Principle 5: The ocean supports a great diversity of life and ecosystems.

The ocean provides a vast living space and unique ecosystems, from the surface, through the water column, to the sea floor.

Diversity of Ecosystem — A

Ocean ecosystems vary widely, based on the variety of environmental factors and the community of organisms living there.

Primary Productivity — A1

Ocean systems with the greatest abundance of life occur where environmental conditions and/or adaptations allow for high levels of productivity.

A2

Most primary productivity in the ocean takes place at the surface where there is plentiful sunlight for photosynthesis and nutrients for growth.

A5

Some ecosystems function independent of light energy.

A7

There are six places in the ocean, all on west coasts, with the right environmental conditions to create the most productive areas. These are the coastal upwelling zones.

A10

Coral reefs occur where the water is warm and there are not many nutrients in the water, and yet they are very productive ecosystems.

A12

Environmental conditions in estuaries (e.g., shallow, brackish water) and in mangroves (lots of decaying organisms) result in highly productive nursery areas for a great many ocean organisms.

A13

At the poles, nutrients flowing into the ocean from melting glaciers, combined with long, sunny days in the summer, result in productivity, and abundance unequaled anywhere else in the world.

A3

Microbes (photosynthetic algae and bacteria) are important primary producers and support a huge abundance of life.

A6

Ecosystems, such as deep sea vents and cold water seeps depend on chemosynthesis — a process similar to photosynthesis, but with a different energy source — for primary productivity.

A8

Coastal upwelling occurs when wind and the Coriolis effect push surface water offshore, allowing for cold nutrient water from deeper down to rise to the surface

A9

Kelp forests and other coastal ocean ecosystems in upwelling zones have abundant sunlight, cold water, and nutrients, making them some of the most productive ecosystems in the world

A11

A symbiotic relationship between corals and the algae living inside them allows the corals to thrive, even though the environmental conditions do not seem conducive to supporting life.

A4

Microbes are the basis of most energy in food webs in the ocean. They are the primary food source for grazers, such as zooplankton and clams. Grazers are in turn the primary food for bigger organisms, such as fish and baleen whales.

A14

Differences in light, temperature, pressure, density, and chemical makeup of this fluid environment lead to distinct vertically and horizontally distributed ecosystems

A15

Ecosystems exist in layers of habitats and microhabitats due to gradients in specific environmental factors, such as temperature, salinity, and oxygen within the water column.

A16

Ocean organisms are adapted to live in a relatively stable ocean. They are often adapted to tolerate very specific environmental conditions. For example, corals can only live within specific temperature ranges, and some larval fish can only live in very narrow layers of water with particular salinity and temperature.

A17

Adaptations to specific environmental conditions can result in vertical and horizontal zonation patterns. For example, in intertidal areas, organisms are adapted to crashing waves and the cycle of the tides, while in the open ocean, many organisms are adapted to a specific temperature and salinity level. Different organisms are found in different density layers.

A18

Humans have changed environmental conditions in the ocean, which has had a generally negative impact on organisms adapted to the previous conditions.

A19

Changes to the climate will cause further changes to environmental conditions, which will likely have major impacts on many different ocean organisms.

A20

Ocean ecosystems are connected to each other via a series of food webs.

A21

The diversity of phyla and life history strategies of ocean organisms create complex, interconnected food webs, often with many more levels than in terrestrial ecosystems.

A22

Any change in an ecosystem or an organism in the community may have an adverse effect on many other ecosystems.

Diversity of Life — B

The diversity of ocean ecosystems allows for many unique lifeforms with many unique adaptations.

B1

The diversity of phyla is greater in the ocean than on land.

B3

The ocean supports a range of animals from the smallest living thing to the largest animal on Earth.

B5

Organisms in the ocean exhibit an amazing variety of adaptations to sound, density, pressure, patchy food distribution, and other environmental factors.

B2

Many major groups (phyla and classes) of organisms, such as echinoderms, cephalopods, comb jellies, and many types of worms are found exclusively in the ocean.

B4

Most of the biomass in the ocean is made up of microscopic microbes.

B6

Different ocean organisms have different life history strategies. Some drift with the currents (plankton), some swim (nekton), and some live on the bottom (benthos).

B7

In the tropical ocean where there are fewer nutrients, diversity of life is higher and abundance of life is lower. In the polar regions where there are comparatively more nutrients, there is less diversity of life and more abundance of life.

B8

Some ocean organisms such as phytoplankton have adaptations (e.g., oil droplets, spines, and a large surface area), which allow them to stay near the sunlit surface where photosynthesis can occur.

B9

Many marine animals, from shrimp to whales, rely on sound to communicate, find prey and mates, and sense their environments. Sound travels through the ocean much better than light does.

B10

Some ocean organisms have adaptations for living in or diving to the deep ocean. For example, elephant seals spend most of their life diving in the deep ocean to depths at which most mammals could not survive. Other organisms have bioluminescent lures to capture prey, or huge mouths and stomachs to take advantage of the scarce prey in the deep.

B11

Organisms in the ocean exhibit an amazing variety of life cycles. Some have planktonic stages that help colonize new areas, some undergo long seasonal migrations to mate and have young, and others change sex as they mature or as the dominance hierarchy in the community changes.

B12

Some of these life cycles are unique to ocean organisms, such as those of seahorses, corals, many fish, and kelp.