KIRKWOOD
SCHOOL DISTRICT

Honors Chemistry

Approved by KSD Board of Education: (04/07/17)

Course Description:
Honors Chemistry: Compared to Chemistry, Honors Chemistry is a more analytical and in-depth study of matter and energy from a molecular point of view. Students will use laboratory experiences, classroom demonstrations, discussions, and practical application to investigate atomic structure and the periodic table, bonding, intermolecular forces, chemical, physical and nuclear processes and relevant science practices.

Grade Level: 10th-12th Grade

Unit Scope and Sequence:
Unit 1: Matter and Change
Unit 2: Energy and Number Handling
Unit 3: Reactions and Stoichiometry
Unit 4: Solutions and Gases
Unit 5: Atomic Structure and Light
Unit 6: The Periodic Table
Unit 7: Bonding
Unit 8: Organic and Intermolecular Forces

Course Enduring Understandings:
- Matter is composed of atoms, and these atoms combine in various ways to form all substances. Students should understand the structure of atoms, how they interact, and the various types of bonding (ionic, covalent, metallic) that result in different compounds.
- Conservation of mass is a fundamental concept in chemical reactions. Mass is neither created nor destroyed in chemical processes, and students should grasp the implications of this law in both theoretical and practical situations.

Course Essential Questions:
- What is matter made of, and how do we know?
- In what ways do chemical reactions demonstrate the conservation of mass?

Honors Chemistry
Unit 1: Matter and Change

In this unit, students will explore the fundamental concepts of matter and its transformations. The unit begins by defining matter, distinguishing between physical and chemical properties, and categorizing substances into elements, compounds, and mixtures. Students will delve into the differences between physical and chemical changes and how these processes affect matter at a molecular level.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• All matter is made up of atoms and molecules, which have distinct properties based on their composition and arrangement. Understanding the structure of matter helps explain physical and chemical behavior. • Matter can be described by its physical properties (e.g., state, color, density) and chemical properties (e.g., reactivity, flammability). Differentiating between these properties is crucial for understanding how substances interact. • In any physical or chemical change, mass and energy are conserved. This principle applies to all chemical reactions and physical transformations, helping students predict the outcome of matter changes.	• What is matter, and how is it classified? • How do we distinguish between physical and chemical properties of matter? • How do changes in matter occur? • How do we describe and measure matter? • How can the conservation of mass and energy be demonstrated in chemical reactions?
Students must know:	***Students must be able to:***
• Solid • Liquid • Gas • Aqueous • Reactant • Product • Yields • Subscript • Coefficient • Combustion • Metal • Nonmetal • Element • Compound • Mixture • solute • Solvent • Solution • Ion • Charge	• Label the components of a chemical reaction (reactants, products, state/phase symbols[solid, liquid, gas, aqueous], coefficient, subscript, yield sign, chemical symbol, chemical formula). • Recognize hydrocarbon combustion reactions, and predict the products. • Distinguish among solids, liquids & gases and their properties. • Draw or interpret pictures of solids, liquids and gases on the particle level. • Identify/classify the components of a solution. • Identify correct application of lab safety rules, as well as possible consequential disabilities for not following safe practices. Follow safety protocols when conducting a lab. • Distinguish between chemical and physical changes in matter on the

• Formula	symbolic, macroscopic, and sub-microscopic (particulate) levels. • Write common formulas for all the elements on the periodic table • Identify metals and nonmetals by their position on the periodic table, and describe some of their characteristic properties. • Write formulas and names for binary compounds, both M-N (ionic) and N-N (covalent), given reference materials (except Roman numerals and polyatomics). • Distinguish among elements, compounds and mixtures. • Classify a substance as an element, compound, or mixture on the symbolic, macroscopic, and sub-microscopic (particulate) levels. • Distinguish between atoms and molecules on the symbolic, macroscopic, and sub-microscopic (particulate) levels.

Missouri Learning Standards

Priority Standard: Construct and revise an explanation for the products 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 (9-12.PS1.A.2).

Honors Chemistry
Unit 2: Energy and Number Handling

In this unit, students will explore the fundamental concepts of energy in chemical processes and develop essential skills for handling numerical data in chemistry. The unit begins with an introduction to different forms of energy, including kinetic and potential energy, and their role in chemical reactions.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Energy is conserved in chemical processes: In all chemical reactions, energy is neither created nor destroyed, but it can be transformed from one form to another, such as from chemical energy to thermal energy. Understanding energy flow is critical to understanding how chemical reactions occur. • The study of energy changes helps predict the behavior of chemical reactions: By analyzing the energy involved in reactions (whether they are endothermic or exothermic), students can predict how substances will interact, whether energy will be absorbed or released, and the potential applications of these reactions in the real world. • Precise measurement and accurate data handling are essential in chemistry: Managing numbers correctly—through the use of significant figures, scientific notation, and unit conversions—ensures that scientific data is reliable. Chemistry relies on precise communication of quantitative information to understand and replicate experiments. • Density is a derived measurement of how much matter is found in a given volume. • All measurements involve estimation, and, as such, are not exact. • Manipulation of measurements requires attention to precision (significant figures). • Energy changes accompany every change and can be followed using Potential Energy(PE) diagrams.	• How do we measure physical quantities such as length, mass, volume, temperature, and time accurately and precisely? • How can data be accurately collected, represented, and analyzed to minimize error? • What is the relationship between particle arrangement, density, and observable behaviors of different substances? • How does the density equation D=mVD=Vm help us identify unknown samples? • How does collision theory explain the effects of concentration, temperature, and catalysts on reaction rates? • How can we interpret energy diagrams to determine whether a reaction is exothermic or endothermic? • What role does activation energy play in initiating a chemical reaction, and how does a catalyst impact this energy?
Students must know:	***Students must be able to:***
• Density • Volume • Mass • Precision	• Measure length, mass, volume, temperature, and time to the appropriate precision of the measuring device. • Collect data accurately and precisely

Honors Chemistry
Unit 2: Energy and Number Handling

• Accuracy • Estimation • Significant digits/figures • Energy • Potential energy • Kinetic energy • Heat • Temperature • Endothermic • Exothermic • Calories • Specific heat • Catalyst • Activation energy • Reaction coordinate/reaction progress/reaction pathway • Activated complex • Collision theory (collision, energy, orientation)	(equipment scales, instrumental error) • Represent & analyze data accurately and precisely. • Relate the arrangement of particles in a substance to the intensive property of density and observable behavior. • Use The Equation D=m/V • Use measurements (mass & volume) and the mathematical definition of density to identify samples (regular & irregular solids, liquids and gases). • Explain using collision theory the effect of changing concentration and temperature, or addition of a catalyst, on the rate of reaction. • Given an energy diagram for a reaction or an equation, determine if the reaction is exothermic or endothermic. • Explain at the particle level how activation energy initiates a chemical reaction. Given an energy diagram explain the effect of a catalyst on the activation energy needed to initiate a reaction. • Given an energy diagram for a reaction or an equation, determine if the reaction is exothermic or endothermic. • Explain at the particle level how activation energy initiates a chemical reaction. Given an energy diagram explain the effect • of a catalyst on the activation energy needed to initiate a reaction. • Collect lab data to calculate heat using the equation: Q = mass x specific heat x temperature change • Identify the possible effects of random and systematic errors on observations, measurements, and calculations.

Honors Chemistry
Unit 2: Energy and Number Handling

Missouri Learning Standards
Priority Standard: 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. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graph showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.] (9-12.PS1.A.5).
Priority Standard: 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. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature. No calculations.](9-12.PS1.B.1).

Honors Chemistry
Unit 3: Reaction and Stoichiometry

Chemical reactions can be classified. Balanced chemical reactions demonstrate the conservation of mass. Amounts of matter can be expressed and calculated by mass, mole and particle.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Classification of Reactions: Chemical reactions fall into categories (e.g., synthesis, decomposition, single and double replacement, combustion) that help predict their products and behaviors. • Predictability of Oxidation: Oxidation, including rusting, is a predictable chemical change that involves the combination of oxygen with other elements, often metals. • Chemical Formulas: Chemical formulas provide essential information about the composition and charge balance within compounds, especially those containing polyatomic ions or transition metals (requiring Roman numerals to denote oxidation states). • Law of Conservation of Mass: In a closed system, the mass of reactants equals the mass of products, emphasizing the conservation of atoms during chemical reactions. • The Mole and Atomic Scale: Due to the size of atoms, moles are used to count particles in a quantity of matter, linking atomic-scale measurements to measurable quantities. • Stoichiometry: Balanced equations allow for quantitative predictions about amounts of reactants and products, using relationships based on moles, mass, and particles.	• How can different types of chemical reactions be identified and classified? • What are the predictable patterns in the products of chemical reactions, including oxidation reactions like rusting? • How does the structure of a chemical formula reflect the composition of a compound, including compounds with polyatomic ions and transition metals? • Why is it important to balance chemical equations, and how does this relate to the Law of Conservation of Mass? • How does the mole concept allow chemists to count and measure atoms in a manageable way? • How can we use chemical formulas and balanced equations to calculate relationships between quantities of reactants and products?
Students must know:	***Students must be able to:***
• Chemical Reaction Types: Synthesis, Decomposition, Single Replacement, Double Replacement, Combustion • Oxidation and Reduction: Oxidation, Reduction, Rusting • Compounds and Ions: Polyatomic Ion, Transition Metal, Oxidation State, Ionic Compound, Covalent Compound • Balancing Equations: Reactant, Product, Coefficients, Law of Conservation of Mass	• Classify Reaction Types: Identify and classify reactions as synthesis, decomposition, single replacement, double replacement, or combustion based on reactants and products. • Predict Products of Oxidation: Predict the products of oxidation reactions, especially rusting of iron. • Write Chemical Formulas: Write correct formulas and names for compounds

Honors Chemistry
Unit 3: Reaction and Stoichiometry

• The Mole: Mole, Avogadro's Number, Molar Mass, Atomic Mass Unit (AMU) • Stoichiometry: Molar Ratio, Formula Mass, Molecular Mass, Conversion Factors	containing polyatomic ions and transition metals (with Roman numerals indicating oxidation state). • Balance Chemical Equations: Balance chemical equations by applying conservation of mass and ensuring equal numbers of atoms on both sides of the equation. • Apply Conservation of Mass: Compare the mass of reactants to products to support the Law of Conservation of Mass, using measurements and balanced equations. • Use the Mole Concept: Explain why chemists use the mole and use Avogadro's number (6.022×10^{23}) to count particles and relate grams to atomic mass units. • Calculate Molar Mass: Given a chemical formula, calculate the molar mass by adding atomic masses of each element. • Convert Between Units: Convert between mass, moles, and particles, using molar mass and Avogadro's number as conversion factors. • Solve Stoichiometry Problems: Use balanced equations and known quantities of one reactant/product to calculate proportional amounts of another reactant/product.

Missouri Learning Standards

Priority Standard: Construct and revise an explanation for the products 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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, or of oxygen and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements including synthesis, decomposition, combustion, and/or replacement reactions.] (9-12.PS1.A.2).

Priority Standard: Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on conservation of matter and mass through balanced chemical equations, use of the mole concept and proportional relationships.] [Assessment Boundary: Assessment does not include complex chemical reactions.] (9-12.PS1.B.3).

Honors Chemistry
Unit 4: Solutions and Gases

Acids and bases neutralize each other. Pressure, temperature, volume & moles of gases are interrelated. Concentrations of solutions can be described using molarity. Chemical reactions occur in both the forward and reverse directions.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Acids and Bases: Acids and bases can be distinguished by their chemical formulas and distinct properties, which are reflected in their pH and interactions with other substances. • pH and Neutralization: The pH scale quantifies the acidity or basicity of a solution, and neutralization reactions involve the reaction between an acid and a base to form water and a salt. • Solution Chemistry and Molarity: Molarity, defined as moles of solute per liter of solution, is essential for calculating concentrations and predicting the quantities of reactants or products in a solution. • Gas Laws: The behavior of gases is predictable under changing conditions of pressure, volume, and temperature, and the combined gas law relates these variables quantitatively. • Equilibrium: Some reactions can reach a dynamic equilibrium where the rates of forward and reverse reactions are equal, and the system's balance can shift in response to external changes (Le Chatelier's Principle).	• How do the chemical formulas and properties of acids and bases differ? • What is the pH scale, and how can it be used to classify solutions as acidic, basic, or neutral? • How do neutralization reactions work, and what products can be expected? • How can molarity be used to understand the concentration of solutions and predict quantities in reactions? • How does the combined gas law relate pressure, volume, and temperature in gases, and how can it help solve for unknowns in various conditions? • Why is it useful to understand equilibrium in chemical reactions, and how does a system at equilibrium respond to changes in conditions?
Students must know:	***Students must be able to:***
• Acids and Bases: Acid, Base, pH Scale, Neutralization, Salt • Properties and Indicators: Acidic Solution, Basic Solution, Neutral Solution, Indicator • Solution Chemistry: Molarity, Solute, Solvent, Concentration, Volume • Gas Laws: Combined Gas Law, Ideal Gas Law, STP (Standard Temperature and Pressure), Volume, Pressure, Temperature, Kelvin • Equilibrium: Equilibrium, Forward Reaction, Reverse Reaction, Dynamic Equilibrium, Le Chatelier's Principle	• Identify Acids and Bases: Recognize acids and bases based on their chemical formulas and typical properties (e.g., sour taste, ability to turn litmus paper red or blue, etc.). • Classify Solutions with pH: Use the pH scale to classify solutions as acidic, basic, or neutral. • Describe and Identify Neutralization Reactions: Recognize a neutralization reaction and predict its products (water and a salt). • Calculate Using Molarity: Given two of the three variables (molarity, volume, or

	moles of solute), calculate the third to understand solution concentrations. ● Apply Molarity in Stoichiometry: Use molarity and volume to calculate amounts of reactants or products in solution-based reactions. ● Use the Combined Gas Law: Solve for unknowns in the combined gas law (where P1V1/T1=P2V2/T2P1V1/T1=P2V2/T2) by substituting known values for pressure, volume, or temperature. ● Convert Temperatures: Convert between Celsius and Kelvin to correctly apply temperature in gas law calculations. ● Solve for Variables in the Ideal Gas Law: Use the ideal gas law to determine unknowns in gas samples by applying values for PP, VV, nn, TT, and RR. ● Calculate Gas Volumes at STP: Use balanced equations to determine proportional amounts of gaseous reactants or products at standard temperature and pressure (STP), applying 1 mole=22.4 L'1 mole=22.4 L. ● Understand Reaction Reversibility: Explain that some reactions proceed in both forward and reverse directions, potentially reaching a dynamic equilibrium. ● Predict Equilibrium Shifts: Apply Le Chatelier's Principle to predict the direction of shift in a gaseous equilibrium system when changes in pressure, temperature, or concentration occur.

Missouri Learning Standards

Priority Standard: Construct and revise an explanation for the products 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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, or of oxygen and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements including synthesis, decomposition, combustion, and/or replacement reactions.] (9-12.PS1.A.2)

Priority Standard: Use symbolic representations and mathematical calculations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on conservation of matter and mass through balanced chemical equations, use of the mole concept and proportional relationships.] [Assessment Boundary: Assessment does not include complex chemical reactions.] (9-12.PS1.B.3)

Honors Chemistry
Unit 5: Atomic Structure and Light

The understanding of matter at the subatomic level has developed over time with a progression of models based on increasing technology and scientific analysis. The current model is the orbital model. Nuclear reactions involve changes in the nucleus, a subatomic part of the atom. Light emission occurs due to interaction of the subatomic structure of the atom and energy.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Evolution of Atomic Models: The atomic model has changed significantly over time, driven by experimental evidence, advancing from Dalton's solid sphere to the modern quantum model with a nucleus and electron cloud. • Atomic Structure and Identity: The identity of an atom is defined by its atomic number (protons), while neutrons and electrons contribute to isotopic identity and overall charge. • Isotopes and Atomic Mass: Elements exist as isotopes, which have varying numbers of neutrons, and the average atomic mass reflects the weighted abundance of these isotopes. • Light Emission and Energy Levels: When electrons absorb energy, they move to higher energy levels, and when they fall back, they release energy as light, a process that varies across the electromagnetic spectrum. • Nuclear Stability and Reactions: Changes in the atomic nucleus, such as fusion, fission, and decay, release energy and alter atomic structure, leading to the emission of radiation and forming the basis of nuclear reactions.	• How have atomic models evolved over time with new scientific discoveries? • What determines the number of protons, electrons, and neutrons in an atom, and how do these particles define its identity? • How is the average atomic mass of an element calculated, and what role do isotopes play? • What occurs at the atomic level during light emission, and how is this related to the electromagnetic spectrum? • How does the structure of the atom relate to its behavior in chemical and nuclear reactions? • How can nuclear reactions be identified and understood in terms of changes in subatomic particles?
Students must know:	***Students must be able to:***
• Atomic Models and Particles: Atomic Model, Proton, Neutron, Electron, Nucleus, Electron Cloud, Atomic Number, Mass Number • Isotopes and Atomic Mass: Isotope, Average Atomic Mass, Isotopic Abundance, Percent Composition • Electromagnetic Spectrum: Wavelength, Frequency, Energy, Electromagnetic Spectrum, Photon, Light Emission • Nuclear Reactions: Nuclear Reaction, Radioactive Decay, Fusion, Fission,	• Trace Changes in Atomic Models: Describe the historical evolution of atomic models, including key experiments and discoveries (e.g., Dalton, Thomson, Rutherford, Bohr, Quantum Model). • Calculate Subatomic Particles: Given atomic number, mass number, and charge, calculate the number of protons, neutrons, and electrons in an atom. • Calculate Average Atomic Mass: Using isotopic abundance data, calculate the average atomic mass of an element.

Radiation, Alpha Particle, Beta Particle, Gamma Ray	• Solve Isotopic Composition Problems: Determine the mass of one isotope given other isotope masses and average atomic mass, or calculate percent composition given isotope masses and average atomic mass. • Explain Light Emission: Describe how electrons emit light as they return to lower energy levels, linking this to energy changes and interactions with the electromagnetic spectrum. • Predict Light Properties: Use the electromagnetic spectrum to predict the relative wavelength, energy, and frequency of emitted light. • Describe Atomic Structure: Identify the atom as having a dense, positive nucleus surrounded by a cloud of negatively charged electrons. • Identify Nuclear Reactions: Recognize types of nuclear reactions (decay, fusion, fission) based on reaction patterns, and calculate the particles involved. • Describe Nuclear Changes and Radiation: Explain how nuclear reactions result in changes to the nucleus and emission of radiation, noting differences between alpha, beta, and gamma emissions.

Missouri Learning Standards

Priority Standard: Use symbolic representations 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. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.] (9-12.PS1.C.1).

Priority Standard: Communicate technical information about how electromagnetic radiation interacts with matter. [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.] (9-12.PS4.B.1).

Priority Standard: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions.] (9-12.PS4.B.2).

Honors Chemistry
Unit 6: The Periodic Table

The Periodic Table is based on a variety of patterns that allow chemists to predict properties and reactivity.

Unit Essential Learning Targets	
Enduring Understandings	*Essential Questions*
• Periodic Structure and Patterns: The arrangement of elements on the Periodic Table reflects recurring chemical and physical properties, creating periodic trends across periods and consistent group properties. • Element Classification: The location of elements on the Periodic Table allows for their classification into metals, nonmetals, and metalloids, as well as specific families (e.g., alkali metals, halogens, noble gases), each with unique characteristics. • Periodic Trends: Properties such as atomic radius, ionization energy, and electronegativity vary predictably across periods and down groups, influenced by atomic structure and electron arrangement. • Electron Configurations and Orbitals: The electron configuration and orbital diagram for an element can be derived from its position on the Periodic Table, providing insight into reactivity and bonding. • Valence Electrons and Lewis Structures: The number of valence electrons in a representative element and its ability to form bonds can be determined from its group, aiding in the construction of Lewis dot structures.	• How does the structure of the Periodic Table reflect the properties of elements and trends in their behavior? • How are elements classified as metals, nonmetals, and metalloids, and what defines the specific groups and families? • What periodic trends in properties (such as atomic radius, ionization energy, and electronegativity) can be observed across periods and within groups? • How do electron configurations and orbital diagrams relate to an element's position on the Periodic Table? • How can the number of valence electrons and the Lewis structures for representative elements be determined from the Periodic Table?
Students must know:	*Students must be able to:*
• Periodic Table Structure: Period, Group, Family, Alkali Metals, Alkaline Earth Metals, Transition Metals, Halogens, Noble Gases • Element Classification: Metals, Nonmetals, Metalloids, Semiconductors, Representative Elements • Periodic Trends: Atomic Radius, Ionization Energy, Electronegativity, Reactivity, Electron Affinity • Electron Configuration: Electron Configuration, Orbital Diagram, Valence Electrons, Aufbau Principle, Hund's Rule,	• Explain Periodic Table Structure: Describe how the organization of the Periodic Table reflects common properties within groups and repeating patterns across periods. • Classify Elements: Classify elements as metals, nonmetals, or metalloids, and identify families (alkali, alkaline earth, transition metals, halogens, noble gases) based on their location on the Periodic Table. • Compare Properties: Compare and contrast the physical and chemical properties of metals, nonmetals,

Pauli Exclusion Principle ● Lewis Structures: Lewis Dot Structure, Electron Dot Diagram, Octet Rule	metalloids, and specific families such as halogens and noble gases. ● Analyze Periodic Trends: Interpret data from graphs to analyze trends in atomic radius, ionization energy, and electronegativity across periods and down groups. ● Predict Periodic Properties: Use knowledge of periodic trends to predict properties of elements based on their position in a period or group. ● Derive Electron Configurations: Write both long-form and noble gas (short form) electron configurations for atoms and ions, using the periodic table as a guide. ● Create Orbital Diagrams: Construct orbital diagrams for atoms and ions, applying principles such as the Aufbau principle, Hund's rule, and the Pauli exclusion principle. ● Identify Valence Electrons: Determine the number of valence electrons in a representative element based on its group or electron configuration. ● Construct Lewis Dot Structures: Draw Lewis/electron dot structures for representative elements and simple ions, showing valence electrons as dots around the element symbol.

Missouri Learning Standards

Priority Standard: Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.] (9-12.PS1.A.1).

Priority Standard: Construct and revise an explanation for the products 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. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, or of oxygen and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements including synthesis, decomposition, combustion, and/or replacement reactions.] (9-12.PS1.A.2).

Honors Chemistry
Unit 7: Bonding

Atoms will lose, gain or share electrons in order to become more stable. Electron dot structures depict how electrons are lost, gained or shared to form bonds. Whether atoms lose, gain or share electrons can be determined from the Periodic Table. Electron dot structures can be used to predict molecular shapes.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Stable Ion Formation: Elements tend to form stable ions that fulfill the octet rule, with representative elements gaining or losing electrons to achieve a full valence shell. • Bonding and Electron Sharing: Lewis dot structures depict how atoms achieve stable electron configurations by sharing (covalent) or transferring (ionic) electrons, and the octet and duet rules guide this process. • Bond Types and Electronegativity: The type of bond—ionic, polar covalent, or nonpolar covalent—depends on the difference in electronegativity between atoms, resulting in distinct patterns of electron distribution. • Molecular Geometry: VSEPR theory helps determine molecular shape by considering electron pair repulsion around a central atom, leading to specific geometric arrangements that influence molecular properties.	• How can the octet rule be used to predict stable ion charges for representative elements? • What is the role of Lewis structures in visualizing bond formation and electron sharing? • How do ionic, polar covalent, and nonpolar covalent bonds differ in terms of electron distribution? • How can electronegativity and periodic trends help predict the type of bond between atoms? • How does VSEPR theory explain the 3D shapes of molecules?
Students must know:	***Students must be able to:***
• Bonding Principles: Octet Rule, Duet Rule, Ion Charge, Stability, Valence Electrons • Bond Types: Ionic Bond, Covalent Bond, Polar Covalent Bond, Nonpolar Covalent Bond, Electronegativity • Lewis Structures and Bonding Diagrams: Lewis Dot Structure, Electron Dot Diagram, Bond Formation, Electron Transfer, Electron Sharing • Molecular Shapes and VSEPR Theory: Valence Shell Electron Pair Repulsion (VSEPR) Theory, Molecular Geometry, Tetrahedral, Trigonal Pyramidal, Trigonal Planar, Bent, Linear	• Predict Ion Charges: Use the Periodic Table and the octet rule to predict stable ion charges for representative elements based on family membership. • Draw Lewis Structures for Bonding: Depict bond formation in both ionic and covalent compounds using Lewis/electron dot structures and apply the octet and duet rules to show electron transfer or sharing. • Differentiate Bond Types: Compare and contrast ionic, polar covalent, and nonpolar covalent bonds by examining electron distribution and electronegativity differences. • Predict Bonding Type Using Electronegativity: Use the Periodic Table

	and electronegativity values to determine the likely bond type (ionic, polar covalent, or nonpolar covalent) between two atoms. ● Determine Molecular Shape with VSEPR: Apply VSEPR theory to predict the 3D shape of molecules, identifying shapes such as tetrahedral, trigonal pyramidal, trigonal planar, bent, and linear based on the arrangement of electron pairs around the central atom.

Missouri Learning Standards
Priority Standard: Use the organization of the periodic table to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.] (9-12.PS1.A.1).
Priority Standard: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to a system containing two objects.] (9-12.PS3.C.1).

Honors Chemistry
Unit 8: Organic and Intermolecular Forces

Hydrogen and carbon bond to form organic compounds. Organic compounds contain recognizable functional groups. Molecular shapes affect polarity. Polar substances dissolve polar substances; nonpolar substances dissolve nonpolar substances. Intermolecular attractions of hydrogen bonding, dipole-dipole forces, and dispersion forces can be predicted from molecular structure and polarity. Intermolecular attractions give rise to predictable properties of materials.

Unit Essential Learning Targets	
Enduring Understandings	***Essential Questions***
• Molecular Polarity and Solubility: Molecular polarity is determined by both molecular shape and bond polarity, and it influences how molecules interact with solvents, affecting their solubility. • Intermolecular Forces: Intermolecular forces, such as hydrogen bonding, dipole-dipole interactions, and dispersion forces, depend on molecular structure and polarity and influence macroscopic properties like melting point, boiling point, and solubility. • Structural Representation of Organic Molecules: Structural and line formulas are essential tools in organic chemistry, representing the arrangement of atoms within a molecule and aiding in predicting chemical properties and reactivity. • Functional Groups in Organic Chemistry: Functional groups such as alcohols, amines, and acids determine the reactivity and properties of organic compounds, providing a foundation for understanding organic reactions and mechanisms.	• How can molecular shape and bond polarity help predict whether a molecule is polar or nonpolar? • What role does molecular polarity play in determining the solubility of a substance? • How do different types of intermolecular forces arise from molecular structure, and how do they affect a substance's physical properties? • How can structural and line formulas represent organic molecules, and why is this representation useful? • What are functional groups, and how do they impact the behavior and reactivity of organic compounds?
Students must know:	***Students must be able to:***
• Molecular Polarity and Solubility: Polar Molecule, Nonpolar Molecule, Solubility, "Like Dissolves Like" • Intermolecular Forces: Intermolecular Attraction, Hydrogen Bonding, Dipole-Dipole Interaction, London Dispersion Forces (Van der Waals Forces), Physical Properties (Melting Point, Boiling Point) • Organic Structure Representation: Structural Formula, Line Structural Formula, Organic Molecule • Functional Groups: Functional Group, Alcohol, Amine, Aromatic, Carboxylic	• Predict Molecular Polarity: Use molecular shapes and bond polarities to determine if a molecule is polar or nonpolar. • Predict Solubility: Apply the concept of molecular polarity to predict solubility, understanding the principle of "like dissolves like" (polar with polar, nonpolar with nonpolar). • Identify Intermolecular Forces: Predict the type(s) of intermolecular forces (hydrogen bonding, dipole-dipole, dispersion) in a substance based on its molecular structure, shape, and polarity. • Explain Properties Using Intermolecular

Acid, Ketone, Aldehyde, Ether, Ester, Amide	Forces: Explain macroscopic properties such as melting point and solubility by analyzing the type and strength of intermolecular forces present. ● Draw Structural Formulas: Draw structural formulas to represent organic molecules, showing all atoms and bonds explicitly. ● Draw Line Structural Formulas: Use line structure notation to represent organic molecules concisely, focusing on bonds between carbons and implied hydrogens. ● Identify Functional Groups: Recognize and identify common functional groups (alcohol, amine, aromatic, acid, ketone, aldehyde, ether, ester, amide) within organic compounds based on their structural characteristics.

Missouri Learning Standards

Priority Standard: Plan and conduct an investigation to gather evidence to compare physical and chemical properties of substances such as melting point, boiling point, vapor pressure, surface tension, and chemical reactivity to infer the relative strength of attractive force between particles. [ClarificationStatement:Emphasisisonunderstandingtherelative strength of forces between particles. Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.] (9-12.PS1.A.3).

Priority Standard: Apply the concepts of bonding and crystalline/molecular structure to explain the macroscopic properties of various categories of structural materials, i.e. metals, ionic (ceramics), and polymers. [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to structures of specified materials.] (9-12.PS1.A.4).

Priority Standard: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. . [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to a system containing two objects.] (9-12.PS3.C.1).

Priority Standard: Construct and revise an explanation based on evidence that organic macromolecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules. [Clarification Statement: Large carbon-based molecules included are proteins, carbohydrates,nucleic acids,and lipids.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of specific macromolecules.] (9-12.LS1.C.3).