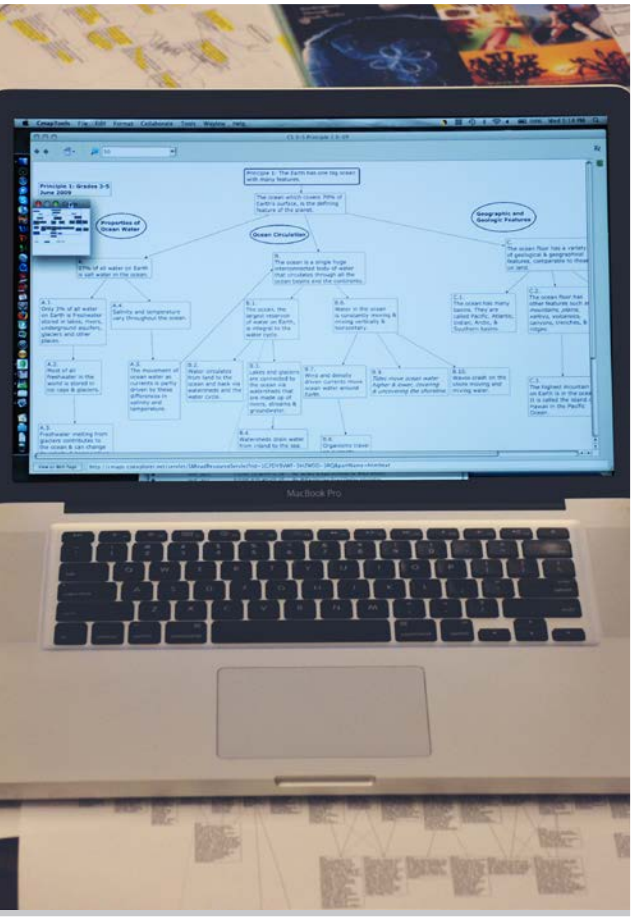


The freeware CmapTools was used in developing the conceptual flow diagrams (Photo credit: Craig Strang)

Introduction to the Ocean Literacy Scope and Sequence for Grades K through 12

The Ocean Literacy Scope and Sequence for Grades K–12 is a series of 28 conceptual flow diagrams[3] that represent and organize the ideas of the seven Ocean Literacy Principles into four grade bands—K through 2, 3 through 5, 6 through 8, and 9 through 12—effectively showing what students should know at the end of 2nd, 5th, 8th, and 12th grades. This document provides specific guidance to educators, standards committees, curriculum developers, and scientists conducting outreach. It is one part of the Ocean Literacy Framework which comprises four key documents:

- *Ocean Literacy: The Essential Principles of Ocean Sciences for Learners of All Ages*;
- *The Ocean Literacy Scope and Sequence for Grades K–12*;
- *Alignment of Ocean Literacy to the Next Generation Science Standards*; and
- *International Ocean Literacy Survey*.

The scope and sequence was developed iteratively and thoughtfully with significant and substantive participation by hundreds of scientists, science educators, and classroom teachers around the country.[4] Thus, it represents a community consensus regarding the essential ideas in ocean sciences that all students should understand by the end of Grade 12 and a road map for how to get there.

The scope and sequence conceptual flow diagrams provide specific guidance to help educators as they work to grow their learner's conceptual understanding of essential ocean concepts. Dive into the conceptual flow diagrams on the following pages.

To access online versions of the Framework documents, please visit www.marine-ed.org/ocean-literacy/overview

3 See "Developing the Ideas of Ocean Literacy Using Conceptual Flow Diagrams" in this handbook.

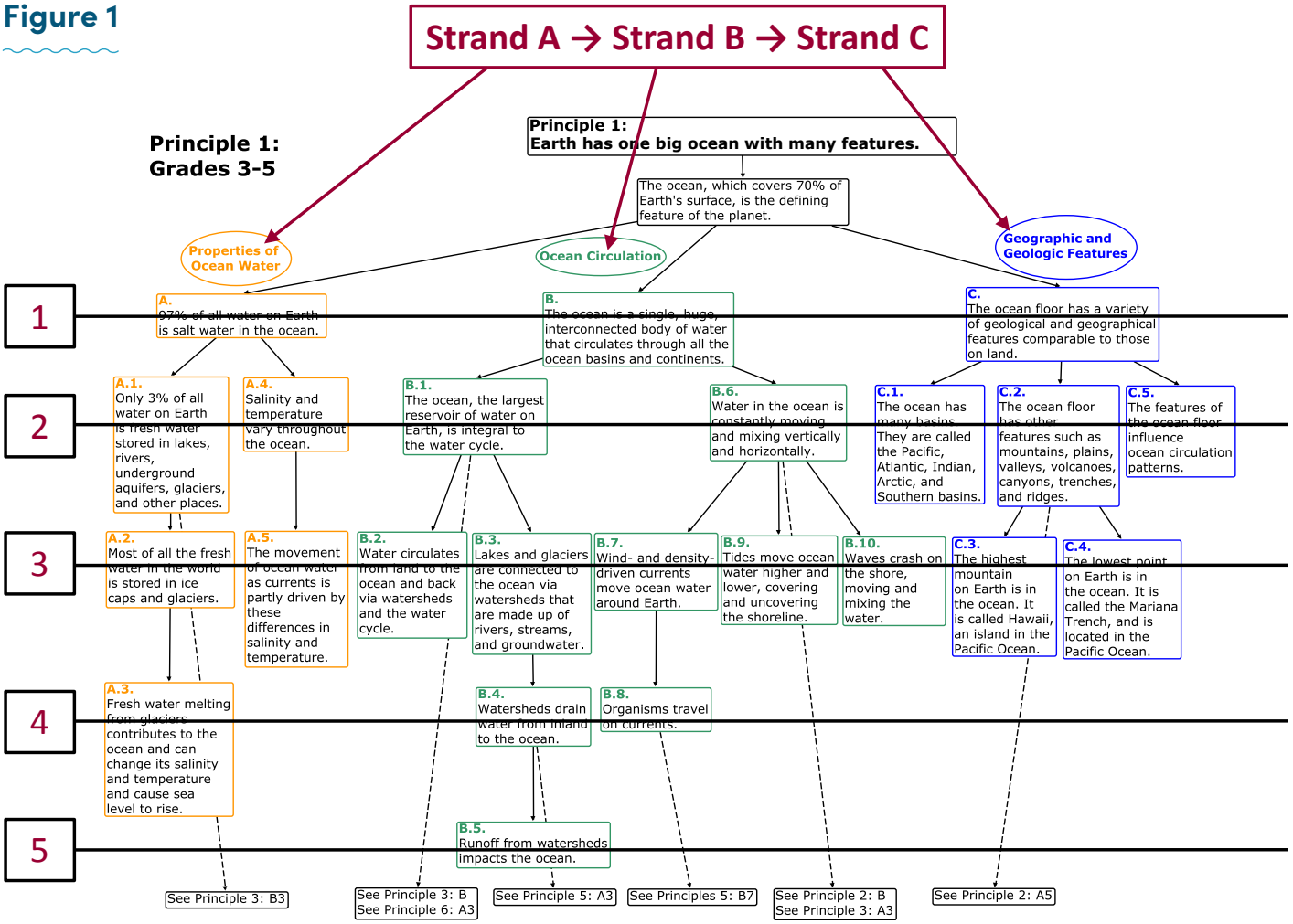
4 A more complete history is provided in the introduction to this handbook.

The Ocean Literacy Scope and Sequence comprises 28 conceptual flow diagrams (hereafter referred to as flows). There is one flow for each principle for each grade band (K through 2, 3 through 5, 6 through 8, and 9 through 12). Each flow is read from top to bottom and left to right and represents one possible way of breaking down and organizing the major concepts and supporting ideas for each principle for a grade band.

The essential principle as well as the grade level are listed at the top of the page. The diagram shows three sets of text boxes (called strands) cascading down the page. Each strand represents a topic related to the essential principle and includes concepts and supporting subconcepts focused on the topic.

Conceptual flow diagrams can be used as a suggested instructional sequence, organizer of ideas, and/or indicator of learning progression.

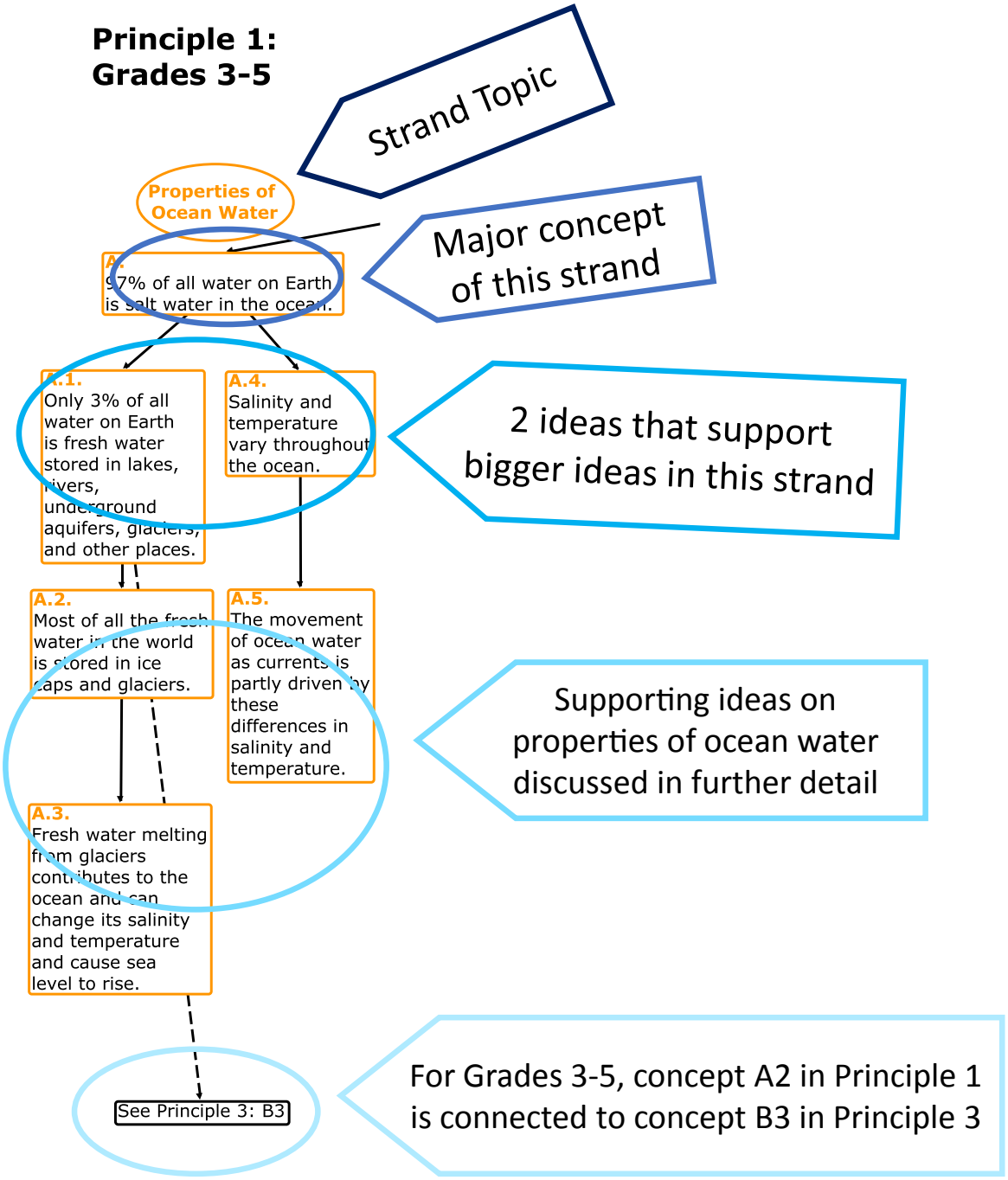
Figure 1



Dashed lines lead to cross-referenced concept statements in other essential principles.

In this flow for Principle 1, Grades 3 through 5, there are three strands of topics and five levels of ideas. Read the flow from top to bottom and left to right, from Strand A (A1 to A5) to Strand B (B1 to B10) to Strand C (C1 to C5). Some of the concepts cross-reference other concepts in other principles within that same grade band. These cross-references are connections between principles.

Figure 2

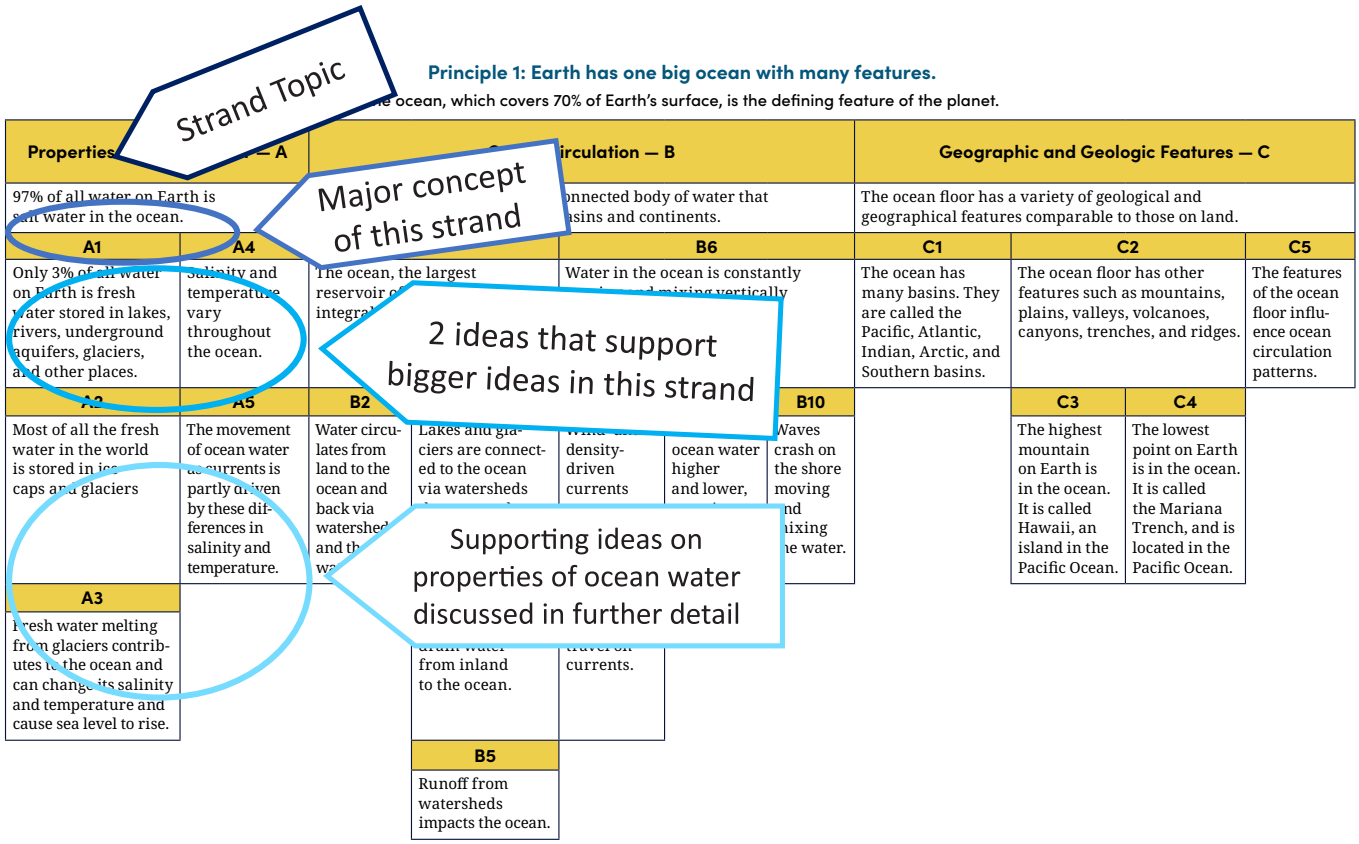


Strand A of conceptual flow diagram of Principle 1 for Grades 3 to 5. Here is a breakdown of the components in a strand. The strand is identified by topic for easy reference. The strand begins with a major concept and then nested below are two levels of ideas that support the bigger idea. Supporting ideas can be examples, but not always.

How to Use the Alternative Form of the Conceptual Flow Diagrams

In addition to the conceptual flow diagrams of the *Ocean Literacy Scope and Sequence for Grades K–12*, we also present the concepts in a tabular format. This helps convey the connections and relationships between concepts, without relying on visual cues.

Strands of connected ideas are organized under a topic title and brief description. Instead of using arrows to convey connections between individual concepts, concepts are stacked in columns in the order in which they should be presented (i.e., top to bottom, then left to right). This means some concepts are repeated under each higher level concept to convey the connections among them. As users of assistive technology navigate the tables, the concepts become more and more specific.



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

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

Properties ... — A		...irculation — B				Geographic and Geologic Features — C			
97% of all water on Earth is ... salt water in the ocean.		...onnected body of water that ...asins and continents.				The ocean floor has a variety of geological and geographical features comparable to those on land.			
A1	**A4**		**B6**			**C1**	**C2**		**C5**
Only 3% of all water on Earth is fresh water stored in lakes, rivers, underground aquifers, glaciers, and other places.	Salinity and temperature vary throughout the ocean.	The ocean, the largest reservoir ... integral	Water in the ocean is constantly ... and mixing vertically			The ocean has many basins. They are called the Pacific, Atlantic, Indian, Arctic, and Southern basins.	The ocean floor has other features such as mountains, plains, valleys, volcanoes, canyons, trenches, and ridges.		The features of the ocean floor influence ocean circulation patterns.
A2	**A5**	**B2**			**B10**		**C3**	**C4**	
Most of all the fresh water in the world is stored in ice caps and glaciers	The movement of ocean water as currents is partly driven by these differences in salinity and temperature.	Water circulates from land to the ocean and back via watershed... and th... wa...	Lakes and glaciers are connected to the ocean via watersheds ...	Wind-... density-driven currents ...	ocean water higher and lower, ...	Waves crash on the shore moving ... and ...ixing ...e water.	The highest mountain on Earth is in the ocean. It is called Hawaii, an island in the Pacific Ocean.	The lowest point on Earth is in the ocean. It is called the Mariana Trench, and is located in the Pacific Ocean.	
A3			... drain water from inland to the ocean.	... travel on currents.					
Fresh water melting from glaciers contributes to the ocean and can change its salinity and temperature and cause sea level to rise.			**B5**						
			Runoff from watersheds impacts the ocean.						

Conceptual Flow Diagrams

Principle 1

Principle 2

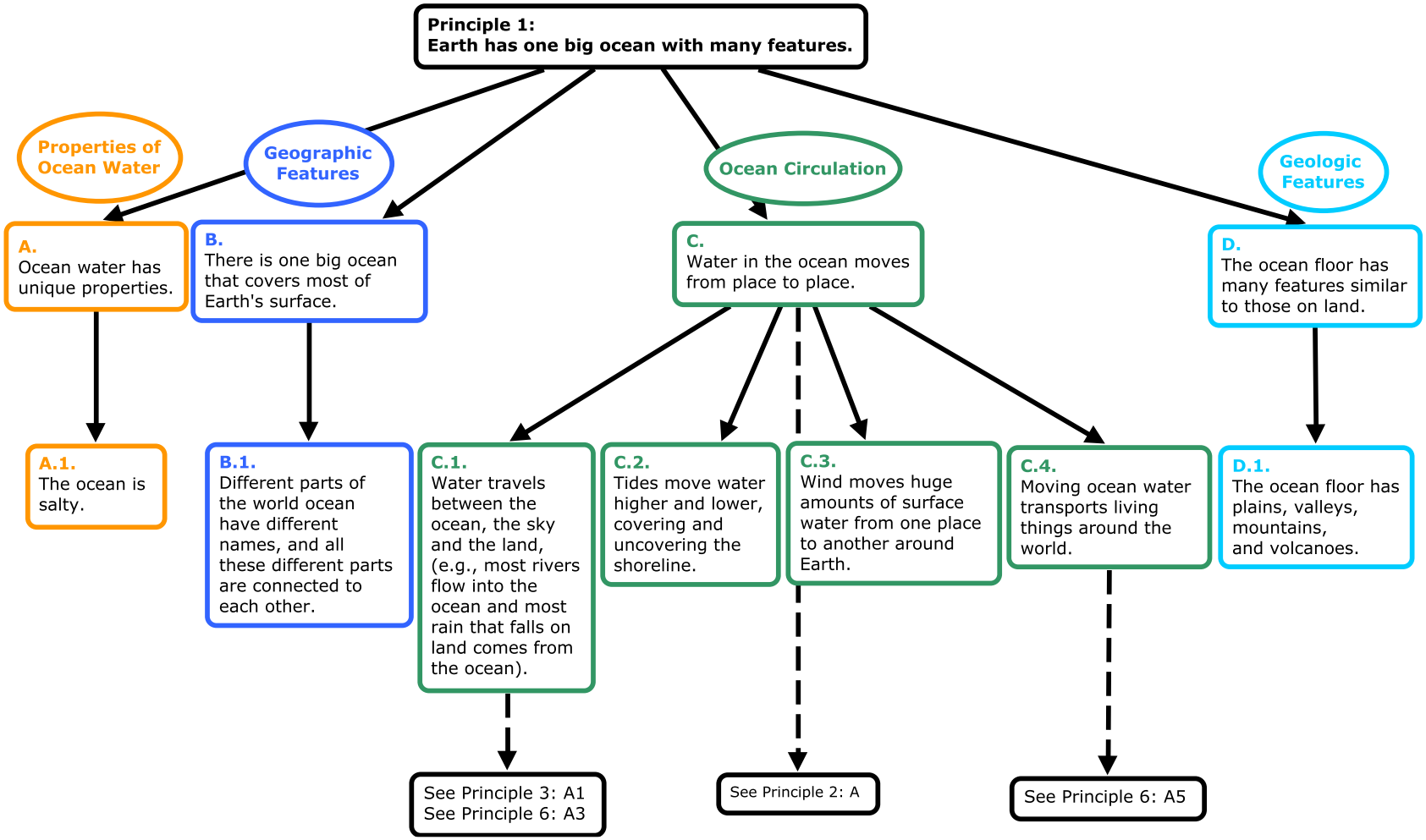
Principle 3

Principle 4

Principle 5

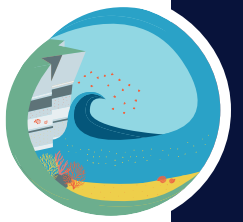
Principle 6

Principle 7


Principle 1:
Earth has one big ocean with many features.
Properties of Ocean Water
Geographic Features
Ocean Circulation
Geologic Features
A.
Ocean water has unique properties.
B.
There is one big ocean that covers most of Earth's surface.
C.
Water in the ocean moves from place to place.
D.
The ocean floor has many features similar to those on land.
A.1.
The ocean is salty.
B.1.
Different parts of the world ocean have different names, and all these different parts are connected to each other.
C.1.
Water travels between the ocean, the sky and the land, (e.g., most rivers flow into the ocean and most rain that falls on land comes from the ocean).
C.2.
Tides move water higher and lower, covering and uncovering the shoreline.
C.3.
Wind moves huge amounts of surface water from one place to another around Earth.
C.4.
Moving ocean water transports living things around the world.
D.1.
The ocean floor has plains, valleys, mountains, and volcanoes.
See Principle 3: A1
See Principle 6: A3
See Principle 2: A
See Principle 6: A5

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

Properties of Ocean Water — A	Geographic Features — B	Ocean Circulation — C				Geologic Features — D
Ocean water has unique properties.	There is one big ocean that covers most of Earth's surface.	Water in the ocean moves from place to place.				The ocean floor has many features similar to those on land.
A1	**B1**	**C1**	**C2**	**C3**	**C4**	**D1**
The ocean is salty.	Different parts of the world ocean have different names, and all these different parts are connected to each other.	Water travels between the ocean, the sky and the land, (e.g., most rivers flow into the ocean and most rain that falls on land comes from the ocean).	Tides move water higher and lower, covering and uncovering the shoreline.	Wind moves huge amounts of surface water from one place to another around Earth.	Moving ocean water transports living things around the world.	The ocean floor has plains, valleys, mountains, and volcanoes.



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

Erosion and Changing Coastlines

A.
Moving water can cause coastal build up and erosion, carrying earth materials from one place to another and shaping the shoreline.

A.1.
Shorelines are built up by earth materials brought to the shore by rivers and waves.

A.2.
Some earth materials from the ocean, such as sand, shells, corals, and rocks, are carried to the shore by waves.

A.3.
Some earth materials from the land, such as rocks, sand, and soils, are carried to the shore by rivers.

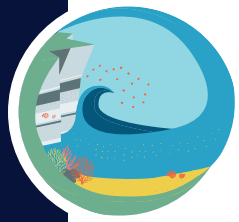
A.4.
Erosion is the wearing away of rocks, soil, shells, and other earth materials and features.

A.5.
Waves can break down and wear away cliffs, beaches, and materials brought to the shore, changing the shape of the shoreline.

A.6.
Rocks, shells, corals, plants, and other materials can be broken down into sand.

See Principle 6: C2

See Principle 1: C



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

<table>
<tr><th colspan="3">Erosion and Changing Coastlines — A</th></tr>
<tr><td colspan="3">Moving water can cause coastal build up and erosion, carrying earth materials from one place to another and shaping the shoreline.</td></tr>
<tr><th colspan="2">A1</th><th>A4</th></tr>
<tr><td colspan="2">Shorelines are built up by earth materials brought to the shore by rivers and waves.</td><td>Erosion is the wearing away of rocks, soil, shells, and other earth materials and features.</td></tr>
<tr><th>A2</th><th>A3</th><th>A5</th></tr>
<tr><td>Some earth materials from the ocean, such as sand, shells, corals, and rocks, are carried to the shore by waves.</td><td>Some earth materials from the land, such as rocks, sand, and soils, are carried to the shore by rivers.</td><td>Waves can break down and wear away cliffs, beaches, and materials brought to the shore, changing the shape of the shoreline.</td></tr>
<tr><td></td><td></td><th>A6</th></tr>
<tr><td></td><td></td><td>Rocks, shells, corals, plants, and other materials can be broken down into sand.</td></tr>
</table>

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

Weather and Water Cycle

A.
Local weather, including precipitation, fog, and wind, can be caused by the ocean—no matter where you live.

A.1.
Most precipitation on Earth comes from water that evaporated from the ocean.

A.2.
When water evaporates and condenses, clouds form, which can lead to precipitation.

A.3.
Most of the water in lakes, ponds, rivers, and the ground comes from water that evaporated from the ocean and fell to the land as precipitation.

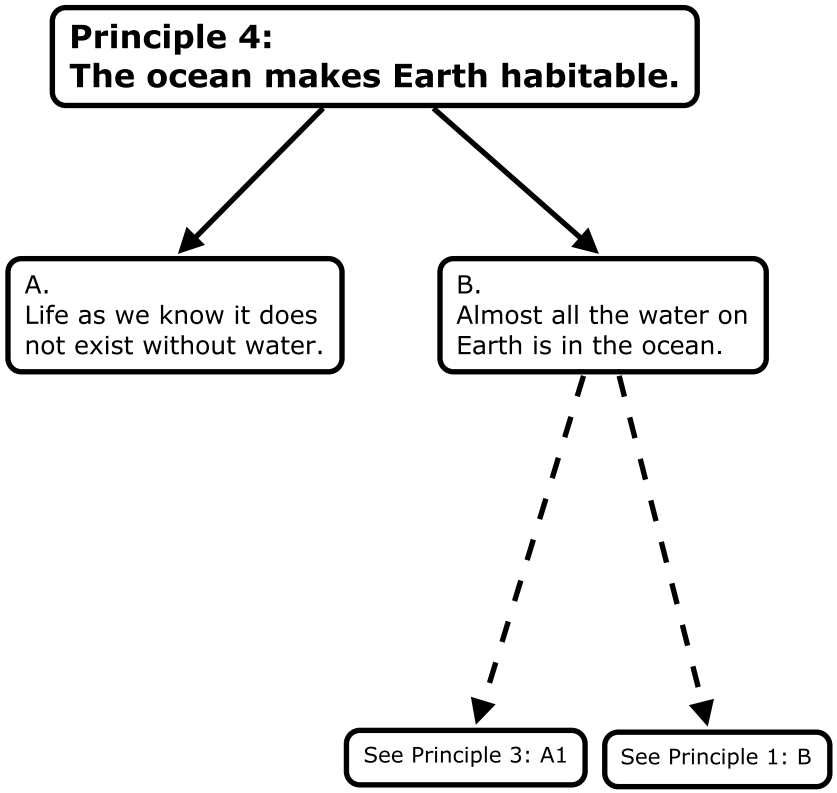
A.4.
Most of the water from land and in the atmosphere eventually returns to the ocean as runoff from rivers or precipitation.

See Principle 1: C1
See Principle 6: A6

See Principle 6: A3

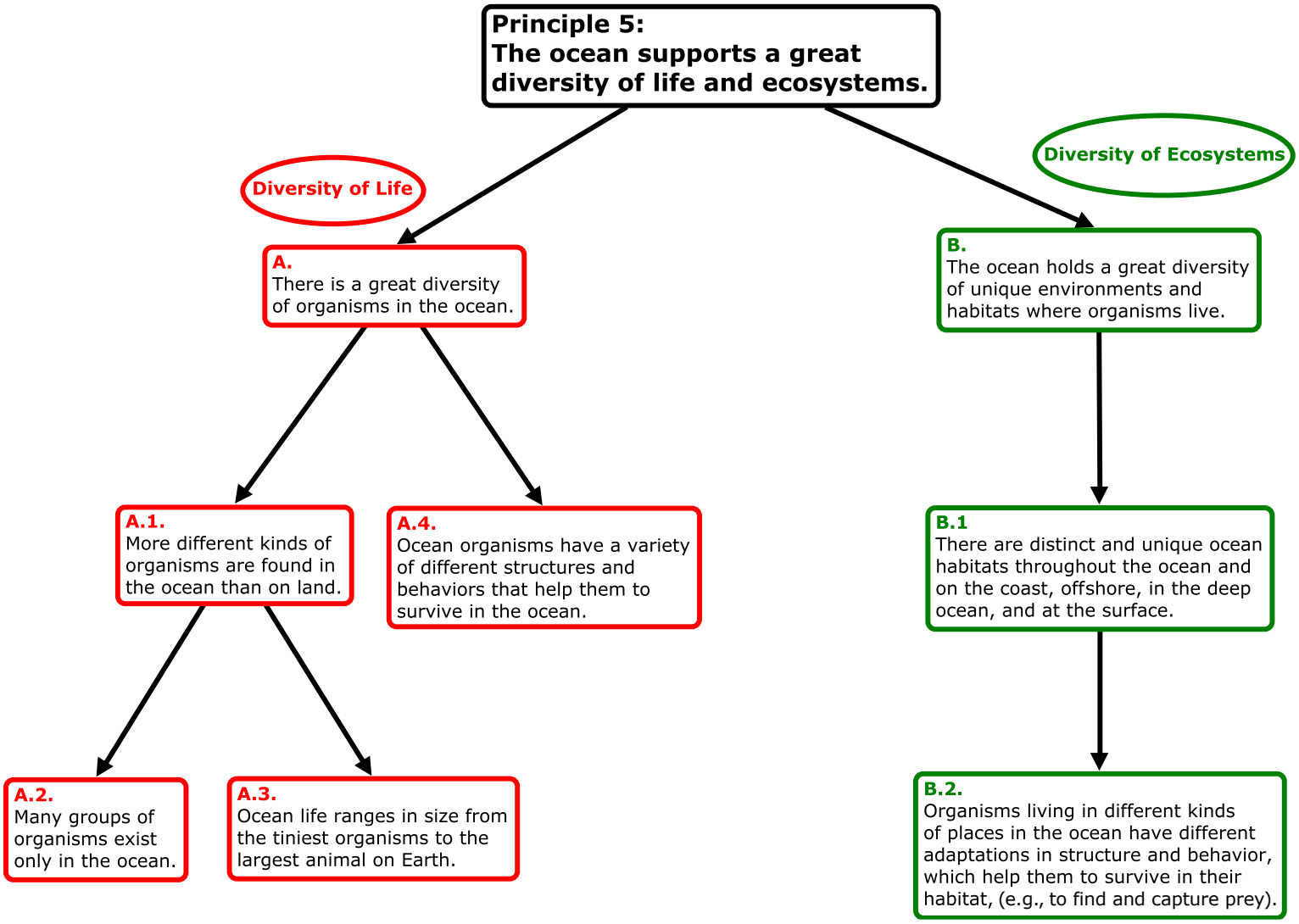
Principle 3: The ocean is a major influence on weather and climate.

Weather and Water Cycle — A		
Local weather, including precipitation, fog, and wind, can be caused by the ocean — no matter where you live.		
A1		
Most precipitation on Earth comes from water that evaporated from the ocean.		
A2	**A3**	**A4**
When water evaporates and condenses, clouds form, which can lead to precipitation.	Most of the water in lakes, ponds, rivers, and the ground comes from water that evaporated from the ocean and fell to the land as precipitation.	Most of the water from land and in the atmosphere eventually returns to the ocean as run-off from rivers or precipitation.


Principle 4:
The ocean makes Earth habitable.
A.
Life as we know it does not exist without water.
B.
Almost all the water on Earth is in the ocean.
See Principle 3: A1
See Principle 1: B

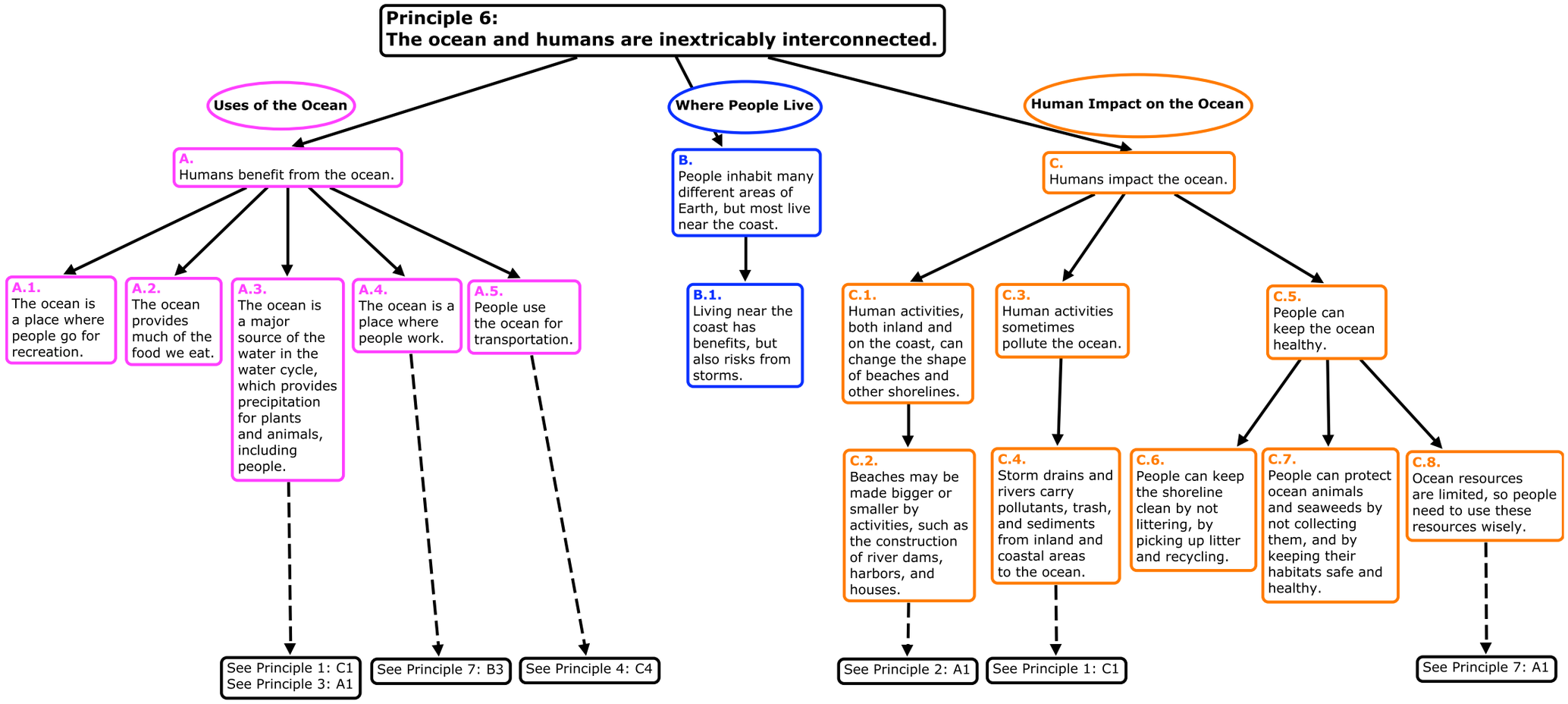
Principle 4: The ocean makes Earth habitable.

A	B
Life as we know it does not exist without water.	Almost all the water on Earth is in the ocean.


Principle 5:
The ocean supports a great diversity of life and ecosystems.
Diversity of Life
Diversity of Ecosystems
A.
There is a great diversity of organisms in the ocean.
B.
The ocean holds a great diversity of unique environments and habitats where organisms live.
A.1.
More different kinds of organisms are found in the ocean than on land.
A.4.
Ocean organisms have a variety of different structures and behaviors that help them to survive in the ocean.
B.1
There are distinct and unique ocean habitats throughout the ocean and on the coast, offshore, in the deep ocean, and at the surface.
A.2.
Many groups of organisms exist only in the ocean.
A.3.
Ocean life ranges in size from the tiniest organisms to the largest animal on Earth.
B.2.
Organisms living in different kinds of places in the ocean have different adaptations in structure and behavior, which help them to survive in their habitat, (e.g., to find and capture prey).

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

<table>
<tr><th colspan="3">Diversity of Life — A</th><th>Diversity of Ecosystems — B</th></tr>
<tr><td colspan="3">There is a great diversity of organisms in the ocean.</td><td>The ocean holds a great diversity of unique environments and habitats where organisms live.</td></tr>
<tr><th colspan="2">A1</th><th>A4</th><th>B1</th></tr>
<tr><td colspan="2">More different kinds of organisms are found in the ocean than on land.</td><td>Ocean organisms have a variety of different structures and behaviors that help them to survive in the ocean.</td><td>There are distinct and unique ocean habitats throughout the ocean and on the coast, offshore, in the deep ocean, and at the surface.</td></tr>
<tr><th>A2</th><th>A3</th><td rowspan="2"></td><th>B2</th></tr>
<tr><td>Many groups of organisms exist only in the ocean.</td><td>Ocean life ranges in size from the tiniest organisms to the largest animal on Earth.</td><td>Organisms living in different kinds of places in the ocean have different adaptations in structure and behavior, which help them to survive in their habitat, (e.g., to find and capture prey).</td></tr>
</table>


Principle 6:
The ocean and humans are inextricably interconnected.
Uses of the Ocean
Where People Live
Human Impact on the Ocean
A.
Humans benefit from the ocean.
B.
People inhabit many different areas of Earth, but most live near the coast.
C.
Humans impact the ocean.
A.1.
The ocean is a place where people go for recreation.
A.2.
The ocean provides much of the food we eat.
A.3.
The ocean is a major source of the water in the water cycle, which provides precipitation for plants and animals, including people.
A.4.
The ocean is a place where people work.
A.5.
People use the ocean for transportation.
B.1.
Living near the coast has benefits, but also risks from storms.
C.1.
Human activities, both inland and on the coast, can change the shape of beaches and other shorelines.
C.3.
Human activities sometimes pollute the ocean.
C.5.
People can keep the ocean healthy.
C.2.
Beaches may be made bigger or smaller by activities, such as the construction of river dams, harbors, and houses.
C.4.
Storm drains and rivers carry pollutants, trash, and sediments from inland and coastal areas to the ocean.
C.6.
People can keep the shoreline clean by not littering, by picking up litter and recycling.
C.7.
People can protect ocean animals and seaweeds by not collecting them, and by keeping their habitats safe and healthy.
C.8.
Ocean resources are limited, so people need to use these resources wisely.
See Principle 1: C1
See Principle 3: A1
See Principle 7: B3
See Principle 4: C4
See Principle 2: A1
See Principle 1: C1
See Principle 7: A1

Principle 6: The ocean and humans are inextricably interconnected.

Uses of the Ocean — A					Where People Live — B	Human Impact on the Ocean — C				
Humans benefit from the ocean.					People inhabit many different areas of Earth, but most live near the coast.	Humans impact the ocean.				
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**C1**	**C3**	**C5**		
The ocean is a place where people go for recreation.	The ocean provides much of the food we eat.	The ocean is a major source of the water in the water cycle, which provides precipitation for plants and animals, including people.	The ocean is a place where people work.	People use the ocean for transportation.	Living near the coast has benefits, but also risks from storms.	Human activities, both inland and on the coast, can change the shape of beaches and other shorelines.	Human activities sometimes pollute the ocean.	People can keep the ocean healthy.		
						C2	**C4**	**C6**	**C7**	**C8**
						Beaches may be made bigger or smaller by activities, such as the construction of river dams, harbors, and houses.	Storm drains and rivers carry pollutants, trash, and sediments from inland and coastal areas to the ocean.	People can keep the shoreline clean by not littering, by picking up litter and recycling.	People can protect ocean animals and seaweeds by not collecting them, and by keeping their habitats safe and healthy.	Ocean resources are limited, so people need to use these resources wisely.

Principle 7:
The ocean is largely unexplored.

Life on Earth Depends on the Ocean

A.
All living things depend on resources from the ocean, such as oxygen, food, water, energy, etc.

A.1.
Ocean resources are limited. People need to learn about these resources through exploration and scientific investigation.

See Principle 6: C8

People Explore the Ocean

B.
People have always been interested in the ocean. People explore the ocean to answer questions they have about it.

B.1.
People are still discovering new things about the ocean all the time.

B.2.
Ocean exploration helps us understand the health of the ocean and find new medicines, food for humans, and new sources of energy (e.g., oil, gas and wind).

B.3.
People explore the ocean through many different hobbies and careers: scientists, fishers, engineers, surfers, swimmers, photographers, filmmakers, artists, and explorers all spend time exploring the ocean.

See Principle 6: A4

B.4.
People use creativity, curiosity, tools, and technology to make better observations of the ocean.

Principle 7: The ocean is largely unexplored.

Life on Earth Depends on the Ocean — A	People Explore the Ocean — B		
All living things depend on resources from the ocean, such as oxygen, food, water, energy, etc.	People have always been interested in the ocean. People explore the ocean to answer questions they have about it.		
A1	**B1**	**B3**	**B4**
Ocean resources are limited. People need to learn about these resources through exploration and scientific investigation.	People are still discovering new things about the ocean all the time.	People explore the ocean through many different hobbies and careers: scientists, fishers, engineers, surfers, swimmers, photographers, filmmakers, artists, and explorers all spend time exploring the ocean.	People use creativity, curiosity, tools, and technology to make better observations of the ocean.
	B2		
	Ocean exploration helps us understand the health of the ocean and find new medicines, food for humans, and new sources of energy (e.g., oil, gas, and wind).		