

Marine Science (Updated June 2025)

The Marine Science course is highly recommended for all high school students building upon and integrating science skills and practices learned in earlier grades. The interdisciplinary nature of Marine Science allows students to see the connections among and explore the applications of other science courses through a study of engaging topics. The course content is designed to be a comprehensive study of the Earth's ocean, including its physics, chemistry, geology, biology, and environmental issues.

In an effort to encourage students to pursue careers in the fields of science, technology, engineering and mathematics (STEM), this course incorporates the scientific and engineering practices that reflect the scientific processes used by scientists. These practices are implemented through an immersive, student-centered and collaborative learning environment using an experiential or hands-on approach including field studies, laboratory studies, classroom work and exposure to practicing scientists.

The Marine Science standards provide the depth of understanding and variety of experiences to prepare students well for college, career and citizenship with an appropriate level of scientific literacy to be able to make informed decisions regarding the ocean and its resources.

The Marine Science course is focused on achieving Ocean Literacy which is the understanding of the ocean's influence on us and our influence on the ocean¹. The Ocean Literacy movement is a wide-ranging, collaborative and de-centralized effort by scientists and educators to create a more ocean literate society¹. This course is organized around the disciplinary core ideas embodied in the seven Essential Principles of Ocean Sciences developed as part of the Ocean Literacy movement and the accompanying fundamental concepts (labeled A-I in the standards below). Principle 1, *The earth has one big ocean with many features*, focuses on physical and chemical characteristics of water, of ocean water and on the interconnectedness of all aquatic systems. *The ocean and life in the ocean shape the features of Earth*. Principle 2 highlights characteristics of the ocean basin and the geological processes which affect the distribution and abundance of matter on Earth. Principle 3, *The ocean is a major influence on weather and climate*, centers on oceanic and atmospheric processes interacting to control weather and climate. *The ocean makes Earth habitable*, Principle 4, emphasizes the flow of energy through Earth's physical and biological systems. Principle 5, *The ocean supports a great diversity of life and ecosystems*, examines the life cycles, adaptations and relationships among the diverse array of life in the ocean ranging from the smallest microbes to the largest animals, blue whales. *The ocean and humans are inextricably interconnected*,

Principle 6, explores the ways humans are dependent on the ocean and the ways the ocean is both positively and negatively affected by human activity. Lastly, *The ocean is largely unexplored*, Principle 7, focuses on the relative lack of knowledge about the deep ocean and the technology scientists are using to explore and understand it. Together these principles and fundamental concepts allow students to understand the importance of the ocean to human lives, to practice current scientific methods, to explore current technological tools and approaches, to investigate effects and discuss impacts of human activity on Earth, and to realize that there is much left to be learned.

Integrated within the content standards are the disciplinary core ideas of the Engineering, Technology and Applications of Science (ETS) domain, which require students to use tools and materials to solve problems and to use representations to convey various design solutions. ETS standards are denoted with a gear icon (⚙️).

The performance expectations below are grouped by Ocean Literacy Principles (OLP) 1-7 from the Ocean Literacy Framework. Each Ocean Literacy Principle consists of Fundamental Concepts which are found in parentheses next to each OLP. The reference for these principles and fundamental concepts may be found in the document [*Ocean Literacy: The Essential Principles and Fundamental Concepts of Ocean Sciences for Learners of All Ages, Version 3.2: January 2024*](#) and [*The Ocean Literacy Overview*](#).

Acronyms (see *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*):

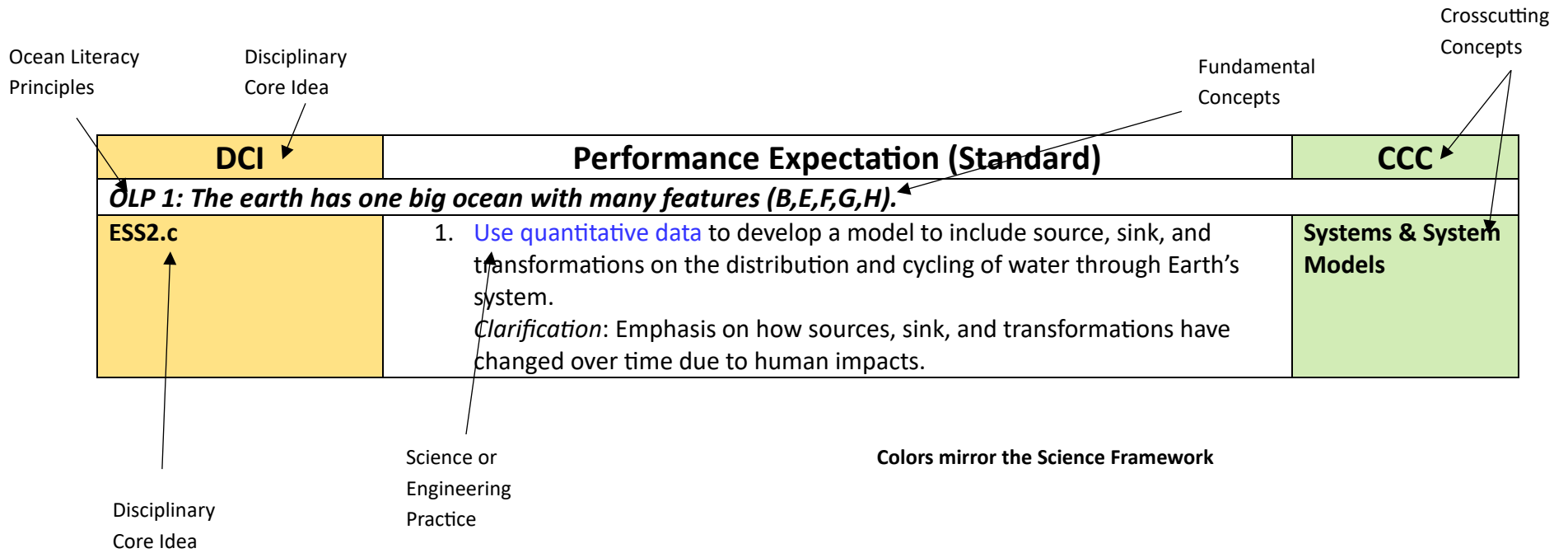
DCI- Disciplinary Core Ideas

CCC- Crosscutting Concept

Highlighted in blue (SEP) – Science and Engineering Practices

OLP – Ocean Literacy Principles including A-I, Fundamental Concepts)





See below for ***How to Read these Standards.***



Marine Science

DCI	Performance Expectation (Standard)	CCC
<i>OLP 1: The earth has one big ocean with many features (B,E,F,G,H).</i>		
ESS2.c	1. Use quantitative data to develop a model to include source, sink, and transformations on the distribution and cycling of water through Earth's system. <i>Clarification:</i> Emphasis on how sources, sink, and transformations have changed over time due to human impacts.	Systems & System Models
PS1.a	2. Plan and carry out investigations to explain how the physical and chemical properties of fresh and saltwater affect the abiotic characteristics of marine habitats.	Structure & Function
ESS2.c	3. Construct an evidence-based explanation of how local area water quality impacts water quality in Mobile Bay, Alabama's largest watershed.	Cause & Effect
ESS2.b	4. Develop and use physical models to describe the structure and origin of the major topographic features of the seafloor. <i>Clarification:</i> Emphasis on plate tectonics and how geologic activity, plate boundaries and plate movement are related.	Systems & System Models
<i>OLP 2: The ocean and life in the ocean shape the features of Earth (C,D,E).</i>		
ESS2.e	5. Use models and mathematics to describe how changes in the carbon cycle impact the Earth's ocean and atmosphere. <i>Clarification:</i> Emphasis on how these cycles have changed over time due to human impacts.	Energy & Matter
PS4.a	6. Analyze and interpret data to understand how wave and tidal energy interact to influence coastal landforms and are affected by human activities.	Energy & Matter Cause & Effect
<i>OLP 3: The ocean is a major influence on weather and climate (A,B,C,F,G).</i>		
ESS2.d ESS3.d	7. Obtain, evaluate and communicate information to explain interactions between the major ocean and atmospheric currents and how ocean currents affect regional climate and ecosystem diversity.	Systems & System Models

<i>OLP 4: The ocean made Earth habitable (C).</i>		
LS2.b LS1.c	8. Use mathematics and computational thinking to describe the flow of energy and the relationships between primary productivity, food webs and ocean food production. <i>Clarification:</i> Emphasis on the 2 contrasting forms of primary productivity (photo- and chemosynthesis), and the cycling of nutrients (nitrogen and others).	Energy & Matter
<i>OLP 5: The ocean supports a great diversity of life and ecosystems (A,B,C,D,E,F,H,I).</i>		
LS4.a LS3.a	9. Engage in argument from evidence to explain how dichotomous keys reflect organisms' morphology and our current understanding of phylogeny.	Patterns
LS4	10. Obtain and communicate information to describe the anatomy, life cycles, reproductive patterns, feeding strategies and adaptations of the major groups of marine organisms (microbes, algae, plants, invertebrate animals, vertebrate animals).	Structure & Function
LS2.a LS4.d	11. Analyze and interpret abiotic and biotic data to understand the ocean's ecosystems diversity and the characteristics of major marine and coastal ecosystems (e.g. estuaries, salt marshes, mangroves, open ocean, deep sea, coral reefs).	Structure & Function
<i>OLP 6: The ocean and humans are inextricably connected (A,B,D,E,F).</i>		
LS4.d	12. Obtain, evaluate and communicate information on the variety of ways in which humans depend on ocean ecosystems.	Cause & Effect
LS2.c ESS3.c LS4.d ETS2.b	13. Engage in argument from evidence to describe how human activities affect marine ecosystems positively and negatively.	Cause & Effect

OLP 7: The ocean is largely unexplored (A,D,E,F).		
ETS2.b	14.  Analyze and interpret data on the degree to which humans have explored, mapped and understand ocean ecosystems. <i>Clarification:</i> Emphasis will be on the midwater realm, twilight zone and deep sea.	Stability and Change
ETS1 ETS2.a ETS2.b	15.  Obtain, evaluate and communicate information on the degree to which technological innovations have advanced our understanding of the ocean. <i>Clarification:</i> Emphasis will be on sensors, underwater vehicles, drifters/floats/buoys, satellites and mathematical models.	Systems & System Models
ETS1	16.  Design, build and test the ability of an underwater robot (ROV, AUV) to collect data for underwater exploration.	Systems & System Models
ETS2.a ETS2.b	17.  Obtain, evaluate and communicate information on possible careers in the blue economy, marine industries, ocean research, ocean science education, ocean exploration and the maritime industry.	Systems & System Models

¹Centers for Ocean Science Education Excellence, National Geographic Society, National Oceanic and Atmospheric Administration, and College of Exploration (2005). *Ocean Literacy: The Essential Principles of Ocean Sciences Grades K–12*. <http://oceanliteracy.wp2.coexploration.org>