simulation</p>

<p>plants/bombs to produce energy?</p> <p>Half-life:</p> <p>How can we use nuclear chemistry to determine the age of organisms and the Earth?</p>	<p>Compare nuclear reactions (fission, fusion) with chemical reactions in terms of energy change, mass change, and particle emission.</p> <p>Model and explain the processes of alpha, beta, gamma decay and positron emission, and their effects on atomic structure.</p> <p>Use the concept of half-life to calculate the age of materials through radiometric dating techniques (e.g., carbon dating).</p> <p>Evaluate the benefits and risks of nuclear technologies including power generation, weapons, and medical uses.</p> <p>Design and interpret simulations (e.g., dice/penny labs) to visualize the random nature of radioactive decay.</p> <p>Use nuclear chemistry concepts to explain the challenges of nuclear waste disposal, energy policy, and isotope use in medicine and research.</p> <p>Honors will also look at decay series and uranium/lead dating</p>	<p>Fusion Positron emission</p>	<p>PHeT Colorado nuclear reaction web lab</p> <p>Dice/Penny half life Flinn Scientific Item #: AP8009</p>
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