

HONORS CHEMISTRY
Semester One
Benchmark Blueprint

Strand 2: History and Nature of Science

Scientific investigation grows from the contributions of many people. History and Nature of Science emphasizes the importance of the inclusion of historical perspectives and the advances that each new development brings to technology and human knowledge. This strand focuses on the human aspects of science and the role that scientists play in the development of various cultures.

CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 1: History of Science as a Human Endeavor Identify individual, cultural, and technological contributions to scientific knowledge.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	PO 1. Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.	
		<i>PO 2. Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.</i>	
		PO 3. Analyze how specific changes in science have affected society.	
		PO 4. Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.	

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CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 2: Nature of Scientific Knowledge Understand how science is a process for generating knowledge.</p>	<p>Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.</p>	<p>PO 1. Specify the requirements of a valid, scientific explanation (theory), including that it be:</p> <ul style="list-style-type: none"> • logical • subject to peer review • public • respectful of rules of evidence 	
	<p>Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments.</p>	<p>PO 2. Explain the process by which accepted ideas are challenged or extended by scientific innovation.</p>	
	<p>B. Demonstrate care and use of appropriate technology and equipment.</p>	<p>PO 3. Distinguish between pure and applied science.</p>	
		<p>PO 4. Describe how scientists continue to investigate and critically analyze aspects of theories.</p>	

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Strand 5: Physical Science

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CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 1: Structure and Properties of Matter Understand physical, chemical, and atomic properties of matter.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	PO 1. Describe substances based on their physical properties.	
		PO 2. Describe substances based on their chemical properties.	
		PO 3. Predict properties of elements and compounds using trends of the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).	
		PO 3H. Describe the periodic trends in atomic radii, ionic radii, ionization energies and electronegativity.	
		PO 4. Separate mixtures of substances based on their physical properties.	
		PO 5. Describe the properties of electric charge and the conservation of electric charge.	
		PO 6. Describe the following features and components of the atom: <ul style="list-style-type: none"> • protons • neutrons • electrons • mass • number and type of particles • structure • organization 	
		PO 7. Describe the historical development of models of the atom.	

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<p>Concept 1: Structure and Properties of Matter Understand physical, chemical, and atomic properties of matter</p>	<p>Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.</p> <p>Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments.</p> <p>B. Demonstrate care and use of appropriate technology and equipment.</p>	<p>PO 8. Explain the details of atomic structure (e.g., electron configuration, energy levels, isotopes).</p> <hr/> <p>PO 8H. Explain the details of atomic structure to include the following:</p> <ul style="list-style-type: none"> • electron configuration • energy levels • isotopes • orbital diagrams 	

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CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 3: Conservation of Energy and Increase in Disorder Understand ways that energy is conserved, stored, and transferred.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	<p>PO 1. Describe the following ways in which energy is stored in a system:</p> <ul style="list-style-type: none"> • mechanical • electrical • chemical • nuclear 	
		<p>PO 2. Describe various ways in which energy is transferred from one system to another (e.g., mechanical contact, thermal conduction, electromagnetic radiation.)</p>	
		<p>PO 3. Recognize that energy is conserved in a closed system.</p>	
		<p>PO 4. Calculate quantitative relationships associated with the conservation of energy.</p>	
		<p>PO 5. Analyze the relationship between energy transfer and disorder in the universe (2nd Law of Thermodynamics).</p>	
		<p>PO 6. Distinguish between heat and temperature.</p>	
		<p>PO 7. Explain how molecular motion is related to temperature and phase changes.</p>	
		<p>PO 7H. Interpret phase diagrams.</p>	

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Strand 1: Inquiry Process

Inquiry Process establishes the basis for students' learning in science. Students use scientific processes: questioning, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, and communicating results.

CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 1: Observations, Questions, and Hypotheses Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	PO 1. Evaluate scientific information for relevance to a given problem.	
		PO 2. Develop questions from observations that transition into testable hypotheses.	
		PO 3. Formulate a testable hypothesis.	
		PO 4. Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).	

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Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.	Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.	PO 1. Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.	
		PO 1H. Demonstrate proper chemical waste procedures.	
	Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments. B. Demonstrate care and use of appropriate technology and equipment.	PO 2. Identify the resources needed to conduct an investigation.	
		PO 3. Design an appropriate protocol (written plan of action) for testing a hypothesis: <ul style="list-style-type: none"> • Identify dependent and independent variables in a controlled investigation. • Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes). • Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators). 	
		PO 3H. Application of appropriate lab technique including the following: <ul style="list-style-type: none"> • Filtration • Titration • Making solutions (standards/dilutions) • Pipetting • Recording temperature appropriately 	

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Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.	Goal 1: Problem Solving/Reasoning Skills A. Predicting outcomes based on observed events, data analysis and/or background knowledge. B. Formulating concepts based on observations, making distinctions, and forming generalizations C. Making inferences based on data interpretation or observations to imply a given concept(s). D. Analysis of events based on an examination of the data and application of background knowledge E. Making connections between cause/effect variables.	PO 4. Conduct a scientific investigation that is based on a research design.	
		PO 5. Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.	
		PO 5H. Record measurements using proper units and significant digits.	
		PO 6H. Determine uncertainty of a piece of equipment or measurement.	
		PO 7H. Calculate chemistry problems with proper units and significant digits.	

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CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 3: Analysis, Conclusions, and Refinements Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.</p>	<p>Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.</p> <p>Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments.</p> <p>B. Demonstrate care and use of appropriate technology and equipment.</p>	<p><i>PO 1. Interpret data that show a variety of possible relationships between variables, including:</i></p> <ul style="list-style-type: none"> • <i>positive relationship</i> • <i>negative relationship</i> • <i>no relationship</i> 	
		<p>PO 1H Make appropriate graphs and interpret graphical models.</p>	
		<p>PO 2. Evaluate whether investigational data support or do not support the proposed hypothesis.</p>	
		<p>PO 3. Critique reports of scientific studies (e.g., published papers, student reports).</p>	
		<p>PO 4. Evaluate the design of an investigation to identify possible sources of procedural error, including:</p> <ul style="list-style-type: none"> • sample size • trials • controls • analyses 	
<p>PO 4H. Evaluate the design of an investigation to identify possible sources of procedural error, including:</p> <ul style="list-style-type: none"> • use of equipment • the investigational process • management of time 			

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<p>Concept 3: Analysis, Conclusions, and Refinements Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	<p>PO 5. Design models (conceptual or physical) of the following to represent "real world" scenarios:</p> <ul style="list-style-type: none"> • carbon cycle • water cycle • phase change • collisions 	
		<p>PO 6. Use descriptive statistics to analyze data, including:</p> <ul style="list-style-type: none"> • mean • frequency • range <p>(See MHS-S2C1-10)</p>	
		<p>PO 6H. Apply statistical techniques to data including the following:</p> <ul style="list-style-type: none"> • Percent error • T-test 	
		<p>PO 7H. Determine statistical significance (i.e. what does the error mean?)</p>	
		<p>PO 7. Propose further investigations based on the findings of a conducted investigation.</p>	

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CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 4: Communication Communicate results of investigations.	Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.	PO 1. For a specific investigation, choose an appropriate method for communicating the results.	
		PO 2. Produce graphs that communicate data. (See MHS-S2C1-02)	
	Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments.	PO 3. Communicate results clearly and logically.	
	B. Demonstrate care and use of appropriate technology and equipment.	PO 4. Support conclusions with logical scientific arguments.	
		PO 4H. Present student research in a public format (i.e., science fair, symposium, classroom presentations)	

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Strand 3: Science in Personal and Social Perspectives

Science in Personal and Social Perspectives emphasizes developing the ability to design a solution to a problem, to understand the relationship between science and technology, and the ways people are involved in both. Students understand the impact of science and technology on human activity and the environment. This strand affords students the opportunity to understand their place in the world – as living creatures, consumers, decision makers, problem solvers, managers, and planners.

CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 2: Science and Technology in Society Develop viable solutions to a need or problem.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	<p>PO 1. Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:</p> <ul style="list-style-type: none"> • various forms of alternative energy • storage of nuclear waste • abandoned mines • greenhouse gases • hazardous wastes <p>PO 2. Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.</p> <p>PO 3. Support a position on a science or technology issue.</p> <p>PO 4. Analyze the use of renewable and nonrenewable resources in Arizona:</p> <ul style="list-style-type: none"> • water • land • soil • minerals • air <p>PO 5. Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).</p>	

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<p>Concept 4: Chemical Reactions Investigate relationships between reactants and products in chemical reactions.</p>	<p>Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.</p>	PO 1. Apply the law of conservation of matter to changes in a system.		
		PO 2. Identify the indicators of chemical change, including formation of a precipitate, evolution of a gas, color change, absorption or release of heat energy.		
		PO 3. Represent a chemical reaction by using a balanced equation.		
		<p>Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments.</p>		PO 4. Distinguish among the types of bonds (i.e., ionic, covalent, metallic, hydrogen bonding).
				PO 4H. Identify Lewis structures of molecules and ions.
				PO 5. Describe the mole concept and its relationship to Avogadro's number.
		B. Demonstrate care and use of appropriate technology and equipment.		PO 6. Solve problems involving such quantities as moles, mass, molecules, volume of a gas, and molarity using the mole concept and Avogadro's number.
				PO 7. Predict the properties (e.g., melting point, boiling point, conductivity) of substances based upon bond type.
				PO 8. Quantify the relationships between reactants and products in chemical reactions (e.g., stoichiometry, equilibrium, energy transfers).
		PO 8H. Determine the limiting reactant and percent yield when quantities of a reacting substance are given.		

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<p>Concept 4: Chemical Reactions Investigate relationships between reactants and products in chemical reactions.</p>	<p>Goal 1: Problem Solving/Reasoning Skills</p> <p>A. Predicting outcomes based on observed events, data analysis and/or background knowledge.</p> <p>B. Formulating concepts based on observations, making distinctions, and forming generalizations</p> <p>C. Making inferences based on data interpretation or observations to imply a given concept(s).</p> <p>D. Analysis of events based on an examination of the data and application of background knowledge</p> <p>E. Making connections between cause/effect variables.</p>	PO 9. Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion).	
		PO 9H. Construct a net ionic equation.	
		PO 10. Explain the energy transfers within chemical reactions using the law of conservation of energy.	
		PO 11. Predict the effect of various factors (e.g., temperature, concentration, pressure, catalyst) on the equilibrium state and on the rates of chemical reaction.	
		PO 12. Compare the nature, behavior, concentration, and strengths of acids and bases.	
		PO 12H. Calculate the missing variable for titration experiments.	
		PO 13. Determine the transfer of electrons in oxidation/reduction reactions.	
		PO 13H. Balance equations of redox reactions.	
		PO 14H. Explain how a redox reaction is used to produce electricity in voltaic cells.	
		PO 15H. Identify the factors that affect solubility and interpret solubility curves.	
		PO 16H. Solve calculations involving concentration, amount of solute and volume of solution.	

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CONCEPT	HONORS GOALS	PERFORMANCE OBJECTIVE	ASSESSMENT
<p>Concept 5: Interactions of Energy and Matter Understand the interactions of energy and matter.</p>	<p>Goal 2: Mastery of Mathematical Skills A. Construct and interpret graphs related to data collected and analyzed.</p>	PO 1. Describe various ways in which matter and energy interact (e.g., photosynthesis, phase change).	
		PO 4. Describe the basic assumptions of kinetic molecular theory.	
	<p>Goal 3: Laboratory and Field Skills A. Actively design, implement and analyze information gained through laboratory experiments.</p>	PO 5. Apply kinetic molecular theory to the behavior of matter (e.g., gas laws).	
		PO 5H. Solve gas law problems including the following: <ul style="list-style-type: none"> • Boyle's Law • Charles's Law • combined gas law • ideal gas law • partial pressure 	
		PO 6. Analyze calorimetric measurements in simple systems and the energy involved in changes of state.	
	B. Demonstrate care and use of appropriate technology and equipment.	PO 7. Explain the relationship between the wavelength of light absorbed or released by an atom or molecule and the transfer of a discrete amount of energy.	