Principle 1:
Grades 3-5

Principle 1:
The Earth has one big ocean with many features.

The ocean, which covers 70% of Earth's surface, is the defining feature of the planet.

Properties of Ocean Water

A.
97% of all water on Earth is salt water in the ocean.

A.1.
Only 3% of all water on Earth is fresh water stored in lakes, rivers, underground aquifers, glaciers, and other places.

A.2.
Most of all the fresh water in the world is stored in ice caps and glaciers.

A.3.
Fresh water melting from glaciers contributes to the ocean and can change its salinity and temperature and cause sea level to rise.

→ See Principle 3: B3

A.4.
Salinity and temperature vary throughout the ocean.

A.5.
The movement of ocean water as currents is partly driven by these differences in salinity and temperature.

Ocean Circulation

B.
The ocean is a single, huge, interconnected body of water that circulates through all the ocean basins and continents.

B.1.
The ocean, the largest reservoir of water on Earth, is integral to the water cycle.

B.2.
Water circulates from land to the ocean and back via watersheds and the water cycle.

→ See Principle 3: B
See Principle 6: A3

B.3.
Lakes and glaciers are connected to the ocean via watersheds that are made up of rivers, streams, and groundwater.

B.4.
Watersheds drain water from inland to the ocean.

B.5.
Runoff from watersheds impacts the ocean.

→ See Principle 5: A3

B.6.
Water in the ocean is constantly moving and mixing vertically and horizontally.

B.7.
Wind- and density-driven currents move ocean water around Earth.

→ See Principles 5: B7

B.8.
Organisms travel on currents.

B.9.
Tides move ocean water higher and lower, covering and uncovering the shoreline.

B.10.
Waves crash on the shore, moving and mixing the water.

→ See Principle 2: B
See Principle 3: A3

Geographic and Geologic Features

C.
The ocean floor has a variety of geological and geographical features comparable to those on land.

C.1.
The ocean has many basins. They are called the Pacific, Atlantic, Indian, Arctic, and Southern basins.

C.2.
The ocean floor has other features such as mountains, plains, valleys, volcanoes, canyons, trenches, and ridges.

C.3.
The highest mountain on Earth is in the ocean. It is called Hawaii, an island in the Pacific Ocean.

→ See Principle 2: A5

C.4.
The lowest point on Earth is in the ocean. It is called the Mariana Trench, and is located in the Pacific Ocean.

C.5.
The features of the ocean floor influence ocean circulation patterns.

Principle 2:
Grades 3-5

Principle 2:
The ocean and life in the ocean shape the features of Earth.

Rock Cycle

A.
Many rocks found on land were formed in the ocean.

A.1.
Some rocks found on land were formed from compacted ocean sediments.

A.5.
Some rocks found on land were formed in the ocean by underwater volcanic activity.

A.2.
Sediment is made up of materials that sink to the bottom of the ocean, which may include the shells of dead ocean organisms.

A.3.
Dead organisms that fall into ocean sediments may become fossils.

A.4.
Marine fossils can be found on land in places that used to be covered by the ocean, (e.g., the Rocky Mountains).

See Principle 4: A1

See Principle 1: C2

Erosion

B.
The movement of water erodes and deposits materials that shape the coastline.

B.1.
The movement of water can break down cliffs, rocks, and other beach materials, which constantly changes the appearance and location of the shoreline.

B.7.
Rivers carry sediments downstream to the ocean.

B.9.
Waves and currents move sediment along the coastline.

B.2.
Beaches are made of different materials, such as sand, rocks, silt, and organic material.

B.8.
Sediments are deposited at the mouths of rivers, contributing to formation of coastlines.

B.10.
Large amounts of sediment from one area can be deposited in other locations along the coast.

B.3.
Rocks and minerals from the shoreline and from inland are broken down into pebbles, sand, silt and smaller materials.

B.4.
Shells and other hard materials from once-living organisms are broken down into sand, silt, and smaller materials.

B.5.
Most sand on most ocean beaches comes from rivers.

B.6.
Sand grains come in many shapes, sizes, and colors that provide clues to their origin.

See Principle 1: B6

Principle 3:
Grades 3-5

Principle 3:
The ocean is a major influence on weather and climate.

Nearly all the water on Earth is stored in the ocean. The ocean, which covers over 70% of Earth's surface, controls the weather by dominating Earth's energy and water systems.

Weather

A.
The ocean absorbs and holds much of the solar energy that reaches Earth.

A.1.
The ocean absorbs and holds more heat than the land.

A.2.
The ocean moderates coastal weather because the temperature of air masses over the ocean fluctuates less than the temperature of air masses over the land.

See Principle 6: B3

A.3.
The uneven heating of Earth causes convection currents, the movement of air and ocean water, from one place to another.

A.4.
Ocean currents move heat throughout ocean basins, which in turn, affects Earth's weather.

A.5.
Warm ocean water warms the air. The warm air rises, creating a low pressure area. Winds are set in motion as air moves from high-pressure to low-pressure areas.

See Principle 1: B6

A.6.
The ocean provides the energy for wind, which can produce severe weather, such as hurricanes and cyclones.

See Principle 6: B4

Water Cycle

B.
The ocean is an integral part of the water cycle. Solar energy absorbed by the ocean drives the water cycle.

B.1.
Solar energy warms water in the ocean and causes it to evaporate. Most water in the air comes from the ocean.

B.2.
Water in the air eventually cools, condenses into clouds, and returns to the ocean or the land as precipitation.

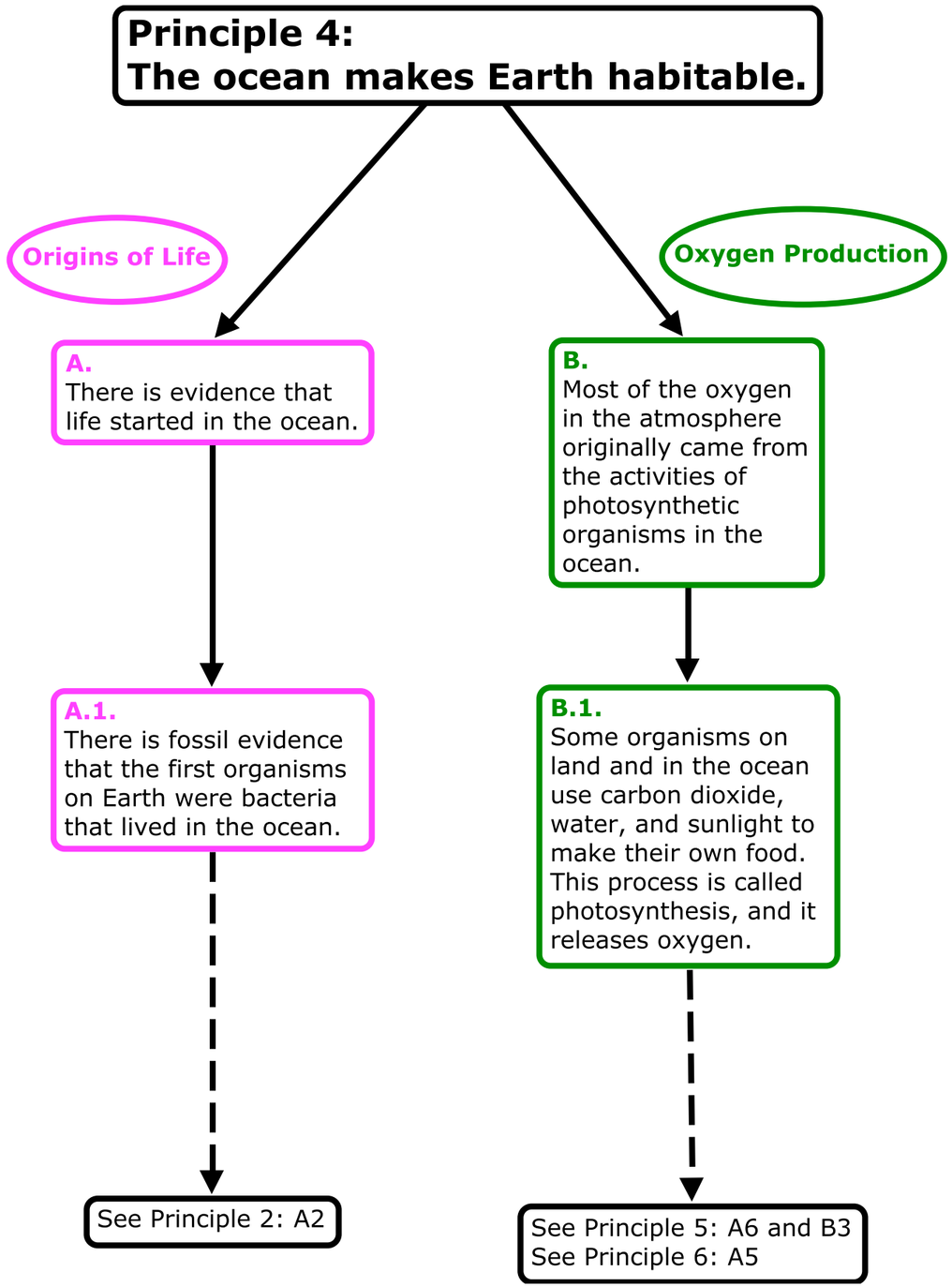
B.3.
Most of the fresh water on Earth comes from water that evaporated from the tropical ocean.

See Principle 1: A1

B.4.
Most of the water on land returns to the ocean through river runoff.

See Principle 1: B1
See Principle 6: A3

Principle 4:
Grades 3-5



Principle 5:
Grades 3-5

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

Diversity of Ecosystem

Diversity of Life

A.
The ocean supports a great diversity of interconnected and interdependent ecosystems, each defined by the interaction of the physical environment and the community of organisms living there.

B.
The ocean provides most of Earth's living space and supports a great diversity of life from the surface, through the water column, and down to the sea floor.

A.1.
Coastal ocean ecosystems, (e.g., rocky seashores, kelp forests, and surface waters around the Arctic and Antarctic) that support the most life are mainly located in sunlit areas where the water is cold and nutrient-rich.

A.3.
Estuaries—shallow coastal ecosystems where fresh water from rivers mixes with salt water from the ocean—are important nursery grounds for many different ocean organisms.

A.4.
Coral reefs are productive ecosystems found in clear, warm, nutrient-poor, tropical water. Algae living inside the coral provide them with some of the nutrients they need to survive.

A.5.
The open ocean ecosystem consists of the surface, mid-water, and deep parts of the ocean away from the coast and sea floor bottom. Each of these areas is made up of entirely different physical characteristics and diverse communities of organisms.

A.9.
There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms.

B.1.
The great diversity of ecosystems in the ocean provides opportunities for organisms to develop a great diversity of adaptations, many of which are unique to organisms living in the ocean.

B.6.
There are many groups of organisms that occur in the ocean that do not occur on land or in fresh water, such as sea stars, squid, jellyfish, corals, many types of worms, and seaweeds.

A.2.
Phytoplankton, the base of most ocean food webs, flourish in coastal surface waters where there are plenty of nutrients and sunlight.

A.6.
The sunlit surface layers of the ocean are where the sun's energy is captured by photosynthetic phytoplankton (algae and bacteria). This layer only extends down about 200 meters.

A.7.
The middle ocean layers are important living spaces for for many organisms, such as large fish and jellyfish. There is not enough light to support photosynthesis here. This zone extends from 200 meters down to 1,000 meters.

A.8.
Deep water ecosystems below 1,000 meters are in complete darkness and under extreme pressure.

B.2.
There are adaptations and life histories that exist only in the ocean, due to unique environmental and physical properties, such as salinity, pressure, temperature, light, and density, that are associated with living in a liquid environment.

B.5.
Organisms in the ocean exhibit an amazing variety of life cycles. Some undergo metamorphosis and have planktonic phases, some lay eggs, and others nurse their young.

B.7.
The ocean supports a tremendous variety of sizes of organisms, from extremely small to the largest animal ever to live on Earth.

B.3.
Adaptations that help some organisms survive in the ocean include: blubber to retain heat, fins for swimming, gills for removing oxygen from water, collapsible lungs for deep diving, and acute hearing under water.

B.4.
Migration (both horizontal and vertical) is a strategy used by marine organisms to help them respond to daily and seasonal changes in ecosystems, such as the seasonal availability of food, high and low tides, and escape from predators.

B.8.
Most of the organisms in the ocean are microscopic. Photosynthetic microbes are the most abundant forms of life in the ocean.

See Principle 1: B4

See Principle 4: B1

See Principle 1: B8

Principle 6:
Grades 3-5

Principle 6:
The ocean and humans are inextricably interconnected.

Uses of the Ocean

A.
The ocean provides basic support for all life, including human life.

A.1.
The ocean is an important source of food for humans.

A.2.
Food from the ocean includes organisms, such as fish, crab, and oysters, as well as prepared products that contain organisms, such as algae.

See Principle 1: B1
See Principle 3: B

A.3.
The fresh water that humans need is formed as a part of the water cycle when water evaporates from the ocean and returns to land as rain.

A.4.
Humans use the ocean as a source for minerals, energy resources, and medicines.

See Principle 7: A

A.5.
Most of the oxygen humans breathe comes from photosynthetic organisms that live in the ocean.

See Principle 4: B1

A.6.
Humans use the ocean for inspiration, recreation, and discovery.

Where People Live

B.
The ocean has always influenced where the majority of the human population lives.

B.1.
The ocean has influenced the evolution of transportation throughout human history.

B.2.
Major coastal cities grew out of ports, which supported the transport and trade of goods and resources.

See Principle 3: A2

B.3.
People continue to live near the ocean because of access to resources, transportation, commerce, jobs, recreation, scenery, and moderate weather.

B.4.
Living near the ocean exposes people to tsunamis, hurricanes, and severe storms.

See Principle 3: A5

Human Impact on the Ocean

C.
Humans impact the ocean in positive and negative ways.

C.1.
The trash and pollutants people put into the environment affects the ocean and life in the ocean.

C.2.
Putting chemical pollution into the ocean can poison fish and shellfish, and the people eating them.

C.3.
Marine debris entangles ocean life, introduces chemical pollutants, and can become a hazard to navigation.

C.4.
Pollution from cars and factories contributes to global climate change.

C.5.
Ocean resources are finite and should be respected and cared for by people.

C.6.
Overfishing can lead to the extinction of species.

See Principle 7: B4

C.7.
Individuals can take action to protect the ocean.

C.8.
Individuals can help protect the ocean by picking up trash, riding their bikes, using public transportation, and eating seafood that is not overfished.

C.9.
Public knowledge and opinion can greatly affect the choices that people make about the ocean.

C.10.
Everyone can learn and influence other people about the wise use and protection of the ocean.

C.11.
School clubs and afterschool groups can help educate and involve the community about the wise use and protection of the ocean.

C.12.
National and international laws define how we protect the ocean.

C.13.
Laws create marine sanctuaries, reserves, and marine protected areas that are intended to keep these ocean areas safe and healthy.

Principle 7:
Grades 3-5

Principle 7:
The ocean is largely unexplored.

People Explore the Ocean

A.
Human interest has led to the exploration of and research about the ocean and its resources; 95% of the ocean, however, remains unexplored.

A.1.
People explore the ocean to learn and discover more about it for many different political, economic, scientific, and social reasons.

A.2.
In the past, people explored the ocean for reasons that included discovering new land, locating trading routes, searching for gold and silver, spreading religion and, expanding political power.

A.3.
Today we explore the ocean for reasons, such as: to understand the climate, to assess the health of the ocean, to find medicine and food for humans, and to search for sources of energy (e.g., petroleum, natural gas, wind, wave, and tidal power).

A.4.
The future health of the ocean and our ability to use and benefit from its resources depends on our understanding of the ocean.

A.5.
The ocean affects all life on Earth because the ocean interacts with all other Earth systems: the atmosphere, biosphere, and lithosphere.

A.6.
The ocean will provide future generations with many opportunities for exploration, discovery, inquiry, and investigation.

See Principle 6: A

Ocean Exploration Requires Collaboration

B.
Ocean exploration is a collaborative process. It requires people with different areas of expertise and from different places and/or countries to work together, share knowledge, and use many types of technology to build a better understanding of the complex ocean system.

B.1.
People develop areas of expertise for careers and/or hobbies in ocean exploration. These careers and hobbies include scientists, engineers, filmmakers, photographers, divers, architects, boat crews, and technicians.

B.2.
Scientists specialize in different aspects of ocean exploration through the variety of science topics they study (e.g., weather, climate, animals, algae, geology). They share their expertise as work with other scientists and engineers.

B.3.
Engineers specialize in different aspects of ocean exploration through the variety of topics they study (e.g., chemical, mechanical, and electrical engineering). They share their expertise as they work with other engineers and scientists.

B.4.
Communication of accurate and timely information by collaborative teams enables the public to make informed decisions that promote sustainability of the ocean.

See Principle 6: C7 and C9

Ocean Exploration Requires Technological Innovations

C.
Ocean exploration requires people to use creativity and knowledge to develop specialized tools because the ocean is so vast, and the human body and senses are not well adapted for life under water.

C.1.
Humans require specialized equipment for immersion in the water or for gathering information about the ocean without actually going under water.

C.2.
Humans are adapted to breathe air, and thus require special breathing equipment to explore under water (e.g., snorkels, SCUBA gear).

C.3.
Human eyes are adapted to function in the air, and thus require special tools to see under water (e.g. masks, cameras).

C.4.
Humans require a certain amount of light to see, and thus require special lights to see deep in the ocean (e.g., dive lights).

C.5.
Humans are adapted to living on land, and thus require special tools for protection from the increasing pressure as we explore deeper into the ocean (e.g., human-occupied submersibles).

C.6.
Humans are adapted to survive within a particular range of temperatures, and thus require special equipment for protection from the cold temperatures in the ocean (e.g., wetsuits, dry suits, submersibles).

C.7.
Ocean scientists and engineers develop specialized technology that allows the collection of complex information over large areas of the ocean without actually going under water themselves, such as satellites, sensors, computers, and robots.