# Science: Marine Science
## Unit 1: Maine Marine Ecosystems

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| **Essential Understandings** | ▪ Maine has a rich and important historical association with commercial fishing.<br>▪ Numerous marine organisms offer sustainable fishing populations off the Coast of Maine.<br>▪ The fish stocks in the Gulf of Maine are being depleted.<br>▪ Pollution and other human interferences are greatly affecting Maine marine resources.<br>▪ Certain organisms have evolved to survive the harsh conditions of a rocky shore.<br>▪ Maine's rocky shore is unique.<br>▪ Maine's climate and terrestrial enterprises affect the productivity level of the coastal marine ecosystems.<br>▪ There are numerous career opportunities connected with Marine resources. |
| **Essential Questions** | ▪ What is the history of fish stocks in Maine?<br>▪ What marine organisms offer sustainable fishing populations off the coast of Maine?<br>▪ How has fishing affected fish stocks both in the past and at present?<br>▪ What options remain to restore fish stocks?<br>▪ What is the correlation between Maine's climate and the productivity level of Maine's ecosystem?<br>▪ How do people fish commercially in the Gulf of Maine?<br>▪ What steps can be taken to further protect the Gulf of Maine from pollution?<br>▪ Who benefits from Maine's fisheries?<br>▪ What makes Maine's rocky shore a unique ecosystem?<br>▪ What specific adaptations have organisms evolved to survive the harsh conditions of the rocky shore? |
| **Essential Knowledge** | ▪ Maine's marine resources affect trade markets around the world.<br>▪ Maine's marine organisms affect food webs around the world.<br>▪ Fish populations can be categorized in a variety of ways.<br>▪ Discoveries and changes in 20$^{th}$ century science have led to the expansion of fisheries in Maine and unstable fish populations.<br>▪ There are arguments for and against expanding fishing regulations off the Coast of Maine.<br>▪ Ocean resources can be either physical or biological.<br>▪ Maine's marine ecosystems provide numerous limiting factors affecting diverse populations.<br>▪ There are 5 standard types of commercial fishing.<br>▪ All fishing endeavors impact the Maine Coast and ocean environments.<br>▪ Pollution is a major threat to the Coast of Maine in a variety of ways.<br>▪ The tidal cycle greatly affects the rocky shore and the organisms that live there. |

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| | ▪ Organisms of the Maine's rocky shores have developed specific adaptations to help them survive harsh conditions. |
| **Vocabulary** | ▪ Terms:<br>○ Ecosystem, fish stocks, rocky shores, tidal systems, pollution, physical resource, biological resource, regulation, adaptation, population, commercial, gulf, alternative energy, limiting factor |
| **Essential Skills** | ▪ Discuss and analyze the contributions of marine organisms to the world food webs.<br>▪ Categorize Maine's fish populations.<br>▪ Justify how technology has affected fisheries in Maine both for better and worse.<br>▪ Interpret and expand arguments for and against changing fishing regulations.<br>▪ Discriminate between different ocean resources.<br>▪ Identify at least 5 limiting factors of Maine's Marine ecosystem.<br>▪ Summarize the five standard types of commercial fishing.<br>▪ Describe how various methods of fish harvesting impact the Maine Coast and ocean environments.<br>▪ Identify and illustrate at least 10 sources of pollution in the Gulf of Maine.<br>▪ List career opportunities related to Maine's Oceans.<br>▪ Diagram the relationship between organisms living on the rocky shore and the tidal cycle.<br>▪ Distinguish specific adaptations related to species survival on Maine's rocky shore. |

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| **Related Maine Learning Results** | Science<br>B. The Skills and Traits of Scientific Inquiry and Technological Design<br>B1. Skills and Traits of Scientific Inquiry<br>Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis.<br>a. Identify questions, concepts, and testable hypotheses that guide scientific investigations.<br>b. Design and safely conduct methodical scientific investigations, including experiments with controls.<br>c. Use statistics to summarize, describe, analyze, and interpret results.<br>d. Formulate and revise scientific investigations and models using logic and evidence.<br>e. Use a variety of tools and technologies to improve investigations and communications.<br>f. Recognize and analyze alternative explanations and models using scientific criteria.<br>g. Communicate and defend scientific ideas.<br>B2. Skills and Traits of Technological Design<br>Students use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs.<br>a. Identify new problems or a current design in need of improvement.<br>b. Generate alternative design solutions.<br>c. Select the design that best meets established criteria.<br>d. Use models and simulations as prototypes in the design planning process.<br>e. Implement the proposed design solution.<br>f. Evaluate the solution to a design problem and the consequences of that solution.<br>g. Present the problem, design process, and solution to a design problem including models, diagrams, and demonstrations.<br>C. The Scientific and Technological Enterprise<br>C1. Understandings of Inquiry<br>Students describe key aspects of scientific investigations: that they are guided by scientific principles and knowledge, that they are performed to test ideas, and that they are communicated and defended publicly.<br>a. Describe how hypotheses and past and present knowledge guide and influence scientific investigations.<br>b. Describe how scientists defend their evidence and explanations using logical argument and verifiable results. |

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| **Related Maine Learning Results** | C2.Understanings About Science and Technology<br>Students explain how the relationship between scientific inquiry and technological design influences the advancement of ideas, products, and systems.<br>a. Provide an example that shows how science advances with the introduction of new technologies and how solving technological problems often impacts new scientific knowledge.<br>b. Provide examples of how creativity, imagination, and a good knowledge base are required to advance scientific ideas and technological design.<br>C3.Science, Technology, and Society<br>Students describe the role of science and technology in creating and solving contemporary issues and challenges.<br>c. Explain how ethical, societal, political, economic, religious, and cultural factors influence the development and use of science and technology.<br>C4.History and Nature of Science<br>Students describe the human dimensions and traditions of science, the nature of scientific knowledge, and historical episodes in science that impacted science and society.<br>a. Describe the ethical traditions in science including peer review, truthful reporting, and making results public.<br>b. Select and describe one of the major episodes in the history of science including how the scientific knowledge changed over time and any important effects on science and society.<br>c. Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists.<br>d. Provide examples of criteria that distinguish scientific explanations from pseudoscientific ones.<br>D. The Physical Setting<br>D2.Earth<br>Students describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems.<br>a. Describe and analyze the effect of solar radiation, ocean currents, and atmospheric conditions on the Earth's surface and the habitability of Earth.<br>c. Describe and analyze the effects of biological and geophysical influences on the origin and changing nature of Earth Systems.<br>D3.Matter and Energy<br>Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy.<br>b. Describe how the number and arrangement of atoms in a |

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| | molecule determine a molecule's properties, including the types of bonds it makes with other molecules and its mass, and apply this to predications about chemical reactions.<br>c. Explain the essential roles of carbon and water in life processes.<br>e. Describe factors that affect the rate of chemical reactions (including concentration, pressure, temperature, and the presence of molecules that encourage interaction with other molecules).<br>f. Apply an understanding of the factors that affect the rate of chemical reaction to predictions about the rate of chemical reactions. |

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| **Related Maine Learning Results** | E. The Living Environment<br>E1.Biodiversity<br>Students describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity.<br>a. Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a changing environment.<br>b. Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species.<br>c. Analyze the relatedness among organisms using structural and molecular evidence.<br>d. Analyze the effects of changes in biodiversity and predict possible consequences.<br>E2.Ecosystems<br>Students describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change.<br>a. Explain why ecosystems can be reasonably stable over hundreds or thousands of years, even though populations may fluctuate.<br>b. Describe dynamic equilibrium in ecosystems and factors that can, in the long run, lead to change in the normal pattern of cyclic fluctuations and apply that knowledge to actual situations.<br>E3.Cells<br>Students describe structure and function of cells at the intracellular and molecular level including differentiation to form systems, interactions between cells and their environment, and the impact of cellular processes and changes on individuals.<br>c. Describe the interactions that lead to cell growth and division (mitosis) and allow new cells to carry the same information as the original cell (meiosis).<br>E4.Heredity and Reproduction<br>Students examine the role of DNA in transferring traits from generation to generation, in differentiating cells, and in evolving new species.<br>c. Explain how the instructions in DNA that lead to cell differentiation result in varied cell functions in the organism and DNA.<br>d. Describe the possible causes and effects of gene mutations. |

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| **Related Maine Learning Results** | E5. Evolution<br>Students describe the interactions between and among species, populations, and environments that lead to natural selection and evolution.<br>a. Describe the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms.<br>b. Describe the origins of life and how the concept of natural selection provides a mechanism for evolution that can be advantageous or disadvantageous to the next generation.<br>c. Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage.<br>d. Relate structural and behavioral adaptations of an organism to its survival in the environment. |
| **Sample Lessons and Activities** | ▪ Historical research<br>▪ Diagram/illustration of rocky shore<br>▪ Organism dissection<br>▪ Shore clean up<br>▪ Debate on fishing regulations<br>▪ Interview with a lobsterman |
| **Sample Classroom Assessment Methods** | ▪ Quiz<br>▪ Chapter Test<br>▪ Worksheets<br>▪ Labs<br>▪ Debates<br>▪ Dissections<br>▪ Interviews |
| **Sample Resources** | ▪ Publications:<br>o Biology – Kenneth Miller and Josephine Levine<br>o Biology the Dynamics of Life – Glencoe Internet Resources<br>o An introduction to Marine Life 6th Ed. By James Sumich<br>▪ Other Resources<br>o Lab Supplies |