INVESTIGATIVE SCIENCE
Benchmark Blueprint

Investigative Science: Energy, Matter and Organization Curriculum Overview			
Semester 1		Semester 2	
Unit Focus	Concepts	Unit Focus	Concepts
Matter Unit 1	Origin of the Universe	Energy and Matter Unit 6	Energy in Earth Systems Forces and Motion
Matter Unit 2	Properties of Matter Atomic Nature Periodic Table	Energy and Matter Unit 7	Interaction of Energy and Matter
Energy and Matter Unit 3	Conservation of Energy	Energy, Matter and Organization Unit 8	Ecosystems/Food Chains
Energy and Matter Unit 4	Chemical Reactions	Energy, Matter and Organization Unit 9	Interdependence of Organisms
Energy and Matter Unit 5	Geochemical Cycles	Energy, Matter and Organization Unit 10	Organization of Living Things

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.

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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. (See R09-S3C1, R10-S3C1, R11-S3C1, and R12-S3C1)	
	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).	
	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.	

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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
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	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	
	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.	

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Concept 4: Communication Communicate results of investigations.	PO 1. For a specific investigation, choose an appropriate method for communicating the results. (See W09-S3C2-01 and W10-S3C3-01)	
	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.	

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.

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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	
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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.

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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 6. Describe the following features and components of the atom: ○ protons ○ neutrons ○ electrons ○ mass ○ number and type of particles ○ structure ○ organization	
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 • chemical	
	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 7. Explain how molecular motion is related to temperature and phase changes.	

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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.	

Strand 6: Earth and Space Science

Earth and Space Science provides the foundation for students to develop an understanding of the Earth, its history, composition, and formative processes, and an understanding of the solar system and the universe. Students study the regularities of the interrelated systems of the natural world. In doing so, they develop understandings of the basic laws, theories, and models that explain the world (NSES, 1995). By studying the Earth from both a historical and current time frame, students can make informed decisions about issues affecting the planet on which they live.

CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 1: Geochemical Cycles Analyze the interactions between the Earth's structures, atmosphere, and geochemical cycles.	PO 1. Identify ways materials are cycled within the Earth system (i.e., carbon cycle, water cycle, rock cycle).	
	PO 7. Explain how the geochemical processes are responsible for the concentration of economically valuable minerals and ores in Arizona and worldwide.	
Concept 4: Origin and Evolution of the Universe Analyze the factors used to explain the origin and evolution of the universe.	PO 1. Describe the Big Bang Theory as an explanation for the origin of the universe.	
	PO7*. Describe the Nebular Hypothesis relates to the formation of stars and/or solar systems.	

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Strand 4: Life Science

Life Science expands students' biological understanding of life by focusing on the characteristics of living things, the diversity of life, and how organisms and populations change over time in terms of biological adaptation and genetics. This understanding includes the relationship of structures to their functions and life cycles, interrelationships of matter and energy in living organisms, and the interactions of living organisms with their environment.

CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 3: Interdependence of Organisms Analyze the relationships among various organisms and their environment.	PO 1. Identify the relationships among organisms within populations, communities, ecosystems, and biomes.	
	PO 2. Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment.	
	PO 3. Assess how the size and the rate of growth of a population are determined by birth rate, death rate, immigration, emigration, and carrying capacity of the environment.	
Concept 4: Biological Evolution Understand the scientific principles and processes involved in biological evolution.	PO 2. Explain how genotypic and phenotypic variation can result in adaptations that influence an organism's success in an environment.	
	PO 3. Describe how the continuing operation of natural selection underlies a population's ability to adapt to changes in the environment and leads to biodiversity and the origin of new species.	
	PO 4. Predict how a change in an environmental factor (e.g., rainfall, habitat loss, non-native species) can affect the number and diversity of species in an ecosystem.	
Concept 5: Matter, Energy, and Organization in Living Systems (Including Human Systems) Understand the organization of living systems, and the role of energy within those systems.	PO 2. Describe the role of organic and inorganic chemicals (e.g., carbohydrates, proteins, lipids, nucleic acids, water, ATP) important to living things.	
	PO 3. Diagram the following biogeochemical cycles in an ecosystem: • water • carbon • nitrogen	
	PO 4. Diagram the energy flow in an ecosystem through a food chain.	
	PO 5. Describe the levels of organization of living things from cells, through tissues, organs, organ systems, organisms, populations, and communities to ecosystems.	

INVESTIGATIVE SCIENCE
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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 2: Motions and Forces Analyze relationships between forces and motion.	PO 1. Determine the rate of change of a quantity (e.g., rate of erosion, rate of reaction, rate of growth, velocity).	
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).	

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CONCEPT	PERFORMANCE OBJECTIVE	ASSESSMENT
Concept 2: Energy in the Earth System (Both Internal and External) Understand the relationships between the Earth's landmasses, oceans, and atmosphere.	PO 1. Describe the flow of energy to and from the Earth.	
	PO 2. Explain the mechanisms of heat transfer (convection, conduction, radiation) among the atmosphere, landmasses, and oceans.	
	PO 3. Distinguish between weather and climate.	
	External Energy: PO 9. Explain the effect of heat transfer on climate and weather.	
	PO 10. Demonstrate the effect of the Earth's rotation (i.e., Coriolis effect) on the movement of water and air.	
	PO 15. List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).	
	PO 16. Explain the causes and/or effects of climate changes over long periods of time (e.g., glaciation, desertification, solar activity, greenhouse effect).	
	PO 17. Investigate the effects of acid rain, smoke, volcanic dust, urban development, and greenhouse gases, on climate change over various periods of time.	