Alignment of Ocean Literacy Framework to the NGSS for Grades 3–5

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

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

3-5-ETS1 Engineering Design

OLP 6. This is a 3 because human development and activity around the ocean (OLP 6d; 3-5 S&S 6A.4) 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 3 because technologies for exploring the ocean (OLP 7d; 3-5 S&S 7C) provide good examples of how possible engineering solutions are developed (ETS1.B, C). Similarly, collaboration among interdisciplinary ocean scientists (OLP 7f; 3-5 S&S 7B) 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 3 because the interaction of the ocean and atmosphere (OLP 3a-d; 3-5 S&S 3A.1-2) 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 students 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 3 because natural hazards related to the ocean, e.g., hurricanes, cyclones, and El Niño (OLP 3c-d; 3-5 S&S 3A.6) are important examples of natural hazards that may impact humans (ESS3.B).

OLP 6. This is a 3 because tsunamis, hurricanes, cyclones, sea level change and storm surges (OLP 6f; 3-5 S&S 6B.4) 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 1 because the DCI (LS1.B), OLP (5b, d, i) and S&S (3-5 S&S 5B.5) 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 3 because the ocean (OLP 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 4 because knowing the concepts of inheritance and variation (DCI LS3.A, B) can help students understand how millions of different species on Earth are related by descent from common ancestors that evolved in the ocean (OLP 4b).

OLP 5. This is a 3 because the great diversity of major groups of organisms in the ocean (OLP 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 (OLP 5f, h).

3-LS4 Biological Evolution: Unity and Diversity

OLP 2. This is a 3 because marine fossils found on land (OLP 2a; 3-5 S&S 2A.3-4) 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 students 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 (OLP 2b).

OLP 4. This is a 3 because students 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 (3-5 S&S 4A, A.1), but is not required in order to understand the DCI.

OLP 5. This is a 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 (OLP 5f; S&S 5B.1). The DCI concepts generally support understanding of the ideas in the OLP and S&S.

OLP 6. This is a 1 because the DCI (LS4.D), OLP (6, 6d), and S&S (3-5 S&S 6C.1-4) all discuss how changes to a habitat may affect organisms living there.

OLP 7. This is a 3 because the concept that people are not adapted to survive well in an ocean environment (3-5 S&S 7C.2-3, 5-6) 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 3 because ocean circulation (OLP 1c; 3-5 S&S 1B, B.1-10) 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 3 because forces that cause erosion and change the physical structure of coastal landforms (OLP 2c, e; 3-5 S&S 2B) 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 (OLP 2c, e).

4-ESS1 Earth's Place in the Universe

OLP 1. This is a 3 because the presence of marine terraces and other geological marine features (OLP 1b; 3-5 S&S 1C 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 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), one needs to understand that ocean life laid down sediments; that dead ocean organisms falling into those sediments often formed fossils; and that marine fossils found on land are evidence that the land was once covered by ocean (OLP 2a; 3-5 S&S 2A.2-4).

4-ESS2 Earth's Systems

OLP 1. This is a 1 because the DCI, OLP, and S&S all list geologic seafloor features (DCI ESS 2.B, OLP 1b; 3-5 S&S 1C strand). 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; OLP 1f, g).

OLP 2. This is a 1 because the DCI, OLP, and S&S all describe processes of erosion that act to shape the land/coastline (DCI ESS2.A; OLP 2c-d; 3-5 S&S 2B strand). 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 (OLP 2A; 3-5 S&S 2A.2).

4-ESS3 Earth and Human Activity

OLP 3. This is a 3 because ocean-related natural hazards, such as hurricanes and cyclones (OLP 3d; 3-5 S&S 3A.6), are strong examples of natural hazards that humans cannot eliminate, but humans can take steps to reduce their impact (DCI ESS3.B). The OLP and S&S also discuss the underlying causes of these natural hazards (OLP 3d; 3-5 S&S 3A.3, 5-6). 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 3 because the DCI discusses natural hazards and human response to those hazards (DCI ESS3.B). 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 (OLP 6f; 3-5 S&S 6B.4). Additionally, energy resources from the ocean (OLP 6b; 3-5 S&S 6A.4) 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 2 because students' 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 (OLP 5d; 3-5 S&S 5B1-3,5). The growth rates and life cycles of ocean microbes (OLP 5b) are also connected, but not as strongly.

4-PS3 Energy

OLP 3. This is a 3 because, wave movement and heat exchange between the ocean and atmosphere (3-5 S&S 3A-A.5) 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 3 because the ocean research and communications technology necessary for commerce, resource extraction and resource management (OLP 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 3 because examples of "new ocean technologies, sensors, and tools" (OLP 7d) are dependent on the wave properties of sound and visible light (DCI PS4.C). These real-world examples would add interest for students, but are not essential to understanding the concepts.

5-ESS1 Earth's Place in the Universe

No alignment between OL and NGSS.

5-ESS2 Earth's Systems

OLP 1. This is a 1 because concepts connected to the role of water in Earth's surface processes (ESS2.C) are directly referenced throughout OLP (OLP 1a, e, g). Also, the DCI, OLP, and S&S all directly address ocean system concepts (DCI ESS2.A; OLP 1c; 3-5 S&S 1A, B).

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

OLP 3. This is a 2 because the concepts about how the ocean and atmosphere interact (3-5 S&S 3) are essential for understanding how Earth's systems interact (ESS2.A).

OLP 5. This is a 1 because the language regarding ocean ecosystems in the DCI (ESS2.A) is nearly the same as several fundamental concepts in the Ocean Literacy Framework (OLP 5e-g, i; 3-5 S&S 5A). The OLP and S&S provide multiple, diverse examples of ocean ecosystems.

5-ESS3 Earth and Human Activity

OLP 6. This is a 1 because the OLP (5d, e, g), and specifically the concepts developed in the S&S (3-5 S&S P5C), 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 2 because in order to fully understand how communities use science ideas to protect the earth (DCI ESS3.C), related ocean science ideas must be considered (3-5 S&S 7). 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 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 (3-5 S&S 4B.1) would address this bias and lead to a more complete understanding of primary productivity.

OLP 5. This is a 2 because the concept that "plants" get what they need to live from air and water (DCI LS1.C) represents a terrestrial bias. Understanding primary productivity is incomplete without understanding the huge ecological role played by photosynthetic ocean microbes and algae that do not require "air" (OLP 5b; 3-5 S&S A.6, B.8).

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

OLP 2. This is a 4 because one needs to understand chemical cycling (DCI LS2.B) before being able to understand biogeochemical cycling (OLP 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 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 (OLP 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 (OLP 5d, g; 3-5 S&S 5A.2, 9).

5-PS1 Matter and Its Interactions

No alignment between OL and NGSS.

5-PS2 Motion and Stability: Forces and Interactions

OLP 1. This is a 4 because understanding the concept of gravitational force (DCI PS2.B) helps to build an understanding of density-driven currents and tides (3-5 S&S 1B.7, 9).

OLP 5. This is a 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 (OLP 5h).

5-PS3 Energy

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