Alignment of the Ocean Literacy Framework to the NGSS

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

Alignment of the Ocean Literacy Framework to the NGSS

Explanation for Ratings

3 through 5 ETS1 Engineering Design

OLP 6. This is a rating of 3 because human development and activity around the ocean (OLFC 6D; S&S grades 3 through 5, A4) provide many examples of design solutions to problems (ETS1.A, B, C) that unintentionally led to other problems such as pollution, changes to ocean chemistry, and physical modifications.

OLP 7. This is a rating of 3 because technologies for exploring the ocean (OLFC 7D; S&S grades 3 through 5, C strand) provide good examples of how possible engineering solutions are developed (ETS1.B, C). Similarly, collaboration among interdisciplinary ocean scientists (OLFC 7F; S&S grades 3 through 5, B strand) is a good example of how communication and sharing of ideas among peers can lead to improved designs (ETS1.B, C).

3-ESS2 Earth's Systems

OLP 3. This is a rating of 3 because the interaction of the ocean and atmosphere (OLFC 3A through D; S&S grades 3 through 5, A1 and A2) controls and regulates most of Earth's weather and climate patterns that are recorded by scientists (DCI ESS2.D). Note: this could be rated as a 2 if the instructor's intent is for learners to understand causes of weather and climate rather than only to observe and record weather and climate.

3-ESS3 Earth and Human Activity

OLP 3. This is a rating of 3 because natural hazards related to the ocean, e.g., hurricanes, cyclones, and El Niño (OLFC 3C, D; S&S grades 3 through 5, A6) are important examples of natural hazards that may impact humans (ESS3.B).

OLP 6. This is a rating of 3 because tsunamis, hurricanes, cyclones, sea level change, and storm surges (OLFC 6F; S&S grades 3 through 5, B4) are important examples of natural hazards that may impact humans (ESS3.B).

3-LS1 From Molecules to Organisms: Structures and Processes

OLP 5. This is a rating of 1 because the DCI (LS1.B), OLFC (5B, D, I) and S&S (grades 3 through 5, B5) all discuss reproduction and unique and diverse life cycles. Understanding life in the ocean is essential to understanding the diversity of life on Earth.

3-LS2 Ecosystems: Interactions, Energy, and Dynamics

OLP 5. This is a rating of 3 because the ocean (OLFC 5D) provides unique examples of animals working in groups to obtain food, defend themselves, and cope with changes (DCI LS2.D). For example, schooling behavior can be readily observed in an aquarium in the classroom.

3-LS3 Heredity: Inheritance and Variation of Traits

OLP 4. This is a rating of 4 because knowing the concepts of inheritance and variation (DCI LS3.A, B) can help learners understand how millions of different species on Earth are related by descent from common ancestors that evolved in the ocean (OLFC 4B).

OLP 5. This is a rating of 3 because the great diversity of major groups of organisms in the ocean (OLFC 5A, C) are compelling and illustrative examples of the concepts of inheritance, variation and diversity (DCI LS3.A, B). The concept that the environment can affect an organism's traits (DCI LS3.A, B) is also related

to the concept that physical factors influence the distribution of ocean organisms (OLFC 5F, H).

3–LS4 Biological Evolution: Unity and Diversity

OLP 2. This is a rating of 3 because marine fossils found on land (OLFC 2A; S&S grades 3 through 5, A3, A4) are excellent examples of fossils that provide evidence of the types of organisms that lived long ago and of their environments (DCI LS4.A). Additionally, for learners to understand the evidence provided by land-based marine fossils, it is useful for them to know that sea level changes over time have contracted continental shelves and destroyed inland seas (OLFC 2B).

OLP 4. This is a rating of 3 because learners begin to learn about fossils and the environments indicated by those fossils (DCI LS4.A). The ocean provides many excellent examples for such fossil environment relationships (S&S grades 3 through 5, A, A1) but is not required in order to understand the DCI.

OLP 5. This is a rating of 4 because understanding adaptation, diverse environments, natural selection, and biodiversity (LS4.B, C, D) build and support understanding that ocean ecosystems are defined by environmental factors and the community of organisms living there and that the ocean supports a great diversity of ecosystems and adaptations (OLFC 5F; S&S grades 3 through 5, B1). The DCI concepts generally support understanding of the ideas in the OLP and S&S.

OLP 6. This is a rating of 1 because the DCI (LS4.D), OLP, OLFC (6D), and S&S (grades 3 through 5, C1 through C4) all discuss how changes to a habitat may affect organisms living there.

OLP 7. This is a rating of 3 because the concept that people are not adapted to survive well in an ocean environment (S&S grades 3 through

5, C2, C3, C5, C6) is an excellent example of how some kinds of organisms survive better than others in particular environments (DCI LS4.C).

3–PS2 Motion and Stability: Forces and Interactions

OLP 1. This is a rating of 3 because ocean circulation (OLFC 1C; S&S grades 3 through 5, B, B1 through B10) provides a good example of forces and motion (DCI PS2.A). In later grades one would use an understanding of forces and motion to support deep understanding of ocean circulation.

OLP 2. This is a rating of 3 because forces that cause erosion and change the physical structure of coastal landforms (OLFC 2C, E; S&S grades 3 through 5, B strand) provide good examples of how objects in contact exert forces on one another (DCI PS2.B). Additionally, the concepts that objects can exert force on one another and that an object's motion can be observed and predicted (DCI PS2.A, B), support an understanding of the forces of waves and other forces that contribute to erosion and the formation of landforms (OLFC 2C, E).

4–ESS1 Earth's Place in the Universe

OLP 1. This is a rating of 3 because the presence of marine terraces and other geological marine features (OLFC 1B; S&S grades 3 through 5, C strand) seen on land provide examples of and support an explanation for change over time (DCI ESS1.C; PE-ESS1-1).

OLP 2. This is a rating of 2 because in order to have a complete understanding of how patterns of rock formation reveal changes over time and how fossils can provide indications of the order of the change-causing events (DCI ESS1.C) learners need to understand ocean life laid down sediments, dead ocean organisms falling into those sediments often formed fossils, and marine fossils found on land are

evidence that the land was once covered by ocean (OLFC 2A; S&S grades 3 through 5, A2 through A4).

4-ESS2 Earth's Systems

OLP 1. This is a rating of 1 because DCI ESS 2.B, OLFC 1B, and S&S grades 3 through 5, C strand all list geologic seafloor features. Additionally, the OLP and DCI refer to plate movement/movement of Earth's crust as giving rise to many of these features (DCI ESS2.B; OLP 1B). The DCI and OLP also discuss the water cycle/rainfall and how water breaks down and transports materials (DCI ESS2.A; OLFC 1F, G).

OLP 2. This is a rating of 1 because DCI ESS2.A; OLFC 2C, D; and S&S grades 3 through 5, B strand all describe processes of erosion that act to shape the land/coastline. In addition, the idea that living things affect the physical characteristics of their regions (DCI ESS2.E) is directly supported by the concept that ocean life laid down the vast volume of siliceous and carbonate rocks (OLFC 2A; S&S grades 3 through 5, A2).

4-ESS3 Earth and Human Activity

OLP 3. This is a rating of 3 because ocean-related natural hazards, such as hurricanes and cyclones (OLFC 3D; S&S grades 3 through 5, A6), are strong examples of natural hazards humans cannot eliminate but can take steps to reduce their impact (DCI ESS3.B). The OLP and S&S also discuss the underlying causes of these natural hazards (OLFC 3D; S&S grades 3 through 5, A3, A5, A6). The standard does not call for a complete understanding of all natural hazards or their underlying causes. Therefore, it is not essential to understand ocean-related natural hazards to meet the standard, but ocean-related hazards are among the most prominent and dramatic examples.

OLP 6. This is a rating of 3 because the DCI ESS3.B discusses natural hazards and human response to those hazards. There are many ocean-related examples of these hazards as well as information about how humans may be affected because a large proportion of the human population live near the ocean (OLFC 6F; S&S grades 3 through 5, B4). Additionally, energy resources from the ocean (OLFC 6B; S&S grades 3 through 5, A4) provide examples of naturally-derived energy and fuels (DCI ESS3.A).

4-LS1 From Molecules to Organisms: Structures and Processes

OLP 5. This is a rating of 2 because learners' understanding of structure, function, and information processing (DCI LS1.A, D) is not complete unless they are aware of both terrestrial and marine examples (e.g., gills, collapsible lungs for deep diving, fins) since there are many categories of unique organisms that live only in the ocean. Ocean organisms provide many examples of unique life cycles and adaptations (OLFC 5D; S&S grades 3 through 5, B1 through B3, B5). The growth rates and life cycles of ocean microbes (OLFC 5B) are also connected, but not as strongly.

4-PS3 Energy

OLP 3. This is a rating of 3 because wave movement and heat exchange between the ocean and atmosphere (S&S grades 3 through 5, A through A5) are helpful examples of the transfer, transport, and conversion of energy (DCI PS3.B).

4-PS4 Waves and Their Applications in Technologies for Information Transfer

OLP 6. This is a rating of 3 because the ocean research and communications technology necessary for commerce, resource extraction, and resource management (OLFC 6B, D, E, G) would make interesting examples of information technologies and instrumentation (PS4.C) but are not essential to understanding them.

OLP 7. This is a rating of 3 because examples of "new ocean technologies, sensors, and tools" (OLFC 7D) are dependent on the wave properties of sound and visible light (DCI PS4.C). These real-world examples would add interest for learners but are not essential to understanding the concepts.

5-ESS1 Earth's Place in the Universe

No alignment between OLP and NGSS.

5-ESS2 Earth's Systems

OLP 1. This is a rating of 1 because concepts connected to the role of water in Earth's surface processes (ESS2.C) are directly referenced throughout the OLFC (1A, E, G). Also, the DCI, OLP, and S&S all directly address ocean system concepts (DCI ESS2.A; OLFC 1C; S&S grades 3 through 5, A and B strands).

OLP 2. This is a rating of 2 because many of the concepts related to how the movement of water erodes and deposits material that shape the coastline (S&S grades 3 through 5, B strand) are essential to fully understanding how the ocean shapes landforms (ESS2.A).

OLP 3. This is a rating of 2 because the concepts about how the ocean and atmosphere interact (S&S grades 3 through 5, A and B strands) are essential for understanding how Earth's systems interact (ESS2.A).

OLP 5. This is a rating of 1 because the language regarding ocean ecosystems in the DCI (ESS2.A) is nearly the same as in the OLP (OLFC 5E through G, and I; S&S grades 3 through 5, A strand). The OLP and S&S provide multiple, diverse examples of ocean ecosystems.

5-ESS3 Earth and Human Activity

OLP 6. This is a rating of 1 because the OLP (OLFC 5D, E, G) and specifically the concepts developed in the S&S grades 3 through 5,

C strand), provide an overview of how human activity has had and can have major effects on the ocean as identified in the DCI (ESS3.C).

OLP 7. This is a rating of 2 because in order to fully understand how communities use science ideas to protect Earth (DCI ESS3.C), related ocean science ideas must be considered (S&S grades 3 through 5, all strands). Excluding ocean concepts would result in an incomplete and inaccurate understanding of how to protect Earth's resources and environment.

5-LS1 From Molecules to Organisms: Structures and Processes

OLP 4. This is a rating of 2 because the concept that plants acquire material for growth chiefly from the air and water (DCI LS1.C; PE 5-LS1-1) demonstrates a terrestrial bias. The use of additional ocean examples, such as algae or microbes (S&S grades 3 through 5, B1) would address this bias and lead to a more complete understanding of primary productivity.

OLP 5. This is a rating of 2 because the concept that "plants" get what they need to live from air and water (DCI LS1.C) represents a terrestrial bias. An understanding of primary productivity is incomplete without understanding the huge ecological role played by photosynthetic ocean microbes and algae that do not require "air" (OLFC 5B; S&S grades 3 through 5, A6, B8).

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

OLP 2. This is a rating of 4 because learners need to understand chemical cycling (DCI LS2.B) before being able to understand biogeochemical cycling (OLFC 2A). This DCI is a building block for comprehending the concept of chemical cycling that will support discussion of biogeochemical cycling in a later grade.

OLP 5. This is a rating of 2 because a full understanding of food webs (DCI LS2.B) requires examples of species and ecosystems from the ocean which are fundamentally different from those on land. Ocean food webs begin with microbes, not plants (OLFC 5B). There are unique types of energy transfer in the ocean that do not occur on land, including ecosystems that do not depend on light and photosynthesis (OLFC 5D, G; S&S grades 3 through 5, A2, A9).

5-PS1 Matter and Its Interactions

No alignment between OLP and NGSS.

5-PS2 Motion and Stability: Forces and Interactions

OLP 1. This is a rating of 4 because understanding the concept of gravitational force (DCI PS2.B) helps to build an understanding of density-driven currents and tides (S&S grades 3 through 5, B7, B9).

OLP 5. This is a rating of 4 because the focus on Earth's gravitational force (DCI PS2.B) is a building block to understanding tides. This DCI has a tangential but important relationship to the discussion of tide-influenced vertical zonation in intertidal habitats (OLFC 5H).

5-PS3 Energy

OLP 5. This is a rating of 2 because the idea that all ecosystems are driven by the sun's energy and all energy in food comes from the sun (DCI PS3.D) is inaccurate and represents a terrestrial bias. It is essential that learners explicitly understand there are important ecosystems and organisms supported through chemosynthetic processes (OLFC 5D, G).