

# SCIENCE

# SC50 Environmental Science

Course #: SC-50	Grade Level: 9 - 12
Course Name: Environmental Science	Level of Difficulty: Medium
Prerequisites: None	# of Credits: 1

## Strand 1: Inquiry Process

*“Science as inquiry is basic to science education and a controlling principle in the continuing organization and selection of students’ activities. Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry...”* (National Science Education Standards, 1995).

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.

## Concepts

### 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.

## Students should know and be able to...

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C1	Observations, Questions, and Hypotheses	1	Evaluate scientific information for relevance to a given problem.		
		2	Develop questions from observations that transition into testable hypotheses.	affect	
		3	Formulate a testable hypothesis.	propose, hypothesis, formulate	
		4	Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).	probability, predict, investigate	

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C2	Scientific Testing (Investigating and Modeling)	1	Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, and organisms) and behavior in all science inquiry.		
		2	Identify the resources needed to conduct an investigation.	investigation, bias	
		3	<b>Design an appropriate protocol (written plan of action) for testing a hypothesis:</b> <ul style="list-style-type: none"> <li>▪ Identify dependent and independent variables in a controlled investigation.</li> <li>▪ Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).</li> <li>▪ Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).</li> </ul>	qualitative, quantitative, procedure, controlled experiment, variable, observation	
		4	Conduct a scientific investigation that is based on a research design.	experimentation	
		5	Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.	data	

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C3	Analysis and Conclusions, and Refinements	1	<i>Interpret data that show a variety of possible relationships between variables, including:</i> <ul style="list-style-type: none"> <li>▪ <i>positive relationship</i></li> <li>▪ <i>negative relationship</i></li> <li>▪ <i>no relationship</i></li> </ul>		
		2	Evaluate whether investigational data support or do not support the proposed hypothesis.	prediction, interpretation	
		4	Evaluate the design of an investigation to identify possible sources of procedural error, including: <ul style="list-style-type: none"> <li>▪ sample size</li> <li>▪ trials</li> <li>▪ controls</li> <li>▪ analyses</li> </ul>		
		5	Design models (conceptual or physical) of the following to represent "real world" scenarios. <ul style="list-style-type: none"> <li>▪ carbon cycle</li> <li>▪ water cycle</li> </ul>		
		6	Use descriptive statistics to analyze data, including: <ul style="list-style-type: none"> <li>▪ mean</li> <li>▪ frequency</li> <li>▪ range</li> </ul> (see MHS-S2C1-10)	data, frequency, mean	
		7	Propose further investigations based on the findings of a conducted investigation.		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C4	Communication	1	<b>For a specific investigation, choose an appropriate method for communicating the results.</b>		
		2	<b>Produce graphs that help communicate data. (See MHS-S2C1-02)</b>		
		3	<b>Communicate results clearly and logically.</b>		
		4	<b>Support conclusions with logical scientific arguments.</b>		

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**Strand 2: History and Nature of Science**

*Knowledge of the nature of science is central to the understanding of the scientific enterprise” (National Assessment of Educational Progress, 2000).*

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.

**Concepts**

**Concept 1: History of Science as a Human Endeavor**

- Identify individual, cultural, and technological contributions to scientific knowledge.

**Concept 2: Nature of Scientific Knowledge**

- Understand how science is a process for generating knowledge.

Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S2C1	History of Science as a Human Endeavor	1	Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.		
		3	Analyze how specific changes in science have affected society.		
S2C2	Nature of Scientific Knowledge	1	Specify the requirements of a valid, scientific explanation (theory), including that it be: <ul style="list-style-type: none"> <li>▪ logical</li> <li>▪ subject to peer review</li> <li>▪ public</li> <li>▪ respectful of rules of evidence</li> </ul>	pure science, applied science, technology	
		2	Explain the process by which accepted ideas are challenged or extended by scientific innovation.		
		3	Distinguish between pure and applied science.		
		4	Describe how scientists continue to investigate and critically analyze aspects of theories.		

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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.

**Concepts**

**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.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C1	Changes in Environments	1	Evaluate how the processes of natural ecosystems affect, and are affected by, humans.	interdependence	
		2	Describe the environmental effects of the following natural and/or human-caused hazards: <ul style="list-style-type: none"> <li>▪ flooding</li> <li>▪ drought</li> <li>▪ earthquakes</li> <li>▪ fires</li> <li>▪ pollution</li> <li>▪ extreme weather</li> </ul>		
		3	Assess how human activities (e.g., clear cutting, water management, tree thinning) can affect the potential for hazards.	conservation	

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Students should know and be able to...					
Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C1 (cont.)	Changes in Environments	4	Evaluate the following factors that affect the quality of the environment: <ul style="list-style-type: none"> <li>▪ urban development</li> <li>▪ smoke</li> <li>▪ volcanic dust</li> </ul>		
		5	Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality and biodiversity.		
S3C2	Science and Technology in Society	1	Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems: <ul style="list-style-type: none"> <li>▪ various forms of alternative energy</li> <li>▪ storage of nuclear waste</li> <li>▪ abandoned mines</li> <li>▪ greenhouse gases</li> <li>▪ hazardous wastes</li> </ul>	greenhouse gas, hazardous waste	
		3	Support a position on a science or technology issue.		
		4	Analyze the use of renewable and nonrenewable resources in Arizona: <ul style="list-style-type: none"> <li>▪ water</li> <li>▪ land</li> <li>▪ soil</li> <li>▪ minerals</li> <li>▪ air</li> </ul>	erosion	
		5	Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C3	Human Population Characteristics	1	Analyze social factors that limit the growth of a human population, including: <ul style="list-style-type: none"> <li>▪ affluence</li> <li>▪ education</li> <li>▪ access to health care</li> <li>▪ cultural influences</li> </ul>		
		2	Describe biotic (living) and abiotic (nonliving) factors that affect human populations.	abiotic, biotic	
		3	Predict the effect of a change in a specific factor on a human population.		

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**Strand 4: Life Science**

*“The fundamental goal of life sciences is to attempt to understand and explain the nature of life” (NAEP 2000).*

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.

**Concepts**

**Concept 1: The Cell**

- Understand the role of the cell and cellular processes.

**Concept 2: Molecular Basis of Heredity**

- Understand the molecular basis of heredity and resulting genetic diversity.

**Concept 3: Interdependence of Organisms**

- Analyze the relationships among various organisms and their environment.

**Concept 4: Biological Evolution**

- Understand the scientific principles and processes involved in biological evolution.

**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.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S4C3	Interdependence of Organisms	1	Identify the relationships among organisms within populations, communities, ecosystems, and biomes.	organism, species, viable, population, ecology, communities, ecosystem, biome	
		2	Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an environment.	extinct, endangered, biodiversity, environment, limiting factor	
		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.	carrying capacity, population density	

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S4C4	Biological Evolution	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.	natural selection, biodiversity, habitat, interrelationship, symbiotic relationship, mutualism	
S4C5	Matter, Energy, and Organization in Living Systems (including Human Systems)	1	Compare the processes of photosynthesis and cellular respiration in terms of energy flow, reactants, and products.		
		3	Diagram the following biogeochemical cycles in an ecosystem: <ul style="list-style-type: none"> <li>▪ water</li> <li>▪ carbon</li> <li>▪ nitrogen</li> </ul>	organic, inorganic, matter, photosynthesis, cellular respiration	
		4	Diagram the energy flow in an ecosystem through a food chain.	food chain, food web, producer, consumer, decomposer, <b>trophic level</b>	

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**Strand 5: Physical Science**

*The physical science component ... should probe the following major topics: matter and its transformations, energy and its transformations, and the motion of things” (NAEP 2000).*

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.

**Concepts**

**Concept 1: Structure and Properties of Matter**

- Understand physical, chemical, and atomic properties of matter.

**Concept 2: Motions and Forces**

- Analyze relationships between forces and motion.

**Concept 3: Conservation of Energy and Increase in Disorder**

- Understand ways that energy is conserved, stored, and transferred.

**Concept 4: Chemical Reactions**

- Investigate relationships between reactants and products in chemical reactions.

**Concept 5: Interactions of Energy and Matter**

- Understand the interactions of energy and matter.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S5C3	Conservation of Energy and Increase in Disorder	1	Describe the following ways in which energy is stored in a system: <ul style="list-style-type: none"> <li>▪ mechanical</li> <li>▪ electrical</li> <li>▪ chemical</li> <li>▪ nuclear</li> </ul>		
		3	Recognize that energy is conserved in a closed system.	open system, closed system	
		5	Analyze the relationship between energy transfer and disorder in the universe (2 <sup>nd</sup> Law of Thermodynamics	1 <sup>st</sup> law of thermodynamics	

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**Strand 6: Earth and Space Science**

*“Earth science is the study of the planets, Earth’s composition, processes, environments and history, focusing on the solid Earth, and its interaction with air and water” (NAEP 2000).*

Earth and Space Science provides the foundation for students to develop an understanding of the Earth, its history, composition, and formative processes, 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.

**Concepts**

**Concept 1: Geochemical Cycles**

- Analyze the interactions between the Earth’s structures, atmosphere, and geochemical cycles.

**Concept 2: Energy in the Earth System (Both Internal and External)**

- Understand the relationships between the Earth’s land masses, oceans, and atmosphere.

**Concept 3: Origin and Evolution of the Earth System**

- Analyze the factors used to explain the history and evolution of the Earth.

**Concept 4: Origin and Evolution of the Universe**

- Analyze the factors used to explain the origin and evolution of the universe.

**Students should know and be able to...**

Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S6C1	Geochemical Cycles	5	Describe factors that impact current and future water quantity and quality including surface, ground, and local water issues.		
		6	Analyze methods of reclamation and conservation of water.		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
			<b>External Energy:</b>		
S6C2	Energy in the Earth System (Both Internal and External)	14	Analyze how weather is influenced by both natural and artificial earth features (e.g., mountain ranges, bodies of water, cities, air pollution).		
		15	List the factors that determine climate (e.g., altitude, latitude, water bodies, precipitation, prevailing winds, topography).		
		16	Explain the causes and/or effects of climate changes over long periods of time (e.g., glaciation, desertification, solar activity, greenhouse effect).		
		17	Investigate the effects of acid rain, smoke, volcanic dust, urban development, and greenhouse gases, on climate change over various periods of time.		

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