

# SCIENCE

# SC75 Ecology of Marine Ecosystems

Course #: SC-75	Grade Level: 11-12
Course Name: Ecology of Marine Ecosystems	Level of Difficulty: Average to High
Prerequisites: SC49 Biology and SC71 Chemistry (or higher)	# 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.		Background research on Brine shrimp lab
		2	Develop questions from observations that transition into testable hypotheses.		
		3	Formulate a testable hypothesis.		Various labs

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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.		Brine shrimp lab and others
		2	Identify the resources needed to conduct an investigation.  - Material list of lab report		
		3	Design an appropriate protocol (written plan of action) for testing a hypothesis: <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, pH probe, dissolved O<sub>2</sub> probe, using qualitative changes).</li> <li>▪ Determine an appropriate method for recording data (e.g., notes, sketches, Turbidity sensor, journals (logs), charts, computers).</li> </ul>	Controlled experiment variable procedure	Graphical analysis lab pros used to collect data on aquarium habitats
		4	Conduct a scientific investigation that is based on a research design.		
		5	Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.		Graphical analysis Brine shrimp lab  Aquarium habitats

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S1C3	Analysis and Conclusions, and Refinements	1	<p><i>Interpret data that show a variety of possible relationships between variables, including:</i></p> <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>	osmoregulation	Diffusion in potato cores
		2	Evaluate whether investigational data support or do not support the proposed hypothesis.		
		3	Critique reports of scientific studies (e.g., published papers, student reports).		Sea Hare research from Marine Biology journal
		4	Evaluate the design of an investigation to identify possible sources of procedural error, including:		Sea Hare research from Marine Biology journal
			<ul style="list-style-type: none"> <li>▪ sample size</li> <li>▪ trials</li> <li>▪ controls</li> <li>▪ analyses</li> </ul>		
		6	Use descriptive statistics to analyze data, including:	mean median mode range	Variation in mollusk shells
			<ul style="list-style-type: none"> <li>▪ mean</li> <li>▪ frequency</li> <li>▪ range</li> </ul> (see MHS-S2C1-10)		
7	Propose further investigations based on the findings of a conducted investigation.		Part of lab write-up procedure		

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S1C4	Communication	1	<b>For a specific investigation, choose an appropriate method for communicating the results.</b>		Lab write-up
		2	<b>Produce graphs that help communicate data. (See MHS-S2C1-02)</b>		Graphical analysis most labs include graphs
		3	<b>Communicate results clearly and logically.</b>		Lab write-up
		4	<b>Support conclusions with logical scientific arguments.</b>		Explain in discussion portion of lab write-up

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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.  – e.g., marine exploration, scuba, submarine		
		2	<i>Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.</i>		
		3	Analyze how specific changes in science have affected society.		
		4	Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.  – e.g., oceanic research has not been popular therefore little is being done		

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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	<p><b>Evaluate how the processes of natural ecosystems affect, and are affected by, humans.</b></p> <ul style="list-style-type: none"> <li>- e.g., collecting/over-fishing, over use of natural resources</li> </ul>		
		2	<p><b>Describe the environmental effects of the following natural and/or human-caused hazards:</b></p> <ul style="list-style-type: none"> <li>▪ sewage in waterways</li> <li>▪ oil spills</li> <li>▪ clear cutting</li> <li>▪ mining contributes to sediments in coral reefs</li> <li>▪ <b>pollution</b></li> <li>▪ <b>extreme weather</b></li> </ul>		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S3C1 (cont.)	Changes in Environments	3	Assess how human activities (e.g., clear cutting, water management) can affect the potential for hazards.	eutrophication	
		4	Evaluate the following factors that affect the quality of the environment: <ul style="list-style-type: none"> <li>▪ pollution</li> <li>▪ over-fishing</li> <li>▪ loss of species</li> </ul>		
		5	Evaluate the effectiveness of conservation practices and preservation techniques on environmental quality and biodiversity. <ul style="list-style-type: none"> <li>- e.g., "setting" on dolphins, Marine Mammal Protection Act</li> </ul>		
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>▪ over-fishing</li> <li>▪ pollution</li> <li>▪ aquarium trade</li> </ul>		
		2	Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.		
		3	Support a position on a science or technology issue.		
		5	Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology). <ul style="list-style-type: none"> <li>- e.g., fishing regulations, local and international waters</li> </ul>		

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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
S4C1	The cell	2	Compare the form and function of prokaryotic and eukaryotic cells and their cellular components.  – e.g., marine producers and bacteria	osmoregulation	
		3	Explain the importance of water to cells		

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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.	food chains, food webs, symbiosis	
		2	Describe how organisms are influenced by a particular combination of biotic (living) and abiotic (nonliving) factors in an 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	
S4C4	Biological Evolution	1	Identify the following components of natural selection, which can lead to speciation: <ul style="list-style-type: none"> <li>▪ potential for a species to increase its numbers</li> <li>▪ genetic variability and inheritance of offspring due to mutation and recombination of genes</li> <li>▪ finite supply of resources required for life</li> <li>▪ selection by the environment of those offspring better able to survive and produce offspring</li> </ul>		
		4	Predict how a change in an environmental factor (e.g., predators removed – sharks) can affect the number and diversity of species in an ecosystem.		

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S4C4 (cont.)	Biological Evolution	5	Analyze how patterns in the fossil record, nuclear chemistry, geology, molecular biology, and geographical distribution give support to the theory of organic evolution through natural selection over billions of years and the resulting present day biodiversity.  - e.g., Cetacean Evolution		
		6	Analyze, using a biological classification system (i.e., cladistics, phylogeny, morphology, DNA analysis) the degree of relatedness among various species.  - e.g., marine organisms		
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.  - e.g., marine organisms	food chain, food web, producer, consumer, decomposer, trophic level	
		4	Diagram the energy flow in an ecosystem through a food chain.		
		5	Describe the levels of organization of living things from cells, through tissues, organs, organ systems, organisms, populations, and communities to ecosystems.		

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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	1	Identify ways materials are cycled within the earth system (i.e., carbon cycle, water cycle).		

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Concept Number	Concept	PO No.	Performance Objective	Vocabulary	Notes/Integration/Resources
S6C2	Energy in the Earth System (Both Internal and External)	2	Explain the mechanisms of heat transfer (convection) among the atmosphere, land masses, and oceans.		
			Internal Energy:		
		4	Demonstrate the relationship between the Earth's internal convective heat flow and plate tectonics.		
		5	Demonstrate the relationships among earthquakes, volcanoes, mountain ranges, mid-oceanic ridges, deep sea trenches, and tectonic plates.		As related to oceanographic features
			External Energy:		
		10	Demonstrate the effect of the Earth's rotation (i.e., Coriolis effect) on the movement of water.		
S6C3	Origin and Evolution of the Earth System		Earth Origin/system:		
		3	Explain the phases of the Moon, eclipses (lunar and solar), and the interaction of the Sun, Moon, and Earth (tidal effect).		

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