

| 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 |

Explanation for Ratings

MS-ESS1 Earth's Place in the Universe

OLP 2. This is a rating of 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 (OLFC 2A; S&S grades 6 through 8 A17 through 19, and B strand).

MS-ESS2 Earth's Systems

OLP 1. This is a rating of 1 because the OLP focuses on the global movement of ocean water (OLFC 1C; S&S grades 6 through 8 C1), the water cycle (OLFC 1F; S&S grades 6 through 8 C), and watersheds and coastal ocean (OLFC 1G; S&S grades 6 through 8 C9). 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 (OLFC 1B; S&S grades 6 through 8 A strand).

OLP 2. This is a rating of 1 because of the strong connections between three DCIs and the OLP. The history of planet Earth (DCI ESS1.C) is strongly connected to how ocean processes and plate tectonics influence the structure of the coast (OLFC 2E; S&S grades 6 through 8 A18, A19). 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 (OLFC 2A) and to erosion redistributing sediments

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(OLFC 2C). Roles of water in Earth's processes (DCI ESS2.C) is strongly connected to wind, waves, and currents eroding and redistributing earth materials (OLFC 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 grades 6 through 8 A1 through A12).

OLP 3. This is a rating of 1 because of the strong connections between three DCIs and the OLP. 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 (OLFC 3A through C; S&S grades 6 through 8 A1, A2, A4). The concept that the ocean has a significant influence on climate by moving heat, carbon, and water (OLFC 3F; S&S grades 6 through 8 A, A1, A7, A10) is strongly aligned with the ocean absorbing, storing, and moving heat through currents (DCI ESS2.D).

OLP 4. This is a rating of 3 because the concept that oxygen in the atmosphere originally came from organisms in the ocean (OLFC 4A; S&S grades 6 through 8 A 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 rating of 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 and atmosphere which can result in changes to the climate (OLFC 3E through G; S&S grades 6 through 8 B, B1) and humans are changing the climate by releasing CO₂ into the

atmosphere (S&S grades 6 through 8 B6). In addition, understanding the importance of mapping natural hazards and geologic forces to forecast future events (DCI ESS3.B) requires knowing about ocean weather maps and oceanographic data sets to predict future weather-related natural hazards, including hurricanes, extreme rainfall, droughts, and El Niño (S&S grades 6 through 8 A7, A8, A11, A12).

OLP 6. This is a rating of 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 following concepts: humans affect the ocean in a variety of ways, including impacting biological diversity and causing extinctions; most people live near coasts (OLFC 6D, F); human activity leads to excess input of greenhouse gases; and pollution affects life in the ocean (S&S grades 6 through 8 D13 through 22).

MS-LS1 From Molecules to Organisms: Structures and Processes

OLP 3. This is a rating of 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 grades 6 through 8 B3).

OLP 4. This is a rating of 4 because understanding photosynthesis (DCI LS1.C, PS3.D) serves as a building block to and is an integral part of understanding oxygen in the atmosphere originally came from photosynthetic organisms in the ocean (OLFC 4A; S&S grades 6 through 8 A4 through 6).

OLP 5. This is a rating of 2 because understanding growth and development of organisms (DCI LS1.B) is incomplete without knowing about adaptations for reproduction and growth in ocean organisms

(OLFC 5D; S&S grades 6 through 8 B strand). In addition, to fully understand organization of matter and energy flow in organisms (DCI LS1.C) learners need to understand that there is non-photosynthetic primary productivity in the ocean (OLFC 5G; S&S grades 6 through 8 A5, A6) and microorganisms in the ocean produce a huge amount of oxygen on Earth (OLFC 5B; S&S grades 6 through 8 A2 through A4).

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

OLP 1. This is a rating of 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 (OLFC 1C; S&S grades 6 through 8 C strand) and physical and biological systems (OLFC 1E).

OLP 2. This is a rating of 2 because learners 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 (OLFC 2A, D; S&S grades 6 through 8 B3).

OLP 3. This is a rating of 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 (OLFC 3E; S&S grades 6 through 8 B2, B3). 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 (OLFC 3G; S&S grades 6 through 8 B1, B5, B6) with regard to disruptions in ecosystems.

OLP 5. This is a rating of 2 because learners 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 grades 6 through 8 A and B strands).

OLP 6. This is a rating of 2 because to understand how changes in biodiversity can influence resources and ecosystem services (DCI LS4.D) learners must know how humans and the ocean are inextricably interconnected (OLP 6; S&S grades 6 through 8 B strand).

MS-LS3 Heredity: Inheritance and Variation of Traits

No alignment between OLP and NGSS.

MS-LS4 Biological Evolution: Unity and Diversity

OLP 4. This is a rating of 2 because to achieve a full understanding of the evidence of common ancestry and diversity (DCI LS4.A) learners need to learn about the origins of life (OLP 4; S&S grades 6 through 8 B strand).

OLP 5. This is a rating of 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 ocean life (OLFC 5D; S&S grades 6 through 8 B strand).

MS-PS1 Matter and Its Interactions

OLP 2. This is a rating of 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 grades 6 through 8 A5).

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OLP 3. This is a rating of 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 (OLFC 3D); and the ocean moves heat, carbon, and water (OLFC 3F, S&S grades 6 through 8 A). Learners 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 (OLFC 3A, B, F; S&S grades 6 through 8 A strand).

OLP 6. This is a rating of 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 grades 6 through 8 D13 through 17) which in turn, can affect the survival of some organisms (OLFC 6E).

MS-PS2 Motion and Stability: Forces and Interactions

OLP 1. This is a rating of 4 because learners need to have a basic understanding of how gravity works (DCI PS2.A, B) to understand tides and density-driven thermohaline circulation (OLFC 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 rating of 3 because thermohaline circulation in the ocean (OLFC 1C; S&S grades 6 through 8 C, C1, C6) 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 rating of 3 because energy transfer from the ocean to the atmosphere (OLFC 3B through 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 OLP and NGSS.

MS-ETS1 Engineering Design

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