Alignment of Ocean Literacy Framework to the NGSS for Grades 6–8

Standards by Disciplinary Core Idea (DCI)	OLP 1	OLP 2	OLP 3	OLP 4	OLP 5	OLP 6	OLP 7	Specific DCI & Performance Expectations (PE)
MS-ESS1 Earth's Place in the Universe		4						ESS1.C
MS-ESS2 Earth's Systems	1	1	1	3				ESS1.C; ESS2.A, C, D; PE ESS2-4, 2-6
MS-ESS3 Earth and Human Activity			1			1		ESS3.B, C, D
MS-LS1 From Molecules to Organisms: Structures and Processes			1	4	2			LS1.B, C; PS3.D
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics	4	2	4		2	2		LS2.A, B, C; LS4.D
MS-LS3 Heredity: Inheritance and Variation of Traits								
MS-LS4 Biological Evolution: Unity and Diversity				2	4			LS4.A, C
MS-PS1 Matter and Its Interactions		4	4			4		PS1.A, B; PS3A, B
MS-PS2 Motion and Stability: Forces and Interactions	4							PS2.A, B
MS-PS3 Energy	3		3					PS3.A, B, C
MS-PS4 Waves and Their Applications in Technologies for Information Transfer								
MS-ETS1 Engineering Design						3		ETS1.A, B

RATING SCALE for Alignment of Ocean Literacy Framework to Next Generation Science Standards (NGSS)

1

Verbatim or nearly verbatim language in both OL Framework (Guide or Scope & Sequence) and NGSS

This rating is self-explanatory. The connection and alignment should be obvious and not in need of any explanation.

2

Understanding these Ocean Literacy Principles and/or Fundamental Concepts is essential to helping students to achieve full understanding of these DCIs and/or PEs.

This rating is given for all the DCIs that have a terrestrial bias or ignore the uniqueness of ocean systems, such as: decomposition breaks things down into soil; references to only terrestrial habitats, ecosystems and food webs, etc. This rating says that a learner cannot achieve full understanding of the DCI without understanding the ocean component of the concept, e.g., you don't fully understand primary productivity if you don't understand chemosynthesis; you don't fully understand decomposition if you only understand how it relates to soil, but not to detritus and marine snow in the water column; you don't fully understand food webs and trophic levels unless you understand about microbes in the ocean because they play a very different role than plants do on land. The ocean "examples" are more than just examples; they illustrate different aspects of the concept than the terrestrial examples do.

3

Examples from the Ocean Literacy Framework (not just any ocean examples) are excellent for teaching and understanding these DCIs and/or PEs

This rating is given when an Ocean Literacy Framework example could be used to explain a general science DCI and/or PE, but using that example to explain that concept is not essential to ocean literacy, nor is it essential to understanding DCI, such as, ocean waves, as mentioned in some OLPs, are good examples of the physical properties of waves.

4

These DCIs and/or PEs are building blocks or foundational ideas that help students to understand these Ocean Literacy Principles and/or Fundamental Concepts

This rating is given for general science concepts that help students understand the mechanisms behind OL concepts, such as, force and motion helping to explain currents or phase change, and conservation of matter helping to explain the water cycle.

Examples of a 4:
K-PS2 Motion and Stability: Forces and Interactions.
Ocean Literacy Essential Principle 2: These basic ideas are important conceptual building blocks that help us understand waves, erosion, and landforms of the coast.

1-LS3 Heredity: Inheritance and Variation of Traits.
Ocean Literacy Essential Principle 5: DCI introduces concept of inheritance and variation and provides introduction to the concept of diversity described in OLP 5A & C.

[blank] No substantive or helpful relationship

No rating is given when there does not appear to be any plausible, helpful, or meaningful relationship between the OL Principles and/or Fundamental Concepts and the DCIs and/or PEs.

Example of a 5:
K-PS2 Motion and Stability: Forces and Interactions
Ocean Literacy Essential Principle 5: No relationship

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Explanation for Ratings

MS-ESS1 Earth's Place in the Universe

OLP 2. This is a 4 because understanding geologic timescales as interpreted through rock strata and fossils (DCI ESS1.C) is a fundamental building block to understanding the geologic changes, plate tectonics, and rock cycle ideas (OLP 2a; S&S 2A.17-19, B strand).

MS-ESS2 Earth's Systems

OLP 1. This is a 1 because the OLP focuses on the global movement of ocean water (OLP 1c; S&S 1C.1), the water cycle (OLP 1f; S&S 1C), and watersheds and coastal ocean (OLP 1g; S&S 1C.9). These concepts are closely aligned with the roles of water in Earth's (and ocean) processes (DCI ESS2.C), cycling of water through Earth's systems (PE ESS2-4), and patterns of ocean and atmospheric circulation (PE ESS2-6). In addition, tectonic processes (DCI ESS1.C) that move Earth's crust form features of the ocean floor (OLP 1b; S&S 1A strand).

OLP 2. This is a 1 because of the strong connections between three DCIs and the Ocean Literacy Framework. The history of planet Earth (DCI ESS1.C) is strongly connected to how ocean processes and plate tectonics influence the structure of the coast (OLP 2e; S&S 2A.18–19). Energy flowing and matter cycling in the planet's systems over various scales have shaped Earth's history (DCI ESS2.A), is strongly connected to Earth's materials and geochemical cycles originating in the ocean (OLP 2a), and to erosion redistributing sediments (OLP 2c). Roles of water in Earth's processes (DCI ESS2.C) is strongly connected to wind, waves, and currents eroding and redistributing earth materials (OLP 2c), as well as to the formation of landforms through a combination of constructive and destructive forces where the ocean meets the land (S&S 2A.1-A.12).

OLP 3. This is a 1 because of the strong connections between three DCIs and the Ocean Literacy Framework. The core ideas that Earth's history has been shaped by water (DCI ESS2.C) and by energy flowing and matter cycling (DCI ESS2.A) is strongly aligned to the concepts of the ocean's role in energy, water and carbon systems (OLP 3a-c; S&S 3A.1-2, 4). The concept that the ocean has a significant influence on climate by moving heat, carbon, and water (OLP 3f; S&S 3A, A.1, 7, 10) is strongly aligned with the ocean absorbing, storing, and moving heat through currents (DCI ESS2.D).

OLP 4. This is a 3 because the concept that oxygen in the atmosphere originally came from organisms in the ocean (OLP 4a; S&S 4A strand) is an excellent example for understanding how interactions between energy flowing and matter cycling in the planet's systems over various scales produces chemical and physical changes in Earth's materials and living organisms, which have shaped Earth's history (DCI ESS2.A).

MS-ESS3 Earth and Human Activity

OLP 3. This is a 1 because the effects of human activities on global climate change (DCI ESS3.D) is strongly aligned with the ideas that CO2 absorbed by the ocean affect the interrelationship between the ocean-atmosphere, which can result in changes to the climate (OLP 3e–g; S&S P3.B, B.1); and that humans are changing the climate by releasing CO2 into the atmosphere (S&S 3B.6). In addition, understanding the use of mapping natural hazards and geologic forces to forecast future events (DCI ESS3.B) requires knowing about ocean weather maps and oceanographic data sets in predicting future weather-related natural hazards, including hurricanes, extreme rainfall, droughts, and El Niño (S&S 3A.7-8, 11-12).

OLP 6. This is a 1 because the DCI focuses on how human activities have altered the biosphere, damaging natural habitats and causing extinctions (DCI ESS3.C), and the effects of human activities on global climate change (DCI ESS3.D). These ideas are strongly connected to the concepts that humans affect the ocean in a variety of ways, including impacting biological diversity and causing extinctions, that most people live near coasts (OLP 6d-f), that human activity leads to excess input of greenhouse gases, and that pollution affects life in the ocean (S&S 6D.13-22).

MS-LS1 From Molecules to Organisms: Structures and Processes

OLP 3. This is a 1 because the process of photosynthesis (DCI LS1.C) occurs in the ocean, with about half the world's photosynthesis taking place in the sunlit layers of the ocean (S&S 3B.3).

OLP 4. This is a 4 because understanding photosynthesis (DCI LS1.C, PS3.D) serves as a building block to and is an integral part of understanding that oxygen in the atmosphere originally came from photosynthetic organisms in the ocean (OLP 4a; S&S 4A.4-6).

OLP 5. This is a 2 because understanding growth and development of organisms (DCI LS1.B) is incomplete without knowing about adaptations for reproduction and growth in ocean organisms (OLP 5d; S&S 5B strand). In addition, to fully understand organization for matter and energy flow in organisms (DCI LS1.C), one needs to understand that there is non-photosynthetic primary productivity in the ocean (OLP 5g; S&S 5A.5-6), and that microorganisms in the ocean produce a huge amount of oxygen on Earth (OLP 5b; S&S 5A.2-4).

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

OLP 1. This is a 4 because an understanding that the basic functions of an ecosystem—interdependent relationships (DCI LS2.A), the cycling of matter and energy transfer (DCI LS2.B), and the dynamic nature of ecosystems (DCI LS2.C)—are integral to understanding ocean circulation (OLP 1c; S&S 1C) and physical and biological systems (OLP 1e).

OLP 2. This is a 2 because students would have an incomplete understanding of the cycling of matter and energy through an ecosystem (DCI LS2.B) without learning about biogeochemical cycles in the ocean (OLP 2a, d; S&S 2B.3).

OLP 3. This is a 4 because cycles of matter and energy transfer in ecosystems (DCI LS2.B) is a building block for understanding the important role of the ocean in the carbon cycle (OLP 3e; S&S 3B.2-3). Additionally, an understanding of ecosystem dynamics, functioning, and resilience (DCI LS2.C) is a building block for comprehending how changes in the ocean-atmosphere system can result in changes to the climate and atmosphere (OLP 3g; S&S 3B.1, 5-6), with regard to disruptions in ecosystems.

OLP 5. This is a 2 because students would have an incomplete understanding of interdependent relationships in ecosystems (DCI LS2.A) and the cycling of matter and energy transfer in ecosystems (DCI LS2.B), if they do not understand how the ocean supports a great diversity of life and ecosystems, including unique adaptations, behaviors, and ecosystems found only in the ocean (OLP 5; S&S 5A, 5B).

OLP 6. This is a 2 because to understand how changes in biodiversity can influence resources and ecosystem services (DCI LS4.D) one must know how humans and the ocean are inextricably interconnected (OLP 6; S&S 6B).

MS-LS3 Heredity: Inheritance and Variation of Traits

No alignment between OL and NGSS.

MS-LS4 Biological Evolution: Unity and Diversity

OLP 4. This is a 2 because in order to achieve a full understanding of the evidence of common ancestry and diversity (DCI LS4.A), one need to learn about origins of life (OLP 4; S&S 4B).

OLP 5. This is a 4 because an understanding of diversity (DCI LS4.A) and adaptations (DCI LS4.C) would be incomplete without learning about the diversity and unique adaptations of the ocean (OLP 5d; S&S 5B).

MS-PS1 Matter and Its Interactions

OLP 2. This is a 4 because an understanding that substances react chemically in characteristic ways and that molecular balance is maintained (DCI PS1.B) is necessary to understand chemical weathering of rocks and minerals (S&S 2A.5).

OLP 3. This is a 4 because an understanding of the structure and properties of matter, and changes of state (DCI PS1.A) and energy (DCI PS3.A), is needed for understanding heat exchange, energy, and the water cycle (OLP 3b); condensation and where rain falls (OLP 3d); and that the ocean moves heat, carbon, and water (OLP 3f, S&S 3A). One must understand energy definitions (DCI PS3.A), heat transfer (DCI PS3.B), and molecular balance (DCI PS1.B) in order to understand how the ocean has such an influence on weather and climate (OLP 3a-b, f; S&S 3A strand).

OLP 6. This is a 4 because understanding the structure and properties of matter (DCI PS1.A), and characteristics and results of chemical reactions (DCI PS1.B), are necessary for understanding how human activities can change ocean temperature and pH (S&S 6D.13-17), which in turn, can affect the survival of some organisms (OLP 6e).

MS-PS2 Motion and Stability: Forces and Interactions

OLP 1. This is a 4 because students need to have a basic understanding of how gravity works (DCI PS2.A, B) in order to understand tides and density-driven thermohaline circulation (OLP 1c). However, the information presented on gravity in these DCIs is not fully supportive of an understanding of thermohaline circulation; it is much more closely tied to understanding tides.

MS-PS3 Energy

OLP 1. This is a 3 because thermohaline circulation in the ocean (OLP 1c; S&S 1C, C.1, 6) provides a helpful example of how energy is transferred out of warmer regions into cooler ones (DCI PS3.B). There is also a connection to understanding that temperature is a measure of the average kinetic energy of particles of matter, and that there is a relationship between temperature and the total energy in a system (DCI PS3.A).

OLP 3. This is a 3 because energy transfer from the ocean to the atmosphere (OLP 3b-d) offers useful examples for understanding energy transfer and related ideas (DCI PS3.A, B, C).

MS-PS4 Waves and their applications

No alignment between OL and NGSS.

MS-ETS1 Engineering Design

OLP 6. This is a 3 because the development of food, medicines, and energy resources (OLP 6b), engaging in discovery (OLP 6e), modifying the ocean environment (OLP 6d), and managing ocean resources (OLP 6g) are all helpful examples of defining problems and developing engineered solutions (DCI ETS1.A, B).