



***Marine Science: The Dynamic Ocean* Meets Next Generation Science Standards (NGSS) and Common Core State Standards (CCCS)**

Marine Science: The Dynamic Ocean offers data driven investigations, meaningful context-based activities and lessons that seamlessly integrate Science, Technology, Engineering and Mathematics (STEM) for the deeper conceptual understanding valued by the Next Generation Science Standards (NGSS).

NGSS focuses the developmental progression through Disciplinary Core Ideas on a core understanding of content and the application of knowledge in real-world scenarios. From cover to cover, *Marine Science: The Dynamic Ocean* is built on the integrated STEM philosophy that drives NGSS.

Lessons are thoughtfully sequenced to build strong, conceptual understanding of the ocean and the Earth as a system, and make real-life data driven connections that are interesting and meaningful to today's high school students.

Foundations of NGSS and *Marine Science: The Dynamic Ocean*

Nature of Science (NOS)

A deep understanding of the NOS is essential to a strong science education and highly valued in *Marine Science: The Dynamic Ocean*. The text directly addresses important NOS terminology and contextualizes examples of how science is conducted in everyday life. The course highlights the tenets of the NOS in each lesson to show the educator exactly how the content helps students learn and apply principles, to ensure that NOS is a consistent, underlying theme.

Science and Engineering Practices

Inquiry as a scientific practice is central to the development of *Marine Science: The Dynamic Ocean*. The application of concepts to socio-scientific issues which inspire meaningful discourse and justification of ideas occurs throughout exciting investigations of marine ecosystems. Students engage in an exploration of the threats to marine life and the responsibility of humans to protect the ocean and its vast resources. They employ the Engineering Design Process, which incorporates *NGSS's eight practices of science and engineering* to investigate point source pollution and design ways to effectively clean up oil spills. Throughout the course, students demonstrate a deep understanding of scientific concepts through the application of engineering.

Crosscutting Concepts

The field of Marine Science is truly interdisciplinary, void of conceptual boundaries. *Marine Science: The Dynamic Ocean* includes exciting applications of STEM that demonstrate bridging concepts across disciplines in the exciting context of the ocean.

Examples of some topics covered in *Marine Science: The Dynamic Ocean* that demonstrate NGSS Crosscutting Concepts:

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1. Patterns.
Classification of marine organisms; structure and function; biological evolution; properties of matter; properties of water
2. Cause and effect: Mechanism and explanation
Scientific investigations; engineering practices; impacts of coastal development; symbiotic relationships between species
3. Scale, proportion, and quantity.
Population dynamics
4. Systems and system models.
Using models to demonstrate various concepts: 1) transfer of energy; 2) using engineering design to address pollution challenges; 3) studying human induced habitat destruction; 4) identifying solutions
5. Energy and matter: Flows, cycles, and conservation.
Cycling of energy and matter; biogeochemical cycles; conservation of energy
6. Structure and function.
Study of living things; cell type; adaptations to marine environments
7. Stability and change.
Population dynamics and age structure diagrams; natural selection

Disciplinary Core Ideas

Marine Science: The Dynamic Ocean is a comprehensive investigation of the ocean, Earth's largest resource, where lessons address the Disciplinary Core Ideas carefully constructed in *A Framework for K-12 Science Education*. Connections to performance expectations are outlined by course lesson below:

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Lesson	Title	Disciplinary Core Idea code
1	<i>Diving into Ocean Ecosystems</i>	HS-LS2-3
2	<i>Water on Earth</i>	HS-ESS2-5, HS-PS1-5, HS-PS1-1
3	<i>More About Water</i>	HS-ESS2-5, HS-PS1-2, HS-PS1-3
4	<i>The Ocean Over Time</i>	HS-ESS3-1, HS-ESS3-4
5	<i>Migrations in the Sea</i>	HS-PS4-5, HS-PS4-2
6	<i>Explore the Sea Floor</i>	HS-PS4-5
7	<i>The Formation of the Ocean</i>	HS-ESS1-5, HS-ESS2-1, HS-ESS2-1, HS-ESS2-3,
8	<i>Seasons of Change</i>	HS-ESS2-1, HS-PS4-3, HS-ESS2-4
9	<i>The Sea Surface: The Great Heat Distributor</i>	HS-PS3-2, HS-ESS2-4, HS-ESS2-5
10	<i>Energy and the Ocean</i>	HS-PS3-1, HS-PS3-2, HS-PS3-4
11	<i>Weather, Climate and the Ocean</i>	HS-ESS2-2
12	<i>Voyage to the Deep</i>	HS-ESS2-2
13	<i>Photosynthesis in the Ocean</i>	HS-LS1-5, HS-LS2-5, HS-ESS2-4, HS-ESS2-5.
14	<i>Biodiversity in the Ocean</i>	HS-LS1-1, HS-LS1-2
15	<i>Marine Populations</i>	HS-LS1-4, HS-LS2-1, HS-LS2-2, HS-LS2-6, HS-LS2-8
16	<i>Population Changes</i>	HS-ESS2-7, HS-LS4-1, HS-LS4-2, HS-LS4-3, HS-LS4-4, HS-LS4-5, HS-LS3-3, HS-LS2-2, HS-LS2-8
17	<i>Food Webs in Action</i>	HS-ESS2-6, HS-LS1-7, HS-LS2-3, HS-LS2-4
18	<i>Introduction to Marine Invertebrates</i>	HS-LS1-2
19	<i>Biology of Fishes</i>	HS-LS4-3, HS-LS1-1
20	<i>Marine Reptiles and birds</i>	HS-LS4-3
21	<i>Marine Mammals</i>	HS-LS1-4, HS-LS2-8
22	<i>Relationships in the Sea</i>	HS-LS2-8
23	<i>The Ocean's Waves</i>	HS-PS4-1
24	<i>A Time for Tides</i>	HS-ESS1-4
25	<i>Animal Needs and Animal Tracking</i>	HS-PS4-2
26	<i>Student Expert Research</i>	HS-PS4-4
27	<i>Student Expert Analysis</i>	HS-PS4-4
28	<i>Which Way to the Sea</i>	HS-ESS2-1, HS-ESS2-2, HS-ESS1-6, HS-ESS2-7
29	<i>Nonpoint Source Pollution</i>	HS-LS4-6
30	<i>Point source pollution - includes expanded oil spill investigation</i>	HS-ESS3-2, HS-ESS3-4, HS-ESS3-6, HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-LS4-6
31	<i>Humans and Coastlines</i>	HS-ESS3-1, HS-LS2-7
32	<i>The Ocean's Resources</i>	HS-ESS3-1
33	<i>Changing Climate</i>	HS-ESS2-2, HS-ESS2-4, HS-ESS3-5, HS-ESS2-7
34	<i>Protecting Marine Habitats</i>	HS-ESS3-6, HS-LS2-7



Common Core State Standards

Marine Science: The Dynamic Ocean meets ALL of the English Language Arts Standards in Science & Technical Subjects for Grades 9-10 and Grades 11-12.

Students engage with the text in various laboratory activities, Engineering Design Challenges, and reading and writing assignments which facilitate deep understanding. For example, students

- engage in close readings of science and technical text while learning precise details of various authentic elements of marine science.
- determine central ideas and conclusions of the text through applications of content in activities, active discussions, labs, group work, etc.
- follow precise procedures in experiments with properties of water, heat transfer, and more.
- use specific symbols and terms in the appropriate scientific context throughout the text.
- identify the close relationships between key terms and concepts used to describe concepts and analyze how ideas are structured in the text based on their relationships.
- discuss and analyze the purpose of the text through activities that require justification and explanation of concepts.
- use charts, graphs, and diagrams to communicate data regarding movement of marine animals and their environments.
- apply reasoning skills when assessing evidence presented for solving problems related to marine pollution, for example.
- compare data generated through experimentation to findings presented by the authors.
- integrate ideas from various sources when addressing questions.
- verify and analyze data on climate change when justifying their position.