

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)
HS-ESS1 Earth's Place in the Universe	2	1						ESS1.C; ESS2.B; PE HS-ESS1-5
HS-ESS2 Earth's Systems	1	3	2	2		1		ESS2.A, C, D, E
HS-ESS3 Earth and Human Activity			1			1	2	ESS2.D; ESS3.B; ESS3.C; ESS3.D
HS-LS1 From Molecules to Organisms: Structures and Processes				4				LS1.C
HS-LS2 Ecosystems: Interactions, Energy, and Dynamics	2	1	2	3	2	1	3	LS2.A, B, C; LS4.D; ETS1.B
HS-LS3 Heredity: Inheritance and Variation of Traits								
HS-LS4 Biological Evolution: Unity and Diversity				2	3	1		LS4.A, C, D
HS-PS1 Matter and Its Interactions								
HS-PS2 Motion and Stability: Forces and Interactions	4							PS1A; PS2.A, B
HS-PS3 Energy			3			3		PS3.A, B, C
HS-PS4 Waves and Their Applications in Technologies for Information Transfer	3		4				3	PS4.A, B, C
HS-ETS 1 Engineering Design						3		ETS1.A, B

## Explanation for Ratings

### HS-ESS1 Earth's Place in the Universe

**OLP 1.** This is a rating of 2 because in order to completely understand plate tectonics as the unifying theory to explain geologic history (DCI ESS2.B; PE HS-ESS1-5), learners need to understand the lithosphere includes the seafloor and all of its geological features and ocean basins vary in size and shape due to movement of Earth's crust (OLFC 1B; S&S grades 9 through 12, A3 and A4).

**OLP 2.** This is a rating of 1 because there is alignment between the concepts that tectonic activity influences the physical structure and landforms of the coast (OLFC 2E; S&S grades 9 through 12, A through A4), many sedimentary rocks now exposed on land were formed in the ocean (OLFC 2A), processes associated with plate

tectonics move sediments (OLFC 2C), and plate tectonics is the unifying theory that explains the past and current movement of rocks at Earth's surface (DCI ESS2.B; PE HS-ESS1-5).

### HS-ESS2 Earth's Systems

**OLP 1.** This is a rating of 1 because the OLP focuses on the concept that the ocean is the defining feature of the planet (OLFC 1A), the ocean transports energy and matter around Earth (OLFC 1C; S&S grades 9 through 12, C7, C11, C12), and the unique properties of water (OLFC 1E; S&S grades 9 through 12, B strand). These concepts are closely aligned with the abundance of liquid water on Earth and its unique properties being central to the planet's dynamics (DCI ESS2.C).

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**OLP 2.** This is a rating of 3 because the OLP provides important Earth system examples of the core idea that feedbacks between the biosphere and other Earth systems cause the co-evolution of life and Earth's surface (DCI ESS2.E). Examples include biogeochemical cycles and sedimentary rocks found on land originated in the ocean (OLFC 2A) and the ocean is the largest reservoir of rapidly cycling carbon on Earth, which is then used by shell and reef building organisms (OLFC 2D; S&S grades 9 through 12, B strand).

**OLP 3.** This is a rating of 2 because in order to fully understand the concepts that interactions and feedback effects between Earth's systems cause changes to climate (DCI ESS2.A) and the foundation of the climate system is energy from the sun and interactions with the atmosphere, ocean and land (DCI ESS2.D). Learners must have an understanding of the following concepts: the interaction of oceanic and atmospheric processes controls climate by dominating Earth's energy, water, and carbon systems (OLFC 3A; S&S grades 9 through 12, A and B strands); the ocean moderates climate by absorbing most of the solar radiation reaching Earth, and heat exchange between the ocean and atmosphere drives oceanic and atmospheric circulation (OLFC 3A, B, F; S&S grades 9 through 12, A and B strands); and changes in the ocean-atmosphere system can result in changes to the climate that in turn, cause further changes to the ocean and atmosphere (OLFC 3G; S&S grades 9 through 12, C strand).

**OLP 4.** This is a rating of 2 because to fully understand the concepts of changes in Earth's atmosphere and feedbacks among Earth's systems (DCI ESS2.D, E), learners must have an understanding of the influence of the ocean on the formation of and changes to Earth's atmosphere and interaction with other systems (OLFC 4A, C; S&S grades 9 through 12, A and B strands).

**OLP 6.** This is a rating of 1 because concepts addressing changes in the atmosphere due to human activity are described in both the DCI (ESS2.D) and the S&S (D1, D2).

## HS-ESS3 Earth and Human Activity

**OLP 3.** This is a rating of 1 because the core ideas of weather and climate models (DCI ESS2.D) are addressed in the OLP, which also provides additional examples of the ocean's influence on weather and climate (OLFC 3F, G; S&S grades 9 through 12, B1, B2, B5, B6).

**OLP 6.** This is a rating of 1 because there are strong connections between three DCIs and the OLP. The core idea about natural hazards (DCI ESS3.B) is aligned with ideas about human actions increasing the effects of hurricanes and tsunamis (OLFC 6F; S&S grades 9 through 12, D4 through D6). Ideas about resource availability and their effect on human society (DCI ESS3.C) are aligned with concepts about foods, medicines, and mineral and energy resources from the ocean that humans depend on (OLFC 6B; S&S grades 9 through 12, A strand). Ideas about human impacts and management of Earth systems (DCI ESS3.C) are aligned with concepts on ocean resource management (OLFC 6E; S&S grades 9 through 12, A2, D1, E3 through E5). Concepts about discovering and modeling Earth's systems (ESS3-D) are aligned with making discoveries about the ocean-atmosphere-biosphere interactions and managing human impacts, including climate change (OLFC 6G; S&S grades 9 through 12, D14, D15, E2).

**OLP 7.** This is a rating of 2 because in order to fully understand the core idea of modeling future climate (DCI ESS2.D) an understanding of ocean exploration and new technologies is needed (OLFC 7D, E; S&S grades 9 through 12, A4, C2 through C5). To fully understand concepts about global climate change (ESS3.D) an understanding of the

complexities and limitations of ocean modeling are needed (S&S grades 9 through 12, C3).

## HS-LS1 From Molecules to Organisms: Structures and Processes

**OLP 4.** This is a rating of 4 because to understand oxygen production and the effect of oxygen on life on Earth (OLFC 4A; S&S grades 9 through 12, A strands) learners need to know about the process of photosynthesis as described in the DCI (LS1.C).

## HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

**OLP 1.** This is a rating of 2 because to fully understand cycles of matter and energy transfer in ecosystems and ecosystem dynamics (DCI LS2.B, C) an understanding of how ocean circulation transports (heat) energy and matter and how changes to it affect climate and climate stability are needed (OLFC 1C).

**OLP 2.** This is a rating of 1 because the concepts that many biogeochemical cycles originate in the ocean (OLFC 2A), the role that rapidly cycling carbon plays in the ocean (OLFC 2D), and the connection of these cycles to the processes of photosynthesis and respiration (S&S grades 9 through 12, B strand) are strongly aligned with the cycles of matter and energy transfer, including photosynthesis, respiration, and the carbon cycle as described in the DCIs (LS2.B).

**OLP 3.** This is a rating of 2 because to fully understand ecosystem dynamics, functioning, and resilience (DCI LS2.C) an understanding of the ocean's influence on climate change and stability is needed (OLFC 3E through G; S&S grades 9 through 12, B and C strands). Additionally, to fully understand cycles of matter and energy transfer in ecosystems (DCI LS2.B) learners need to understand the ocean's role in the carbon cycle (OLFC 3E; S&S grades 9 through 12, B1 through B8).

**OLP 4.** This is a rating of 3 because the concept of Earth's changing atmosphere (OLFC 4C; S&S grades 9 through 12, A strand) provides an example of ecosystem dynamics, functioning, and resilience found in the DCI (LS2.C).

**OLP 5.** This is a rating of 2 because in order to fully understand matter and energy transfer in ecosystems (DCI LS2.B) an understanding of the role microbes play as primary producers in ocean ecosystems (OLFC 5B; S&S grades 9 through 12, A strand) is needed. Understanding the uniqueness and diversity of ocean ecosystems (OLFC 5E, G; S&S grades 9 through 12, B strand) and the diversity of life and adaptations of ocean organisms (OLFC 5C, D, F, H; S&S grades 9 through 12, C strand) are essential to comprehending how ecosystems are defined by environmental factors and the community of organisms living there (DCI LS2.A).

**OLP 6.** This is a rating of 1 because the idea that human interactions with the ocean and ocean-atmosphere ecosystems may have negative consequences (OLFC 6D, E; S&S grades 9 through 12, D strand) is closely aligned to the concept that complex ecosystem interactions are affected by stability vs. extreme fluctuations and anthropogenic effects such as pollution, overexploitation, and climate change (DCI LS2.C). Also, humans depend on living resources and benefit from biodiversity (DCI LS4.D) which aligns with the concept that humans benefit from the food, medicine, resources, biodiversity, and inspiration provided by the ocean (OLFC 6A through D; S&S grades 9 through 12, A and B strands).

**OLP 7.** This is a rating of 3 because many examples of different technological advances to explore the ocean are provided, each with strengths and limitations which must be considered (OLFC 7C through E; S&S grades 9 through 12, C strand) when exploring how human activity impacts ecosystems

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(DCI LS2.C) and when evaluating solutions (DCI ETS1.B) to sustain biodiversity (DCI LS4.D).

## HS-LS4 Biological Evolution: Unity and Diversity

**OLP 4.** This is a rating of 2 because understanding that the earliest evidence of life is found in the ocean (OLFC 4B; S&S grades 9 through 12, B strand) is essential to fully understanding evidence of common ancestry and diversity as described in the DCI (LS4.A).

**OLP 5.** This is a rating of 3 because the ocean provides excellent and diverse examples of adaptations as well as environmental conditions and variations (OLFC 5D, G, H; S&S grades 9 through 12, B and C strands) introduced in the DCI (LS4.C) which focuses on the process of adaptation and connections to environmental change.

**OLP 6.** This is a rating of 1 because the concepts that humans are dependent on natural resources and other benefits provided by biodiversity and on preserving landscapes for recreation and inspiration (DCI LS4.C, D) are strongly aligned with the ocean literacy concepts that although there is a strong interconnection to the environment, humans are having adverse impacts on biodiversity and resources (OLFC 6D, E; S&S grades 9 through 12, A and D strands).

## HS-PS1 Matter and Its Interactions

No alignment between OL and NGSS.

## HS-PS2 Motion and Stability: Forces and Interactions

**OLP 1.** This is a rating of 4 because learners need to understand the structure and properties of matter (DCI PS1.A) as well as forces and motion (DCI PS2.A, B) in order to understand thermal

expansion and the forces at play in ocean circulation (OLFC 1C, D; S&S grades 9 through 12, C strand).

## HS-PS3 Energy

**OLP 3.** This is a 3 because the ocean literacy concepts provide important Earth system examples of fundamental physical energy principles including definitions of energy (DCI PS3.A), conservation of energy, and energy transfer (DCI PS3.B, C). Examples include absorption of solar radiation by the ocean and the energy exchange between the ocean-atmosphere system, which drives Earth's circulation, moderates climate, and provides the energy for hurricanes (OLFC 3A through D; S&S grades 9 through 12, A, A1, A4 through A8, A13).

**OLP 6.** This is a rating of 3 because the ocean literacy concepts provide examples of energy resources from the ocean (OLFC 6B; S&S grades 9 through 12, A5) which help to apply fundamental physical energy principles, including definitions of energy (DCI PS3.A; PE HS-PS3-3).

## HS-PS4 Waves and Their Applications in Technologies for Information Transfer

**OLP 1.** This is a rating of 3 because the core ideas about ocean waves, including how waves transfer energy over a long distance but with very little horizontal movement (S&S grades 9 through 12, C15 through 17), provide strong examples and an application of the concept of wave properties (DCI PS4.A).

**OLP 3.** This is a rating of 4 because in order to understand solar radiation and heat exchange between the ocean and atmosphere (OLFC 3B, C; S&S grades 9 through 12, A and B strands) it is helpful to understand electromagnetic radiation, absorption, and conversion to thermal energy (DCI PS4.B).

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**OLP 7.** This is a rating of 3 because the development and use of information technologies in ocean exploration (OLFC 7D; S&S grades 9 through 12, C strand) are examples of the importance of applying our understanding of waves and their interactions with matter in the use and development of essential tools (DCI PS4.A, C).

## HS-ETS1 Engineering Design

**OLP 6.** This is a rating of 3 because as the human population, climate change, and impact on ocean resources increases (OLFC 6D; S&S grades 9 through

12, A6, D1) achieving environmental sustainability in the ocean depends upon action based on scientific research and exploration (S&S grades 9 through 12, E strand) as well as regulations (S&S grades 9 through 12, E2 through E8, E10). These ocean examples of global challenges may be addressed through engineering (DCI ETS1.A). When evaluating these solutions it is important to take into account social, cultural, and environmental impacts (DCI ETS1.B).