CHEMISTRY
Semester One
Benchmark Blueprint

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	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 1: Observations, Questions, and Hypotheses Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.		
Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.		
Concept 3: Analysis, Conclusions, and Refinements Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.		
Concept 4: Communication Communicate results of investigations.		

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	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 1: History of Science as a Human Endeavor Identify individual, cultural, and technological contributions to scientific knowledge.	PO 1. Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.	
	PO 2. Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.	
	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.	
Concept 2: Nature of Scientific Knowledge Understand how science is a process for generating knowledge.	PO 1. Specify the requirements of a valid, scientific explanation (theory), including that it be: • logical • subject to peer review • public • respectful of rules of evidence	
	PO 2. Explain the process by which accepted ideas are challenged or extended by scientific innovation.	
	PO 3. Distinguish between pure and applied science.	
	PO 4. Describe how scientists continue to investigate and critically analyze aspects of theories.	

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	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 1: Changes in Environments Describe the interactions between human populations, natural hazards, and the environment.		
Concept 2: Science and Technology in Society Develop viable solutions to a need or problem.		
Concept 3: Human Population Characteristics Analyze factors that affect human populations.		

Strand 5: Physical Science

Physical Science affords students the opportunity to increase their understanding of the characteristics of objects and materials they encounter daily. Students gain an understanding of the nature of matter and energy, including their forms, the changes they undergo, and their interactions. By studying objects and the forces that act upon them, students develop an understanding of the fundamental laws of motion, knowledge of the various ways energy is stored in a system, and the processes by which energy is transferred between systems and surroundings.

CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 1: Structure and Properties of Matter Understand physical, chemical, and atomic properties of matter.	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 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: • protons • neutrons • electrons • mass • number and type of particles • structure • organization PO 7. Describe the historical development of models of the atom. PO 8. Explain the details of atomic structure (e.g., electron configuration, energy levels, isotopes).	

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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 3: Conservation of Energy and Increase in Disorder Understand ways that energy is conserved, stored, and transferred.	PO 1. Describe the following ways in which energy is stored in a system: • mechanical • electrical • chemical • nuclear	
	PO 2. Describe various ways in which energy is transferred from one system to another (e.g., mechanical contact, thermal conduction, electromagnetic radiation.)	
	PO 3. Recognize that energy is conserved in a closed system.	
	PO 4. Calculate quantitative relationships associated with the conservation of energy.	
	PO 5. Analyze the relationship between energy transfer and disorder in the universe (2^{nd} Law of Thermodynamics).	
	PO 6. Distinguish between heat and temperature.	
	PO 7. Explain how molecular motion is related to temperature and phase changes.	

CHEMISTRY
Semester Two
Benchmark Blueprint

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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 1: Observations, Questions, and Hypotheses Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.	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).	
Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.	PO 1. Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.	
	PO 2. Identify the resources needed to conduct an investigation.	
	PO 3. Design an appropriate protocol (written plan of action) for testing a hypothesis: • 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).	

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Concept 2: Scientific Testing (Investigating and Modeling) Design and conduct controlled investigations.	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.	
Concept 3: Analysis, Conclusions, and Refinements Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.	*PO 1. Interpret data that show a variety of possible relationships between variables, including:* • *positive relationship* • *negative relationship* • *no relationship*	
	PO 2. Evaluate whether investigational data support or do not support the proposed hypothesis.	
	PO 3. Critique reports of scientific studies (e.g., published papers, student reports).	
	PO 4. Evaluate the design of an investigation to identify possible sources of procedural error, including: • sample size • trials • controls • analyses	

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Concept 3: Analysis, Conclusions, and Refinements Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.	PO 5. Design models (conceptual or physical) of the following to represent "real world" scenarios: • carbon cycle • water cycle • phase change • collisions	
	PO 6. Use descriptive statistics to analyze data, including: • mean • frequency • range (See MHS-S2C1-10)	
	PO 7. Propose further investigations based on the findings of a conducted investigation.	
Concept 4: Communication Communicate results of investigations.	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)	
	PO 3. Communicate results clearly and logically.	
	PO 4. Support conclusions with logical scientific arguments.	

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Concept 2: Science and Technology in Society Develop viable solutions to a need or problem.	PO 1. Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems: • various forms of alternative energy • storage of nuclear waste • abandoned mines • greenhouse gases • hazardous wastes	
	PO 2. Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.	
	PO 3. Support a position on a science or technology issue.	
	PO 4. Analyze the use of renewable and nonrenewable resources in Arizona: • water • land • soil • minerals • air	
	PO 5. Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).	

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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 4: Chemical Reactions Investigate relationships between reactants and products in chemical reactions.	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.	
	PO 4. Distinguish among the types of bonds (i.e., ionic, covalent, metallic, hydrogen bonding).	
	PO 5. Describe the mole concept and its relationship to Avogadro's number.	
	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 9. Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion).	
	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 13. Determine the transfer of electrons in oxidation/reduction reactions.	

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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 5: Interactions of Energy and Matter Understand the interactions of energy and matter.	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.	
	PO 5. Apply kinetic molecular theory to the behavior of matter (e.g., gas laws).	
	PO 6. Analyze calorimetric measurements in simple systems and the energy involved in changes of state.	
	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.	