Course Title:	Content Area:	Grade Level:	Credit (if applicable)
Principles of Chemistry ACA Chemistry ACC	STEM: Science	10-11	1.0

Course Description:

This course is third in a sequence designed to prepare students for the Next Generation Science Standards Assessment in Grade 11. Atomic structure and quantitative relationships between atoms and molecules are stressed to explain chemical reactions. Understanding the concepts of chemistry is developed through the use of real world phenomena that apply chemistry including: The Radium Girls, Airbags and the Environmental phenomena. Students engage in chemistry through the science and engineering practices. Additional depth is provided to accelerated students through added conceptual ideas and a deeper focus on the mathematical and computational understanding of chemistry.

Aligned Core Resources:	Connection to the ***BPS Vision of the Graduate***
• Hands on laboratory experiences and demonstrations • Virtual lab simulations (PhET, Gizmo, etc)	COLLABORATION: • Demonstrates ability to work effectively and respectfully with diverse teams SOCIAL AND CROSS-CULTURAL SKILLS • Know when it is appropriate to listen and when to speak • Conduct themselves in a respectable, professional manner COMMUNICATIONS AND TECHNOLOGY LITERACY • Use digital technology, communication tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society INFORMATION LITERACY • Access information on efficiently (time) and effectively (sources) • Evaluate information critically and competently • Use information accurately and creatively for the issue or problem at hand • Manage the flow of information from a wide variety of sources CONTENT MASTERY • Develop and draw from a baseline understanding of knowledge in academic disciplines from our Bristol curriculum CRITICAL THINKING AND PROBLEM SOLVING • Collect, assess and analyze relevant information • Reason effectively. Use systems thinking • Make sound judgments and decisions. Identify, define and solve authentic problems and essential questions. • Reflect critically on learning experience, processes and solutions • Transfer knowledge to other situations

Additional Course Information: *Knowledge/Skill Dependent courses/prerequisites*	Link to ***Completed Equity Audit***
None	Equity Curriculum Review Audit - Chem ACA/ACC (2026)

Standard Matrix

Standard	Unit 1	Unit 2	Unit 3	Unit 4
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.	X	X		

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.		X		X
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.		X	X	
HS-PS1-4 . 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.				X
HS-PS1-5 . 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.	X			X
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				X
HS-PS1-7 . Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.	X	X		X
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.		X		
HS - PS 2-4 . Use ~~mathematical~~ representations of ~~Newton's Law of Gravitation and~~ Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.		X		
HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.			X	
HS-PS4-3 . 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.		X		
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.		X		

Unit Links

[Unit 1: The Building Blocks of Matter: Elements, Compounds, Mixtures and Quantitative Analysis]
[Unit 2: Atomic Structure, Electrons, Periodic Trends and Bonding]
[Unit 3: Intermolecular Forces]
[Unit 4: Chemical Reactions, Stoichiometry & Gas Laws]

Instructional Pacing

- 84 Blocks x 2 (A and B days) = 168 Days
- 3 DaysCommunity Building
- 10 Days: Midterm review and exams, final review and exams

Unit Title	
Unit 1: The Building Blocks of Matter: Elements, Compounds, Mixtures and Quantitative Analysis	
Relevant Standards: Bold indicates priority	
HS-PS1-1 | HS-PS1-5 | HS-PS1-7	
Essential Question(s)	**Enduring Understanding(s)**
How does the microscopic arrangement of matter dictate its macroscopic identity and behavior? How do chemists bridge the gap between the invisible world of atoms and the measurable world of the lab? How does the proportion of components in a mixture change its "strength" and functionality?	Matter can be classified into elements, compounds, and mixtures based on the arrangement of atoms. These patterns allow us to predict properties and use physical techniques to separate components without changing their chemical identity. Because atoms are too small to count individually, the mole serves as a vital "counting unit" (Avogadro's number). It provides a mathematical bridge that allows us to convert measurable mass into a specific number of particles. Solutions are specific mixtures where the ratio of solute to solvent (molarity) determines the concentration. By mathematically modeling this relationship $M = n/V$ we can precisely create, dilute, and predict the behavior of substances in various applications.
Demonstration of Learning	**Pacing for Unit**
• Separation of Mixture Lab • Element/Compound/Mixture CFA • Molar Conversions Lab • Kool Aid Lab (solutions and dilutions) • Molarity CFA	22 Blocks or Day 1 - 44 of the School Year
Family Overview (link below)	**Integration of Technology**
[Chemistry ACA/ACC Family Overview (2026)]	• *PhET Labs* • *Gizmos* • *Google Slides (Research and Presentations)*
Unit-specific Vocabulary	**Aligned Unit Materials, Resources, and Technology (beyond core resources)**
Matter, Element, Compound, Atom, Molecule, Mixture, Homogenous, Heterogeneous, Solute, Solvent, Physical Property, Chemical Property, Filtration, Evaporation, Magnetism, Molarity, Dilution, Precipitation, Dissolve, Volume, Mass, Percent Composition	Shared Chemistry Materials Fe | glow powder NaCl | thin paint brushes SiO_2 | $CuSO_4$ 1M HCl | colorimeters $NaHCO_3$ | gatoraid powder magnets | large cups chalk | small cups white acrylic paint
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions**
• Environmental Science: The Flint Water Crisis (Molarity & Percent Composition) • Culinary Arts: The "Perfect" Solution (Kool-Aid & Concentration)	• Students often think a mixture is chemically bonded or that a compound is just two elements mixed together. • Confusing physical properties (like boiling point or density) with chemical properties (like reactivity or flammability). • Believing a chemical reaction is required to separate a mixture (e.g., separating salt from water). • Thinking the mole is a unit of mass (like a gram) rather

	than a counting number. • Believing that adding water to a solution changes the *number of solute particles*.
Connections to Prior Units	**Connections to Future Units**
Students can connect to middle school learning and Physical Science in regards to states of matter, structure of the atom, and the periodic table.	Students begin to draw particle diagrams of elements, compounds, and mixtures in Unit 1. This continues in Unit 4 to show the particle diagrams of reactants vs products. Students will begin to use the periodic table to identify elements in Unit 1. Students explore the organization of the periodic table further in Unit 2.

Differentiation through *Universal Design for Learning*

	Engagement	Representation	Action & Expression
LT1	Start with a "Kitchen Chemistry" challenge. Give students a mixture of salt, sand, and iron filings and ask them to brainstorm how to recover the salt for a meal. Relate separation techniques to real-world recycling or water filtration.	Use particle diagrams (circles/dots) alongside physical models (LEGOs or magnets) to represent elements vs. compounds. Provide a "Classification Flowchart" that uses both text and symbols to guide the identification process.	Instead of a standard lab report, allow students to "show" their separation process via a stop-motion video, a narrated photo essay, or a live "cooking show" style demonstration of their lab technique.
LT2	Use "Vertical Non-Permanent Surfaces" (Whiteboards) for group problem-solving. Assign roles (The Calculator, The Units Checker, The Logic Mapper) to sustain effort and persistence during difficult conversions.	Provide a "Mole Map" graphic organizer that color-codes the path from Mass to Moles to Particles. Use the "Dozen" analogy consistently to bridge the gap between a familiar counting unit and Avogadro's number.	Offer tiered practice sets. "Level 1" provides the conversion factors; "Level 2" provides the "Mole Map" but no factors; "Level 3" is a blank slate. Allow students to choose their entry point based on their confidence level.
LT3	Use the Kool-Aid Lab as a central hook. Let students determine their "ideal concentration" (Molarity) for taste. For the "Phosphorescent Paint" target, bring in a blacklight to show the qualitative effects of concentration on brightness.	Use digital simulations like PhET Molarity to allow students to "see" the solute particles dissolve as they change the volume. This makes the invisible ratio (M = n/V) visible and interactive.	Provide a "Solution Design Template" for the Kool-Aid and dilution labs. This checklist helps students plan their steps (Calculate to Measure to Mix to Verify) before they touch the equipment, supporting goal-setting and planning.

Supporting Multilingual/English Learners (*CELP standards*)

	Emerging	Expanding	Bridging
LT1	Learning Target • I can label pictures of elements, compounds, and mixtures and match separation tools to their uses. Scaffolds: • Word banks with pictures; "I see..." sentence starters; physical sorting of manipulatives (LEGOs).	Learning Target • I can describe the patterns in elements, compounds, and mixtures using short sentences and explain a separation step. Scaffolds • Sentence frames: "This is a mixture because..."; bilingual glossaries; graphic organizers for lab steps.	Learning Target • I can compare and contrast elements, compounds, and mixtures and justify my choice of a specific separation technique. Scaffolds • Comparison transition words (however, whereas); peer-to-peer "Think-Pair-Share" for evaluating models.
LT2	Learning Target • I can identify the units (grams, moles, particles) on a conversion map and copy the setup for a calculation. Scaffolds • Visual "Mole Map" with color-coded units; Worked examples with arrows showing the "path."	Learning Target • I can calculate molar mass and summarize the steps to convert mass to moles using academic vocabulary. Scaffolds • Sequence words (first, then, finally); Formula reference sheets with labeled variables.	Learning Target • I can explain the relationship between mass and particles and predict how the number of moles changes if the mass increases. Scaffolds • "If...then..." hypothesis stems; Multi-step word problems; Opportunity to lead a small group "whiteboard" session.

LT3	Learning Target • I can point to and name the solute and solvent in a solution and record the molarity from a simulation. Scaffolds • Realia (actual Kool-Aid packets/water); Interactive PhET simulations; Visual vocabulary cards (Solute = Salt).	Learning Target • I can state the effect of adding more solute to a solution and solve for molarity using the given formula. Scaffolds • Sentence frames for qualitative effects: "When I add more solute, the molarity becomes [higher/lower]."	Learning Target • I can analyze how altering volume or moles affects concentration and communicate the process of diluting a solution. Scaffolds • "Cause and Effect" graphic organizers; Written lab reflections using technical verbs (dilute, dissolve, saturate).

Unit Outline

Lesson Sequence	Learning Target(s)	Success Criteria Resources/Assessments/ Assured Learning Experiences
3 days	Intro to chemistry / SEL	• I can describe lab safety measures and locate safety features • I can name my teacher and classmates and feel comfortable collaborating with them
5 days	**Learning Target 1** I can use patterns to classify matter as an element, compound, or mixture.	• I can define and give examples of atom, element, compound, and mixture. • I can create and evaluate models of elements, compounds, and mixtures. • I can use data to calculate the percent composition of a mixture when given the formula • I can use lab techniques to separate a mixture based on the properties of its components. Shared Chemistry Materials (Separation Lab)
9 days	**Learning Target 2** I can define and explain the mole as a counting number used in chemistry.	• I can state Avogadro's number. • I can calculate molar mass. • I can convert and explain the relationship between the mass of a sample and how many moles the sample contains and in reverse convert from moles to mass • ***ACC Only*** I can convert and explain the relationship between the mass of a sample and how many particles the sample contains; and from particles to mass • ***ACC Only*** I can calculate the number of particles in a given mass of radium.
5 days	**Learning Target 3** I can use the concept of molarity when using solutions	• I can identify a solution as a specific type of mixture containing a solute and solvent and identify which component is the solute vs solvent • I can identify the variables and units in molarity calculations (M=n/V)(number of moles and liters) • ***ACC Only*** I can solve for any of the variables in the molarity equation. (Including converting mL to L and grams to moles) • ***ACA Only*** I can solve for molarity given moles and liters, and the equation. • I can determine the qualitative effects of altering variables in molarity calculations. • I can calculate the molarity of phosphorescent paint. • ***ACC Only*** I can dilute a solution to a given concentration. • I can create solutions of Kool-Aid and qualitatively and quantitatively investigate them Shared Chemistry Materials (Kool-Aid Lab)

Unit Title		
Unit 2: Atomic Structure, Electrons, Periodic Trends, and Bonding		
Relevant Standards: Bold indicates priority		
HS-PS1-1	HS-PS1-7	HS-PS2-4
HS-PS1-2	**HS-PS1-8**	HS-PS4-3
HS-PS1-3		HS-PS4-4

Essential Question(s)	**Enduring Understanding(s)**
How do invisible forces at the atomic level dictate the visible patterns of the universe? How is the "story" of an atom told through the energy it releases? How does an atom's quest for stability lead to the diversity of compounds in our world?	The structure of the atom is governed by Coulombic attraction. Changes in the distance or charge between subatomic particles create predictable patterns (Periodic Trends) that determine how elements behave and interact. Atoms are dynamic; when electrons move between energy levels or when nuclei change (nuclear chemistry), they release energy as light or radiation. These "signatures" allow us to identify elements and understand the history of substances like radium. Atoms bond to achieve lower energy states. Whether they share electrons (covalent) or transfer them (ionic), the resulting structure determines the physical and chemical properties of everything from the air we breathe to the minerals in the earth.
Demonstration of Learning	**Pacing for Unit**
• Flame Test Lab • Isotopes CFA • “My Element” Project • Intermolecular Forces CFA	22 Blocks or Day 45 - 89 of the School Year *(I midterm review and exams follow this unit)*
Family Overview (link below)	**Integration of Technology**
[Chemistry ACA/ACC Family Overview (2026)]	• *PhET Labs* • *Gizmos* • *Google Slides (Research and Presentations)*
Unit-specific Vocabulary	**Aligned Unit Materials, Resources, and Technology (beyond core resources)**
Atom, subatomic particle, proton (p^+), neutron (n^0), electron (e^-), nucleus, electron cloud, mass number, atomic number, atomic mass, isotope, neutral atom, ion, periodic table tile, energy levels (shells), Bohr model, quantum model, orbitals, electron configuration, ground state, excited state, relaxation, photon, emission spectrum, spectral lines, luminescence, energy transitions, wavelength, frequency, color of light, electromagnetic spectrum, group (family), period, metals, nonmetals, metalloids, valence electrons, core electrons, atomic radius, ionization energy, electronegativity, metal reactivity, cation, anion, Coulomb’s Law, electrostatic force, attraction, repulsion, distance (r), charge (q_1, q_2), ionic bond, covalent bond, polar covalent, nonpolar covalent, metallic bond, electronegativity difference, formula unit, molecule, lattice structure, conductivity, solubility, melting point, boiling point, brittle, malleable, ductile, oxidation state, octet rule, Nucleus, Alpha Decay,	Shared Chemistry Materials Various metal ion solutions for flame test lab (examples NaCl, KNO_3, $SrCl_2$, LiCl) / NaCl, sucrose, 1M HCl other ionic and covalent compounds as unknowns / various metals (Mg, Al, Zn, Cu)

Beta Decay, Gamma Radiation, Fission, Fusion, Stability, Radioisotope, Contamination	
Opportunities for Interdisciplinary Connections:	**Anticipated misconceptions**
• Physics Connection: Quantum Mechanics and Light • History & Ethics Connection: The Evolving Atom (LT 4) • Mathematics Connection: Trends and Calculations • History: Context for Radium Girls and Nuclear Energy (Chernobyl) • History/Civics: Labor Law ("Radium Girls")	• The atom is mostly a dense, solid sphere (like a marble) with all the mass spread throughout. • Believing electrons orbit the nucleus like planets (the Bohr or planetary model). • Thinking atoms get larger as you move across a period (left to right). • Believing every single atom in every molecule must have exactly eight valence electrons.
Connections to Prior Units	**Connections to Future Units**
Students can connect to middle school learning and Physical Science in regards to atomic structure (including subatomic particles and Bohr models).	Covalent bonding is first introduced in Unit 2. This is expanded upon in Unit 3, when the shape of covalent compounds is connected to polarity and macroscopic properties.

Differentiation through *Universal Design for Learning*

	Engagement	Representation	Action & Expression
LT 1 & 3	Use a "Model Graveyard" activity. Students look at old atomic models (Dalton, Thomson, Rutherford) and "diagnose" why they died (what new evidence killed them). This hits the success criterion regarding how models change over time.	Use the "Hotel Analogy" for electron configurations (LT 3). Electrons are guests, orbitals are rooms, and energy levels are floors. Provide a visual "floor plan" for s, p, d, f blocks on the periodic table.	Use "Atomic Manipulatives" (beads, coins, or M&Ms) for Bohr models. **ACC**: Have students walk a "Human Orbital Map" on the floor to visualize electron density and energy levels.
LT 2 & 4	Start with a Flame Test Lab or use "glow-in-the-dark" stars. Connect the light they see to the tragic story of the Radium Girls. Use a "Driving Question Board" to capture student empathy and curiosity about why the paint was "deadly but beautiful."	Provide an audio version or a graphic novel summary of the Radium Girls' story. Use an interactive "Energy Ladder" visual to show electrons jumping to the "Excited State" and releasing photons as they fall to the "Ground State."	Students can "explain the glow" (LT 2) through a creative medium: a poem from the perspective of an electron, a technical diagram, or a recorded "news report" from the 1920s explaining the chemistry of the paint.
LT 5	Use a "Pennies/Dice Decay" simulation to model half-life. It turns the math of exponential decay into a tactile game. Connect this to the Ra-226 used by the dial painters to make the risk "real."	Provide a "Translation Key" for isotope notation. Color-coding the Mass Number and Atomic Number in different notations. Use the Band of Stability graph with transparent overlays to help students see where "safety" ends and "radioactivity" begins.	Provide a "Decay Flowchart." When students see "Alpha Decay," the flowchart prompts them to subtract 4 from the mass and 2 from the atomic number. This supports the mathematical model success criterion without the "blank page" panic.
LT 6-10	Run a "Bonding Speed Dating" activity. Students wear signs with their valence electrons and have to find a "partner" (ionic or covalent) to reach stability. For LT 6, have a "Periodic Trend Scavenger Hunt" using data cards.	Use Coulomb's Law qualitatively with a magnet demonstration. More magnets = more charge. Further apart = less force. Show the formula as: F = k (q1 q2}/r2 but emphasize the "size" of the variables visually (e.g., big r means tiny F).	For naming and formulas (LT 9), offer a "Naming Hexagon" puzzle or a digital "Formula Builder" app. For the properties lab (LT 10), allow students to use a "Decision Tree" to identify if their mystery substance is ionic or covalent based on conductivity and melting point.

Supporting Multilingual/English Learners (*CELP standards*)

	Emerging	Expanding	Bridging
LT 1 &3	Learning Target • I can label protons, neutrons, and electrons on a diagram and copy an electron configuration. Scaffolds • Illustrated word bank; color-coded Bohr models (e.g.,	Learning Target • I can describe the location of subatomic particles and follow a map to write electron configurations. Scaffolds • Sentence frames: "The [particle] is in the [location] and	Learning Target • I can compare the Bohr model to the orbital model and explain why electrons fill certain levels first. Scaffolds • Academic transition words (similarly, conversely);

	Protons = Red); PhET "Build an Atom" simulation.	has a [charge] charge." A visual "Aufbau" filling order diagram.	"Think-Aloud" protocols for solving configurations.
LT 2 & 4	Learning Target • I can point to the ground state vs. excited state and match colors to high/low energy. Scaffolds • Visual "Energy Ladder" showing an electron jumping; color-coded arrows (Purple = High, Red = Low energy).	Learning Target • I can explain how an electron makes light and list questions about the Radium Girls' experience. Scaffolds • Sequence signals (First, the electron gains energy. Then, it falls.); Question starters (Who, What, Why, How).	Learning Target • I can relate the color of light to energy loss and argue why the Radium Girls' story matters to chemistry. Scaffolds • Cause/effect organizers; Socratic Seminar sentence stems ("I agree with [Name], because the energy released...").
LT 5	Learning Target • I can identify an isotope by its mass number and label a picture of fission vs. fusion. Scaffolds • Sorting cards for isotope notation (U-235 vs. U-238); "Stability" graph with a green "safe" zone and red "unstable" zone.	Learning Target • I can define an isotope and predict if a nucleus is stable using a graph. Scaffolds • Sentence frames: "This atom is an isotope because it has a different number of [neutrons/protons]." T-chart for Alpha/Beta decay.	Learning Target • I can calculate mass changes in nuclear decay and model the harmful effects of Radium-226. Scaffolds • Modeling software or whiteboarding; Guided lab reflections connecting nuclear decay to biological damage.
LT 6-10	Learning Target • I can sort elements into metals/nonmetals and draw arrows for periodic trends. Scaffolds • Periodic table with "trend arrows" (Size up/down); "Magnet vs. Distance" visual for Coulomb's Law.	Learning Target • I can predict if a bond is ionic or covalent and name simple compounds using a reference sheet. Scaffolds • "If... then..." frames: "If it is a metal and a nonmetal, then the bond is [ionic/covalent]." Naming flowchart.	Learning Target • I can use Coulomb's Law to justify a trend and defend my identification of an unknown compound. Scaffolds • Claims-Evidence-Reasoning (CER) graphic organizer; Peer-review checklists for naming and formula writing.

Unit Outline

Lesson Sequence	Learning Target(s)	Success Criteria Resources/Assessments/ Assured Learning Experiences
3 days	**Learning Target 1** I can describe the structure of an atom and its subatomic particles.	• I can identify protons (p+), neutrons (n0), and electrons (e-) as subatomic particles and model their location, charge, and mass. • I can use the periodic table to determine the number of subatomic particles in a neutral atom. • I can identify the key components of a tile on the periodic table. • I can identify how and why the atomic model has changed over time. • I can draw Bohr models and properly label the location and number of protons, neutrons, and electrons. • I can investigate and explain the existence of electrons in energy levels (rings).
3 days	**Learning Target 2** I can relate the color of light emitted by an element to the relaxing of electrons from a higher energy level to a lower energy level.	• I can identify the differences between the ground state and excited state of an electron. • I can describe how energy in the form of light is emitted when excited electrons relax. • I can relate the color of light emitted to how much energy an electron loses when it changes energy levels. • I can explain why radium paint glows by describing how electrons release energy in the paint.

		Shared Chemistry Materials (Flame Test)
2 days	**Learning Target 3** ***ACC Only*** I can model electron configurations for specified main group elements using the orbital blocks of the periodic table.	• I can describe the existence of electrons in orbitals (s,p,d,f) and name these orbitals. • I can determine the electron configuration of radium.
1.5 days	**Learning Target 4** I can ask questions about the Radium Girls experience with radium.	• I can engage with the Radium Girls story by generating driving questions to deepen my understanding. • I can explain why learning chemistry is important by connecting it to the experiences of the Radium Girls.
4 days	**Learning Target 5** I can investigate nuclear chemistry	• I can define an isotope and describe how differences in neutron number affect atomic mass. • I can use both isotope notations to describe isotopes of the same element. (U-238 and $^{238}_{92}U$) • I can use the band of stability graph to determine if an isotope exists, and if it is radioactive • I can use a model to demonstrate how specific isotopes participate in nuclear fission and fusion reactions. • I can use a mathematical model to describe how matter is conserved in alpha, beta, and gamma decay. • I can model the harmful effects of Ra-226 used in the radium dial painters paint. Shared Chemistry Materials (pHets)
5 days	**Learning Target 6** I can use the trends of the periodic table to make predictions.	• I can identify and define the periodic trends of atomic radius, ionization energy, and electronegativity. • I can use an annotated periodic table to organize a set of elements based on periodic trends. • I can predict the trend of metal reactivity, including radium.
	Learning Target 7 I can use Coulomb's Law to explain the forces between subatomic particles.	• I can determine the effect of altering variables in Coulomb's Law equation qualitatively. • I can describe how Coulomb's law explains periodic trends
3 days	**Learning Target 8** I can identify the differences between ionic and covalent compounds. **Learning Target 9** I can determine the name and formula of an ionic or covalent compound **Learning Target 10** I can investigate the properties of ionic and covalent compounds	• I can use the periodic table to determine if an element is a metal, metalloid, or nonmetal • I can determine if a compound is ionic or covalent based on its elemental composition. • I can identify the forces that hold together the atoms that make up ionic and covalent bonds. • Given the formula, I can name ionic and covalent compounds. • Given the name, I can write the formula of ionic and covalent compounds. • I can describe the properties of ionic and covalent compounds. • I can conduct an investigation using the properties of a compound to identify a substance as an ionic or covalent compound. • I can identify compounds of radium and classify them as ionic or covalent.

<table>
<tr><th colspan="2">Unit Title</th></tr>
<tr><td colspan="2">Unit 3: Intermolecular Forces</td></tr>
<tr><th colspan="2">Relevant Standards: Bold indicates priority</th></tr>
<tr><td>HS-PS1-3</td><td>HS-PS2-6</td></tr>
<tr><th>Essential Question(s)</th><th>Enduring Understanding(s)</th></tr>
<tr><td>How does the "tug-of-war" for electrons create different types of matter?

How does a molecule’s 3D shape determine its "personality"?

Why do some substances "stick" together more than others?</td><td>Atoms achieve stability by rearranging their valence electrons. Whether they transfer electrons (Ionic) or share them (Covalent), the nature of this "tug-of-war" dictates the fundamental structure of the resulting compound.

A molecule’s identity is not just what atoms it has, but how they are arranged in space. Geometric symmetry and electronegativity differences determine polarity, which dictates how a molecule will interact with its neighbors.

Macroscopic properties like boiling point and surface tension are "invisible" clues to microscopic intermolecular forces (IMFs). The more polar a molecule is, the "stickier" it becomes, requiring more energy to pull apart.</td></tr>
<tr><th>Demonstration of Learning</th><th>Pacing for Unit</th></tr>
<tr><td>Stations lab on IMF</td><td>14 Blocks
or
Day 90 - 118 of the School Year</td></tr>
<tr><th>Family Overview (link below)</th><th>Integration of Technology</th></tr>
<tr><td>Chemistry ACA/ACC Family Overview (2026)</td><td>• PhET Labs
• Gizmos
• Google Slides (Research and Presentations)</td></tr>
<tr><th>Unit-specific Vocabulary</th><th>Aligned Unit Materials, Resources, and Technology (beyond core resources)</th></tr>
<tr><td>Intermolecular forces (IMFs), Attraction, Repulsion Surface tension, Volatility, Evaporation rate, Vapor pressure, Boiling point, Melting point, VSEPR theory (Valence Shell Electron Pair Repulsion), Electron domain, Molecular geometry / shape, Linear, Bent, Trigonal planar, Trigonal pyramidal, Tetrahedral, Symmetry, Nonpolar, molecule, Polar molecule, “Like dissolves like” (polarity rule), Chemical formula, Molecular formula, Subscript, Coefficient, Ion, Cation, Anion, Polyatomic ion, Single bond, Double bond, Chemical bond, Ionic bond, Covalent bond, Metallic bond, Electrons,Valence electrons, Octet rule, Electronegativity, Bond polarity, Polar bond, Nonpolar bond, Partial charge (δ+ / δ–)</td><td>Shared Chemistry Materials

molecular model kits
acetone
blue glitter
oil
charging source (fur, wool, etc)
food coloring

capillary tubes
dish soap
balloons
isopropyl alcohol
pepper</td></tr>
<tr><th>Opportunities for Interdisciplinary Connections:</th><th>Anticipated misconceptions</th></tr>
<tr><td>• Biology: The Molecule of Life:
Connect Learning Target 2 & 4 specifically to DNA and proteins. Students can investigate how the polarity of water and the "weak" intermolecular forces (hydrogen bonding) are the only reasons the DNA double helix stays together and why cell membranes form bilayers.</td><td>• Confusing the forces that hold atoms together within a molecule (chemical bonds) with the forces that attract one molecule to another (IMFs).
• Thinking that boiling or melting requires breaking covalent bonds.
• Assuming the molecular shape is simply the 2D arrangement shown in the Lewis structure.</td></tr>
</table>

• Environmental Science: Oceanic Cleanup Use the "Like dissolves like" success criteria to study oil spills. Students can analyze why crude oil (nonpolar) sits on top of the ocean (polar) and the chemistry behind "dispersants" that act as a bridge between the two. • Culinary Arts: The Science of Emulsions Why do oil and vinegar separate in a dressing? Students can apply their knowledge of polar/nonpolar compounds to understand how "emulsifiers" (like lecithin in egg yolks) allow us to make stable mixtures like mayonnaise.	• Thinking that if a molecule contains polar bonds, the molecule *must* be polar.
Connections to Prior Units	**Connections to Future Units**
• Polarity of water and related macroscopic properties is introduced in Bio. • Explanation as to why water is a polar molecule is expanded upon in Chemistry. • Students must know how to identify types of compounds (ionic vs covalent) and how to draw covalent compounds (Unit 2) in order to determine the molecular geometry and polarity in Unit 3.	Gases are first introduced in Unit 3 in the context of explaining how intermolecular forces impact boiling point. Properties of gases are expanded upon in Unit 4.

Differentiation through Universal Design for Learning

	Engagement	Representation	Action & Expression
LT1	Assign students an element and have them "network" to find partners. Ionic "couples" involve a gift (electron transfer), while covalent "couples" involve holding hands (sharing).	Use physical items like Bingo chips, Skittles, or Cheerios as valence electrons. Provide a "Bonding Mat" that clearly shows the nucleus in the center and pre-drawn slots for the octet rule.	Allow students to build Lewis structures using digital "drag-and-drop" tools, physical modeling kits, or by drawing them on mini-whiteboards during a "Check for Understanding" game.
LT2	Start with a classic hook: use a statically charged comb to "bend" a stream of water. Ask students why water reacts this way while a nonpolar liquid (like oil) wouldn't.	To represent 3D geometry, use balloons tied together. They naturally push away from each other, perfectly mimicking how electron pairs (especially lone pairs) create molecular shapes like "Bent" or "Tetrahedral."	Provide a reference sheet where students must use specific colors for partial charges: Red for the more electronegative atom and Blue for the less electronegative atom. This visual consistency helps identify "dipoles" at a glance.
LT3	Relate IMFs to everyday fasteners. Nonpolar molecules have weak "static cling," while polar molecules have "strong magnets" (dipole-dipole). This makes the abstract concept of "attraction" tangible.	Use a visual sliding scale or "thermometer" that ranks forces from weakest to strongest. Place London Dispersion at the bottom and Hydrogen Bonding (a specific IMF) at the top to emphasize the hierarchy.	Give students a set of 3D molecule models and ask them to physically arrange them in a line from "Least Sticky" to "Most Sticky" based on their polarity and predicted IMFs.
LT4	In small groups, students place a drop of water, rubbing alcohol, and acetone on a surface and time how long they take to evaporate. This turns "vapor pressure" into a competitive, observable event.	Provide graphs that show the relationship between IMFs and properties. For example, a graph showing that as "Stickiness" (IMF) goes up, "Boiling Point" also goes up (direct), but "Evaporation Rate" goes down (inverse).	Provide a "Mystery Compound" datasheet. Students must use the boiling point and solubility data to work backward and predict if the molecule is polar or nonpolar, acting as "Chemical Detectives."

Supporting Multilingual/English Learners (CELP standards)

	Emerging	Expanding	Bridging
LT1	Learning Target • I can label valence electrons as dots and circle where atoms are "sharing." Scaffold • Visual Banks: Provide atoms with pre-drawn "slots" for dots.	Learning Target • I can draw a Lewis structure and describe the force holding the atoms together. Scaffold • Sentence Frames: "In this bond, electrons are	Learning Target • I can compare single and triple bonds and explain how electrostatic attraction creates an ionic bond. Scaffold • Comparative Stems: "While

	Use "Take" (Ionic) and "Share" (Covalent) icons.	[shared/transferred]. This is an [ionic/covalent] bond."	covalent bonds share electrons, ionic bonds rely on..."
LT2	Learning Target • I can point to the "puller" (more electronegative) and match shapes to their names (Bent, Linear). Scaffold • Picture Glossary: A "Shape Menu" with 3D photos. Color-coded partial charges (\$\delta+\$ in blue, \$\delta-\$ in red).	Learning Target • I can label partial charges and predict if a substance dissolves in water using a rule. Scaffold • Rule Prompt: "Like dissolves like. Water is polar, so [Sugar] will dissolve because it is [polar/nonpolar]."	Learning Target • I can analyze a 3D model to determine if a molecule is polar based on its symmetry and lone pairs. Scaffold • Reasoning Stems: "Because the lone pairs push the atoms down, the molecule is asymmetrical and therefore..."
LT3	Learning Target • I can identify which molecule is "stickier" based on its polarity level. Scaffold • Stickiness Meter: A visual scale from 1–10. Nonpolar = 1 (Low Stick), Polar = 10 (High Stick).	Learning Target • I can state that all molecules have forces and link polarity to force strength. Scaffold • Relationship Frames: "As polarity increases, the strength of the intermolecular force [increases/decreases]."	Learning Target • I can discuss how different types of polarity (dipoles) lead to different strengths of attraction. Scaffold • Discussion Starters: "The dipole in a water molecule is stronger than in methane because..."
LT4	Learning Target • I can match "High Boiling Point" to "Strong Force" using a picture. Scaffold • Visual Data Cards: Cards with a thermometer icon for boiling point and a "magnet" icon for IMFs.	Learning Target • I can explain why water has a high boiling point by referring to its "stickiness" (IMFs). Scaffold • Cause/Effect Frames: "Water has a [high/low] boiling point because its molecules are [hard/easy] to pull apart."	Learning Target • I can justify a substance's identity by evaluating its evaporation rate and surface tension data. Scaffold • CER Template: "My claim is that this is sugar. My evidence is the high melting point. My reasoning is that high IMFs..."

Unit Outline

Lesson Sequence	Learning Target(s)	Success Criteria Resources/Assessments/ Assured Learning Experiences
3 days	**Learning Target 1** I can create and use lewis structures to explain chemical bonds	• I can identify the forces that hold together the atoms that make up ionic (electrostatic attraction) and covalent bonds (sharing of electrons). • I can model the lewis structure for a main group element and a simple ionic or covalent compound • ***ACC Only*** I can determine the number of bonds formed in a covalent compound. (single, double, triple) pHet Labs - Build a Molecule
5 days	**Learning Target 2** I can identify compounds as polar or nonpolar	• I can define a polar bond as an unequal distribution of electrons, and label atoms with partial charges. • I can identify a bond as polar or nonpolar using differences in electronegativity. (Students will be given electronegativity values and ranges) Electronegativity Reference • I can use the phrase "like dissolves like" to determine whether a compound is polar or nonpolar. • I can use CO_2 and H_2O to model how lone pairs of electrons affect the geometry of a molecule • ***ACA Only*** When given the shape of a molecule, I can determine whether it is polar or nonpolar. Academic students will explore geometries when given the Lewis structure • ***ACC Only*** When given the formula, I can determine the lewis

		structure, shape, and polarity of a molecule when given a reference table molecular geometry reference • I can identify water and sugar as polar compounds.
3 days	**Learning Target 3** I can discuss how differences in molecular polarity affect intermolecular forces	• I can define intermolecular forces (forces such as Hydrogen bonds and London dispersion not required to be known by name) • I can state that all molecules experience intermolecular forces. • I can relate the polarity of a molecule to the strength of its intermolecular forces. Classroom Resources | Simulation Activity: Intermolecular Forces | AACT
3 days	**Learning Target 4** I can explore how the physical properties of substances are affected by intermolecular forces	• I can analyze the strength of intermolecular forces present in water vs sugar based on boiling point, melting point, vapor pressure ***ACC Only*** and surface tension. • I can state the direct relationship between intermolecular forces and boiling point. • I can state the direct relationship between intermolecular forces and melting point. • I can state the direct relationship between intermolecular forces and surface tension. • I can state the inverse relationship between intermolecular forces and rate of evaporation. • ***ACC Only*** I can state the inverse relationship between intermolecular forces and vapor pressure.

Unit Title

Unit 4: Chemical Reactions, Stoichiometry & Gas Laws (Airbags)

Relevant Standards: Bold indicates priority

HS-PS1-2	**HS-PS1-5**	**HS-PS1-7**
HS-PS1-4	**HS-PS1-6**	

Essential Question(s)	Enduring Understanding(s)
How does matter transform while remaining conserved? How do we control the speed and "heat" of a chemical transformation? How can we use the predictable behavior of gasses to save lives?	In a chemical reaction, atoms are never created or destroyed; they are simply rearranged. Balancing equations and using stoichiometry allows us to predict exactly how much "new" substance can be made from a set amount of "old" substance. Reactions occur when particles collide with enough energy and correct orientation (Collision Theory). By manipulating variables like temperature or concentration, we can speed up or slow down a reaction and manage the energy (heat) it absorbs or releases. Gasses respond to changes in pressure, volume, and temperature in mathematically predictable ways. By calculating the exact moles of gas produced in a reaction, we can engineer devices like airbags to inflate to a precise volume at a precise moment.

Demonstration of Learning	Pacing for Unit
• Airbag Lab (inflation of plastic bag) • Evidence of Chemical Reactions Lab (stations) • Single and Double Replacement Lab • Chemical Reactions Assessment • Stoichiometry CFA • Types of Reactions CFA • Limiting and Excess Lab	26 Blocks or Day 119 - 174 of the School Year *(Final review and exam follow this unit)*

Family Overview (link below)	Integration of Technology
Chemistry ACA/ACC Family Overview (2026)	• *PhET Labs* • *Gizmos* • *Google Slides (Research and Presentations)*

Unit-specific Vocabulary	Aligned Unit Materials, Resources, and Technology (beyond core resources)
Physical Change, Chemical Change, Chemical Reaction, Reactant, Product, Evidence of a chemical reaction, Balanced Chemical Equation, Law of Conservation of Mass, Particle Diagram, Synthesis, Decomposition, Single Replacement, Double Replacement, Combustion, Precipitate, Mole Ratio, Stoichiometry, Moles, Limiting Reactant, Excess Reactant, Theoretical Yield, Actual Yield, Percent Yield, Dimensional Analysis, Multi-step Conversions, Molar Mass, Endothermic, Exothermic, Energy Diagram, Collision, Reaction Rate, Activation Energy, Concentration, Surface Area, Catalyst, Pressure, Volume, Boyle's Law, Charles's Law, Gay-Lussac's Law, Combined Gas Law, Ideal Gas Law, Ideal Gas Constant	Shared Chemistry Materials sandwich baggies $NaHCO_3$ acetic acid aluminum $CuSO_4$ other various chemicals to demonstrate single and double replacement labs HCl phenolphthalein NaOH self inflating balloons supplies for s'mores stoichiometry

Opportunities for Interdisciplinary Connections:	Anticipated misconceptions
• Engineering: Airbag design and incorporation into	• Mass is lost if a gas is produced

vehicles • Automotive Engineering & Physics: This unit is a direct bridge to physics. Students can calculate the Impulse required to stop a passenger and relate it to the volume of gas produced. This turns the airbag from a "bag of air" into a calculated safety system. • Environmental Science: Green Chemistry Connect Percent Yield and Stoichiometry to industrial waste. Students can analyze how "Atom Economy" helps factories reduce pollution by ensuring that more of the reactants end up in the desired product rather than as byproduct waste. • Health & Safety: Toxicology Since airbags use Sodium Azide, which is toxic, students can discuss the chemistry of decomposition into harmless Nitrogen gas and how the chemical industry balances "useful" reactions with "safe" waste management.	• Subscripts can be changed to balance equations • Equations show what is actually happening in real-time • The Molar Ratio is a Gram Ratio • The Limiting Reagent is the one with the smallest mass • Exothermic reactions don't need energy to start • Breaking bonds releases energy • Gas particles eventually stop moving if it's cold • Gases have no mass or volume • Increasing the volume of a container increases the pressure
Connections to Prior Units	**Connections to Future Units**
• Students will use Law of Conservation of Matter (introduced in Units 1 and 2) when balancing equations. • Particle diagrams are introduced in Unit 1. • Students learned how to form electrically neutral ionic compounds in Unit 2. This is needed in order to predict the products of chemical reactions. • Students will use ionic and covalent compound naming (Unit 2 and 3) to properly name/ record reactants and products of a chemical reaction	Understanding chemical reactions, conservation of mass and energy, stoichiometry, reaction rates, and gas behavior prepares students to succeed in high school and college-level chemistry, as well as in biology topics such as metabolism and respiration, physics topics involving energy and particle motion, and earth science topics related to atmospheric behavior and climate.

Differentiation through *Universal Design for Learning*

	Engagement	Representation	Action & Expression
LT 1-3	Use "Airbag Launch" videos. Show a failed airbag vs. a successful one to spark a "Driving Question Board" about what went wrong.	Use particle diagrams (colored magnets) to show that atoms don't disappear during balancing—they just move "houses."	Allow students to write equations as "Chemical Sentences" or "Math Equations" before moving to standard symbols.
LT4	Use "Recipe Scaling." Have students scale up a cookie recipe for 1,000 people to understand the "Ratio" concept before using moles.	Provide a "Stoichiometry Flowchart" (Grams to Moles to Moles to Grams) that uses arrows to show the direction of the calculation.	Provide "Calculated Tiers": Tier 1 provides the molar masses; Tier 2 provides the mole ratio; Tier 3 is a blank problem.
LT 5 & 6	Use "Alka-Seltzer Races." Have groups compete to make a tablet disappear the fastest by changing variables (crushing, heating, etc.).	Use "Reaction Coordinate Diagrams" that look like roller coasters. Exothermic "drops" down; Endothermic "climbs" up.	Students can "Narrate the Collision" via a comic strip showing particles hitting each other with enough "oomph" (energy).
LT7	The "Egg in a Bottle" or "Can Crush" demo. Use these "magic" tricks to force students to explain the P, V, T relationship.	Use PhET Gas Properties simulations. Let students "pump" gas into a box to see the particles move faster as they add heat (KMT).	Provide a "Gas Law Organizer" that identifies which variables are held constant for Boyle's, Charles's, and Gay-Lussac's laws.

Supporting Multilingual/English Learners (*CELP standards*)

	Emerging	Expanding	Bridging
LT 2 & 4	Learning Target • I can identify the reactants (left) and products (right) and copy a balanced equation. Scaffold • Color-coded equations	Learning Target • I can state that mass is conserved and calculate a mole ratio using a balanced equation. Scaffold	Learning Target • I can calculate the percent yield and justify why the actual yield might be lower than the theoretical yield. Scaffold

	(Reactants in blue, Products in red).	• Sentence frame: "Because there are 2 moles of A, I need [number] moles of B."	• CER (Claim, Evidence, Reasoning) template for lab reports.
LT 5 & 6	Learning Target • I can label a graph as "Hot" (Exothermic) or "Cold" (Endothermic) and point to a fast reaction. Scaffold • Thermometer icons on energy graphs.	Learning Target • I can describe how heat moves in a reaction and explain how temperature changes the speed. Scaffold • "If I increase temperature, then particles move [faster/slower] and collide [more/less]."	Learning Target • I can analyze a reaction coordinate diagram and evaluate how a catalyst would change the reaction rate. Scaffold • Comparative vocabulary bank (activation energy, catalyst, collision frequency).
LT 7	Learning Target • I can match an increase in pressure to a decrease in volume using a picture. Scaffold • Visual cards showing a piston moving down in a cylinder.	Learning Target • I can predict what happens to a balloon in a freezer vs. a hot car using a gas law. Scaffold • Relationship chart (Variable ↑, Variable ↓)	Learning Target • I can calculate the volume of an airbag using the Ideal Gas Law and explain its importance to safety. Scaffold • Multi-step problem-solving checklist.

Unit Outline

Lesson Sequence	Learning Target(s)	Success Criteria Resources/Assessments/ Assured Learning Experiences
3 days	**Learning Target 1** I can determine if a process is a chemical or physical change	• I can identify indicators of chemical reactions. Shared Chemistry Materials (Evidence of chemical reactions)
3 days	**Learning Target 2** I can represent a chemical reaction:	• I can write a balanced chemical equation showing conservation of mass. • I can explain how atoms are conserved in a reaction using mathematical representations as evidence. • I can write a chemical reaction as a sentence or a chemical equation. • I can identify reactants and products • I can represent reactants and products as a particle diagram
4 days	**Learning Target 3** I can compare and contrast the different types of chemical reactions	• I can identify and describe reaction types generally and as specifically applied to airbags. • I can predict the products of a chemical reaction of main group elements. (***ACC Only*** polyatomic ions)
8 days	**Learning Target 4** I can use stoichiometry to relate the amounts of reactants and products in a chemical reaction.	• Given an amount of one reagent, I can mathematically determine how much reactant would be needed or how much product would be produced. • I can design a model of an airbag that maximizes the production of the product. • I can identify limiting and excess reagents. (***ACC*** quantitatively, **ACA** only qualitatively) • I can perform mathematical calculations to determine the percent yield of a product from a given amount of reactant. Shared Chemistry Materials (Stoich Target Lab)

1 day	**Learning Target 5** I can compare and contrast endothermic or exothermic reactions	• I can show heat on the correct side of a chemical reaction based on if it is an endothermic or exothermic process • I can calculate the amount of heat absorbed/released based on the moles of reactants used. • I can graph, label and interpret the energy change in endothermic and exothermic reactions
3 days	**Learning Target 6** I can use collision theory to discuss reaction rates.	• I can define collision theory and its relationship to reaction rates. • I can determine how a reaction's rate can be altered by manipulating conditions.
4 days	**Learning Target 7** I can use Gas Laws to explain the behavior of ideal gasses.	• I can use Boyle's Law, Charles's Law, and Gay-Lussac's Law to predict the behavior of gasses. (qualitative for **ACA**) • I can relate these gas laws to kinetic molecular theory. • I can use the combined Gas Law to predict the behavior of gasses (qualitative for **ACA**) • I can use the ideal gas law quantitatively to describe the behavior of gasses. (limit to moles for **ACA**) • I can use 22.4 L = 1 mole as a conversion factor (in dimensional analysis for ***ACC***, as a fact only for **ACA**) • I can relate the gas laws to the successful inflation of an airbag. • I can calculate the amount of gas produced in the decomposition of sodium azide in the inflation of an airbag.