Diocese of Greensburg Curriculum
Honors Chemistry I

Unit	Standards	Content	Skills
Structure of Atoms	**CCSS: English Language Arts 6-12** **CCSS: Grades 9-10** **Capacities of the Literate Individual** **Students Who are College and Career Ready in Reading, Writing, Speaking, Listening, & Language** They demonstrate independence. They build strong content knowledge. They respond to the varying demands of audience, task, purpose, and discipline. They comprehend as well as critique. They value evidence. They use technology and digital media strategically and capably. They come to understand other perspectives and cultures. **NGSS: Science Performance Expectations (2013)** **NGSS: HS Physical Sciences** **HS.Structure and Properties of Matter** **Performance Expectations** HS-PS1-1. 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. HS-PS1-8. 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. **HS.Chemical Reactions** **Performance Expectations** HS-PS1-2. 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.	This high school unit of study will focus on the structure, properties, and composition of matter. In this study, students will address the idea that matter has a definite composition, and matter may be individual atoms or combined. Students' understandings will also address that the patterns exist because of the properties of atoms.	The student will be able to: • Explain how science is a developing field where theories are constantly challenged. • Contrast the contributions of Dalton, Thomson, Rutherford, Bohr, and Schroedinger in the development of the modern understanding of atomic structure. • Contrast the modern understanding of atomic structure with historic understandings. • Use language appropriate to atomic structure including atom, ion, isotope, subatomic particle, atomic number, mass number, average atomic mass, and atomic mass unit. • Identify and calculate the number of protons, neutrons, and electrons in any atom, ion, or isotope given sufficient information • Explain how some isotopes are made of unstable nuclei, which

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	NGSS: Disciplinary Core Ideas **NGSS: 9-12** **LS1: From Molecules to Organisms: Structures and Processes** **LS1.A: Structure and Function** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1)(secondary to HS-LS3-1) **LS3: Heredity: Inheritance and Variation of Traits** **LS3.A: Inheritance of Traits** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used(expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) **PS1: Matter and Its Interactions** **PS1.A: Structure and Properties of Matter** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1) The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HSPS1-2) The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HSPS1-3),(secondary to HS-PS2-6) 		decay over time emitting particles and energy. • Contrast the three kinds of emissions (alpha, beta, and gamma), the composition of the emission, and the material required to shield them. • Differentiate between nuclear fission and fusion. d. Identify the common uses of nuclear fission and fusion.

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Electron Behaviors	**CCSS: English Language Arts 6-12** **CCSS: Grades 9-10** **Capacities of the Literate Individual** **Students Who are College and Career Ready in Reading, Writing, Speaking, Listening, & Language** **They demonstrate independence**. They build strong content knowledge. They respond to the varying demands of audience, task, purpose, and discipline. They comprehend as well as critique. They value evidence. They use technology and digital media strategically and capably. They come to understand other perspectives and cultures. **NGSS: Science Performance Expectations (2013)** **NGSS: HS Physical Sciences** **HS.Structure and Properties of Matter** **Performance Expectations** HS-PS1-1. 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. **HS.Chemical Reactions** **Performance Expectations** HS-PS1-2. 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. **HS.Waves and Electromagnetic Radiation** **Performance Expectations** HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either	This high school unit of study will focus on the behavior and arrangement of electrons. In this study students will address the principles of electromagnetic radiation. Student understanding will also address the arrangement of electrons using the Quantum Mechanical Model of the Atom.	The student will be able to: • Distinguish among energy levels, sublevels, and orbitals. • Use the Aufbau principle to fill an energy level diagram. • Determine both the full and shorthand electron configurations for an atom or ion. • Determine the orbital notation for the electron arrangement in an atom or ion using Hund's rule and Pauli's exclusion principle. • Determine the quantum numbers associated with an electron. • Describe the process that creates atomic spectra. • Explain the uniqueness of atomic spectra. • Provide examples of the common applications of atomic spectra, i.e. analysis of a mixture using atomic spectra. • Describe the relative energies of ultraviolet, visible, infrared, microwave, X-ray, radio, and TV waves. • Distinguish between absorption (excitation) and emission of energy.

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	by a wave model or a particle model, and that for some situations one model is more useful than the other. HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.* **NGSS: Disciplinary Core Ideas** **NGSS: 9-12** **ESS1: Earth's Place in the Universe** **ESS1.A: The Universe and Its Stars** The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe.(HSESS1-2) **ESS2: Earth's Systems** **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.(HS-ESS2-4) **AP: Chemistry (2019)** **AP: AP** **ENDURING UNDERSTANDINGS** **STRUCTURE AND PROPERTIES** SAP-1 Atoms and molecules can be identified by their electron distribution and energy. **UNIT 1 Atomic Structure and Properties**		• Describe the properties of light. (i.e. wavelength, frequency and energy) • Calculate the wavelength, frequency and energy for a given electron transition.

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	TOPIC 1.5 Atomic Structure and Electron Configuration SAP-1 Atoms and molecules can be identified by their electron distribution and energy. **TOPIC 1.6 Photoelectron Spectroscopy** SAP-1 Atoms and molecules can be identified by their electron distribution and energy. **TOPIC 1.8 Valence Electrons and Ionic Compounds** SAP-2 The periodic table shows patterns in electronic structure and trends in atomic properties. SAP-2.BExplain the relationship between trends in the reactivity of elements and periodicity. 		
Atomic Interaction	**CCSS: English Language Arts 6-12** **CCSS: Grades 9-10** **Capacities of the Literate Individual** **Students Who are College and Career Ready in Reading, Writing, Speaking, Listening, & Language** They demonstrate independence. They build strong content knowledge. They respond to the varying demands of audience, task, purpose, and discipline. They comprehend as well as critique. They value evidence. They use technology and digital media strategically and capably. They come to understand other perspectives and cultures. **NGSS: Science Performance Expectations (2013)** **NGSS: HS Physical Sciences** **HS.Structure and Properties of Matter** **Performance Expectations** HS-PS1-1. 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.	This high school unit of study will focus on the interaction between atoms. In this study, students will address the idea that bonds are created by transferring or sharing electrons. Students' understandings will also address that the behaviors and patterns exist on the periodic table and the role it plays in bonding, in particular electronegativity.	The students will be able to: • Determine the number of valence electrons in an atom from its position in the Periodic Table. • Describe how atoms interact with one another by transferring and sharing valence electrons. • Use electronegativity values to determine whether a compound is ionic, polar or nonpolar covalent. • Illustrate neutral atoms and ions using electron dot notation. e. Illustrate ionic and covalent bonds utilizing electron dot notation

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	HS-PS1-3. 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. HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* **HS.Chemical Reactions** **Performance Expectations** HS-PS1-2. 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. **AP: Chemistry (2019)** **AP: AP** **SKILLS** **Models and Representations 1** **Describe models and representations, including across scales.** 1.A Describe the components of and quantitative information from models and representations that illustrate particulate-level properties only. 1.B Describe the components of and quantitative information from models and representations that illustrate both particulate-level and macroscopic level properties. **Representing Data and Phenomena 3** **Create representations or models of chemical phenomena.** 3.B Represent chemical substances or phenomena with appropriate diagrams or models (e.g., electron configuration). 3.C Represent visually the relationship between the structures and interactions across multiple levels or scales (e.g., particulate to macroscopic). **Model Analysis 4** **Analyze and interpret models and representations on a single scale or across multiple scales.** 4.A Explain chemical properties or phenomena (e.g., of atoms or molecules) using given chemical theories, models, and representations.		• Use appropriate materials to build adequate models of simple molecules and polyatomic ions representing the shapes of these species. • Describe van der Waals forces (London forces and dipole-dipole forces) and hydrogen bonds. • Identify and differentiate among the linear, bent, and tetrahedral shapes. • Predict the shape of a molecule from its chemical formula. • Predict the polarity of a molecule given its shape and types of bonds • 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. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

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	4.B Explain whether a model is consistent with chemical theories. 4.C Explain the connection between particulate-level and macroscopic properties of a substance using models and representations. 4.D Explain the degree to which a model or representation describes the connection between particulate-level properties and macroscopic properties. **ENDURING UNDERSTANDINGS** **SCALE, PROPORTION, AND QUANTITY** SPQ-2 Chemical formulas identify substances by their unique combination of atoms. SPQ-3 Interactions between intermolecular forces influence the solubility and separation of mixtures. **STRUCTURE AND PROPERTIES** SAP-1 Atoms and molecules can be identified by their electron distribution and energy. SAP-3 Atoms or ions bond due to interactions between them, forming molecules. SAP-4 Molecular compounds are arranged based on Lewis diagrams and Valence Shell Electron Pair Repulsion (VSEPR) theory. SAP-5 Intermolecular forces can explain the physical properties of a material. **UNIT 1 Atomic Structure and Properties** **TOPIC 1.7 Periodic Trends** SAP-2 The periodic table shows patterns in electronic structure and trends in atomic properties. **TOPIC 1.8 Valence Electrons and Ionic Compounds** SAP-2 The periodic table shows patterns in electronic structure and trends in atomic properties. SAP-2.BExplain the relationship between trends in the reactivity of elements and periodicity. **UNIT 2 Molecular and Ionic Compound Structure and Properties** BIG IDEA 2 Structure and Properties SAP How has the discovery of DNA changed the world? How are molecular compounds arranged?		• 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. • 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.

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	TOPIC 2.1 Types of Bonds Chemical SAP-3 Atoms or ions bond due to interactions between them, forming molecules. **TOPIC 2.2 Intramolecular Force and Potential Energy** SAP-3 Atoms or ions bond due to interactions between them, forming molecules. **TOPIC 2.3 Structure of Ionic Solids** SAP-3 Atoms or ions bond due to interactions between them, forming molecules. **TOPIC 2.5 Lewis Diagrams** SAP-4 Molecular compounds are arranged based on Lewis diagrams and Valence Shell Electron Pair Repulsion (VSEPR) theory. **TOPIC 2.7 VSEPR and Bond Hybridization** SAP-4 Molecular compounds are arranged based on Lewis diagrams and Valence Shell Electron Pair Repulsion (VSEPR) theory. **UNIT 3 Intermolecular Forces and Properties** **BIG IDEA 1 Scale, Proportion, and Quantity SPQ** How do interactions between particles influence mixtures? **BIG IDEA 2 Structure and Properties SAP** Why does the smell of perfume only last a short time? Why can you swim in water but you cannot walk through a wall? How are the properties of gases described? How can you determine the structure and concentration of a chemical species in a mixture? **TOPIC 3.1 Intermolecular Forces** **SAP-5 Intermolecular forces can explain the physical properties of a material.** 		

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Stoichiometry	**CCSS: English Language Arts 6-12** **CCSS: Grades 9-10** **Capacities of the Literate Individual** **Students Who are College and Career Ready in Reading, Writing, Speaking, Listening, & Language** They demonstrate independence. They build strong content knowledge. They respond to the varying demands of audience, task, purpose, and discipline. They comprehend as well as critique. They value evidence. They use technology and digital media strategically and capably. They come to understand other perspectives and cultures. **CCSS: Mathematics** **CCSS: HS: Num/Quantity** **Quantities** **HSN-Q.A. Reason quantitatively and use units to solve problems.** **Mathematical Practice** **MP.The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.** **NGSS: Science Performance Expectations (2013)** **NGSS: HS Physical Sciences** **HS.Chemical Reactions** **Performance Expectations** HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	This high school unit of study will focus on the mathematical relationships within compounds as well as chemical reactions. In this study, students will address the idea the mole, molar mass, and Avogadro's number. Students' understandings will also address mathematical patterns that exist. :	The student will be able to: • Explain how a balanced chemical equation relates to the law of conservation of mass. • Define the mole and describe its importance. • Describe how Avogadro's number is related to a mole of any substance. • Define and calculate the molar mass of a compound. • Convert among the number of particles, mass, moles, and volume of a substance. • Calculate the percent composition of a substance from its chemical formula. • Calculate the percent composition of a substance from experimental data. • Distinguish between empirical and molecular formulas. • Derive the empirical formula for a compound by using experimentally obtained masses of each element. • Define stoichiometry and describe its importance. • Identify stoichiometric ratios from balanced chemical equations. • Calculate different types of stoichiometry problems.

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	AP: Chemistry (2019) **AP: AP** **UNIT 1 Atomic Structure and Properties** **TOPIC 1.1 Moles and Molar Mass** **UNIT 4 Chemical Reactions** **TOPIC 4.5 Stoichiometry** **SPQ-4 When a substance changes into a new substance, or when its properties change, no mass is lost or gained.** 		(i.e. mass-mass, mass-volume, volume-volume) • Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. • Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
Ion Interaction	**CCSS: English Language Arts 6-12** **CCSS: Grades 9-10** **Capacities of the Literate Individual** **Students Who are College and Career Ready in Reading, Writing, Speaking, Listening, & Language** They demonstrate independence. They build strong content knowledge. They respond to the varying demands of audience, task, purpose, and discipline. They comprehend as well as critique. They value evidence. They use technology and digital media strategically and capably. They come to understand other perspectives and cultures. **NGSS: Science Performance Expectations (2013)** **NGSS: HS Physical Sciences** **HS.Structure and Properties of Matter** Performance Expectations HS-PS1-3. 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.	This high school unit of study will focus on characteristics of aqueous solutions In this study, students will address the idea that ions affect the behavior of solutions. Students' understandings will also address that the relationships that exist in solutions.	The student will be able to: • Distinguish between homogeneous and heterogeneous mixtures. • Explain how dissolving is different from melting. • Identify and compare the nine different solute-solvent combinations. • Compare solutions, suspensions, and colloids. • Explain how stirring, surface area, temperature, and concentration influence the rate of solution formation. • Explain how distillation, crystallization, and chromatography are used

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	HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* **HS.Chemical Reactions** **Performance Expectations** HS-PS1-2. 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. HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. **NGSS: HS Earth & Space Science** **HS.Earth's Systems** **Performance Expectations** HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. **AP: Chemistry (2019)** **AP: AP** **UNIT 3 Intermolecular Forces and Properties** **TOPIC 3.7 Solutions and Mixtures** SPQ-3 Interactions between intermolecular forces influence the solubility and separation of mixtures. **TOPIC 3.8 Representations of Solutions** SPQ-3 Interactions between intermolecular forces influence the solubility and separation of mixtures. . **TOPIC 3.9 Separation of Solutions and Mixtures Chromatography** SPQ-3 Interactions between intermolecular forces influence the solubility and separation of mixtures.		to separate solutions into their components. • Apply "like dissolves like" to everyday events. (i.e. actions of detergents and soap) • Interpret a solubility curve. • Explain the relationship between equilibrium and solubility. • Explain why gases become less soluble at higher temperatures, whereas most solids become more soluble. • Explain why a precipitate forms when solutions of two ionic compounds are mixed. • Explain why the boiling point increases and the freezing point decreases when solute particles are dissolved. • Give everyday examples of freezing point depression and boiling point elevations.

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	TOPIC 3.10 Solubility SPQ-3 Interactions between intermolecular forces influence the solubility and separation of mixtures. **UNIT 4 Chemical Reactions** **TOPIC 4.2 Net Ionic Equations** TRA-1 A Substance that changes its properties, or that changes into a different substance, can be represented by chemical equations. **TOPIC 4.3 Representations of Reactions** TRA-1 A substance that changes its properties, or that changes into a different substance, can be represented by chemical equations. **TOPIC 4.4 Physical and Chemical Changes** TRA-1A substance that changes its properties, or that changes into a different substance, can be represented by chemical equations. 		