UNIT 1: THE BLUE PLANET

Ocean Literacy **Essential Principle #1:**

"The Earth has one big ocean with many features"

5 Fundamental Concepts that explain **Principle #1:**

1A. The ocean is the defining **physical feature** on our planet Earth—covering approximately 70% of the planet's surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern, and Arctic.

1B. Ocean basins are composed of the seafloor and all of its **geological features** (such as islands, trenches, mid-ocean ridges, and rift valleys) and vary in size, shape and features due to the movement of Earth's crust (lithosphere). Earth's highest peaks, deepest valleys and flattest plains are all in the ocean.

1C. Throughout the ocean there is one interconnected **circulation system** powered by wind, tides, the force of Earth's rotation (Coriolis effect), the Sun and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation. This "global ocean conveyor belt" moves water throughout all of the ocean basins, transporting energy (heat), matter, and organisms around the ocean. Changes in ocean circulation have a large impact on the climate and cause changes in ecosystems.

1D. Sea level is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools.

1G. The ocean is connected to major **lakes, watersheds, and** waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments, and pollutants from watersheds to coastal estuaries and to the ocean.

Scope & Sequence: Adjust for your Grade Level—

K - 2	3 - 5	6 - 8	9 - 12

SUGGESTED ACTIVITIES

ACTIVITY 1.1— A Pale Blue Dot

"There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known."—Carl Sagan, *Pale Blue Dot*, 1994

The "Pale Blue Dot" that Sagan refers to is a photographic image of our Earth that was taken by the Voyager 1 spacecraft on February 14, 1990, from a distance of more than 4 billion miles away. In the image, the Earth is a mere speck of blue light, a crescent only 0.12 pixel in size. Our planet was caught in the center of one of the scattered light rays that results when taking a photograph so close to the Sun.

Discussion: Read the entire passage that was written by Carl Sagen and discuss it in relationship to our first "Ocean Principle": ***The Earth has one big ocean with many features.***

Sagen's main point is that, in comparison to the rest of the known universe, the Earth is infinitely small and fragile. How should that reality influence our study of the oceans and the Earth's natural resources?

ACTIVITY 1.2— "Ocean Literacy" Defined

In 2005, The National Marine Educators Association identified 7 **Essential Principles of Ocean Literacy** that all students should understand by the end of high school to be considered "ocean literate." They are the framework for this curriculum.

Ocean literacy is *an understanding of the ocean's influence on you—and your influence on the ocean*. An ocean-literate person:

- Understands the **7 Essential Principles** and **45 Fundamental Concepts** that are presented in the Ocean Literacy Framework;
- Can communicate about the ocean in a meaningful way; and

- Is able to make informed and responsible decisions regarding the ocean and its resources.

Preview: all *7 Essential Principles of Ocean Literacy*.

- The Earth has one big ocean with many features.
- The ocean, and life in the ocean, shape the features of the earth.
- The ocean is a major influence on weather and climate.
- The ocean makes the Earth habitable.
- The ocean supports a great diversity of life and ecosystems.
- The ocean and humans are inextricably interconnected.
- The ocean is largely unexplored.

Use this introduction as an opportunity to gauge how much your students already know about the ocean.

Ask: "What would you like to learn about the oceans?"

Discuss: Why should all students become *ocean literate*? How does the ocean influence you? How do you influence the ocean? How close is the ocean to where you live?

Reach Out to students across the United States, especially those far away from the ocean, and ask them the same questions.

Watch and discuss the brief National Geographic video called "Why the Ocean Matters."

Note:

Each of the **7 Essential Principles of Ocean Literacy** are supported by some basic, *Fundamental Concepts*.

Think of these *Fundamental Concepts* as standards, or basic elements that students should know. Read each one, sentence by sentence, at the beginning of each unit. Define terms. Use maps, articles, models, current events, videos or any other media

to help every student fully understand the concepts. Some topics might lend themselves to a field trip, or inviting a guest speaker to come to the class.

Review: Fundamental Concepts 1A, 1B, 1C, 1D, and **1G (above).** They are intended to help students understand the broader principle that *The Earth has one big ocean with many features."*

ACTIVITY 1.3— One Big Ocean

> **Fundamental Concept 1A**: The ocean is the defining **physical feature** on our planet Earth—covering approximately 70% of the planet's surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern, and Arctic.

• **Consult** a current world Map. **Identify** the location of each body of water listed in "Concept 1A": the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern, and Arctic.

📖 **Resource:**

• **National Oceanographic and Atmospheric Administration (NOAA)**:"How many oceans are there?"

ACTIVITY 1.4— Watershed

Look at a map of the world again. Notice how much of the earth is covered by water. Notice also, that it's not all oceans.

> **Fundamental Concept 1G:** *The ocean is connected to major **lakes, watersheds, and** waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments, and pollutants from watersheds to coastal estuaries and to the ocean.*

• The National Oceanic and Atmospheric Administration (NOAA) defines a watershed as "a land area that channels rainfall, and snowmelt to creeks, streams, and rivers and eventually to outflow points such as reservoirs, bays, and the ocean."

Read: more on watersheds HERE.)

Create a solution: If *all major waterways on Earth drain to the ocean,* and they are all carrying their pollutant with them, how should we approach the task of ridding the oceans of plastics and garbage?

📖 **Resource:**

• **National Geographic:** Rivers and Streams

ACTIVITY 1.5— The 8 Scientific Practices: *An Introduction*

The *Next Generation Science Standards* identify **8 Scientific Practices** used by scientists, teachers, and students. These are the behaviors that scientists engage in as they investigate and build models and theories about the natural world. The 8 Scientific Practices are listed below along with an Activity Number which they are featured in.

For example, the practice of "Asking Questions and Defining Problems" is featured in, among other places: *Activity 7.2*.

Review and define: all 8 Scientific Practices:

1. Asking Questions and Defining Problems (Activity 7.2)
2. Developing and Using models (Activity 4.5)
3. Planning and Carrying Out Investigations (Activity 2.7)
4. Analyzing and Interpreting Data (Activity ???)
5. Using Mathematical and Computational Thinking (Activity 9.4)
6. Constructing Explanations and Designing Solutions (Activity 8.4)
7. Engaging in Argument from Evidence (Activity 5.5)
8. Obtaining, Evaluating, and Communicating Information (Activity 6.7)

📖 **Resource:**

• **National Science Teaching Association:** Science and Engineering Practices
• Instructional Leadership for Science Practices
• Next Generation Science Standards

ACTIVITY 1.6—Sea Level Rise

1D. **Sea level** is the average height of the ocean relative to the land, taking into account the differences caused by tides. Sea level changes as plate tectonics cause the volume of ocean basins and the height of the land to change. It changes as ice caps on land melt or grow. It also changes as sea water expands and contracts when ocean water warms and cools.

Define: "*Sea Level*"

According to National Geographic, *"Sea level is the base level for measuring elevation and depth on Earth."* But that base level can change.

Watch this brief You Tube video on causes of Sea Level Rise. (It's a public domain video, so make sure your students all have the URL.)

📖 **Resource:**

• National Geographic Education: "Sea Level Rise and Coastal Cities"

National Geographic provides a thorough explanation of Sea Level Rise and its potential impact on Coastal Cities. It begins with this video narrated by Jack Black.

Research: The Sink or Swim Project

The science and statistics are staggering. Over the next few decades sea level rise will change every coastal community on the planet as well as many adjacent inland areas and will have a profound impact on social, biological, political and economic conditions all over the world. Nowhere will the impact be more devastating, or more critical, than in South Florida.

Discuss:
• What are some of the causes of sea level rise?
• What can communities do to "mitigate" the effects of sea rise?
• What is the definition of "mitigation" as it relates to climate change?

Research:
• Does New York City have a similar long-term forecast for potential local impacts of the rising sea level? Does San Diego?

ACTIVITY 1.7— The Tides

1C. Throughout the ocean there is one interconnected **circulation system** powered by wind, tides, the force of Earth's rotation (Coriolis effect), the Sun and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation. This "global ocean conveyor belt" moves water throughout all of the ocean basins, transporting energy (heat), matter, and organisms around the ocean. Changes in ocean circulation have a large impact on the climate and cause changes in ecosystems.

Discuss:

• In what ways are these circulation systems in the ocean, similar to the human circulation system?

• To understand more about ocean tides, read this brief article from Ocean Conservancy on "How the Moon Affects our Ocean."

• The currents "transport energy (heat), matter, and organisms around the ocean." So you can imagine that they carry plastics and trash too. Check out the work of GRID-Ardenal, a Norwegian company who tracks data on the migration of microplastics.

ACTIVITY 1.8 —Rubber Ducks

Another common practice in the study of science is *observing natural phenomenon.*

"Scientific *phenomena* are occurrences in the natural and human-made world that can be observed and cause one to wonder and ask questions."

There is an explanation of phenomena-based learning offered here, by the San Diego County Office of Education.

National Geographic offers an excellent example of how observing a natural phenomena can help us understand more complex topics like ocean circulation, tides, prevailing winds, ocean gyres and the Coriolis effect.

The lesson is described HERE and includes a brief TED-Ed video that explains how ocean currents work. It is a lesson about rubber duckies!

It all began in 1992, when a cargo ship lost a storage container on its voyage from China to the United States. The container was damaged in the accident and soon, 29,000 rubber ducks escaped and bobbed to the surface of the North Pacific. Those rubber ducks have been floating for over twenty years now and have been found in Alaska, Hawaii, Indonesia, and as far away as Australia and Chile.

Critical Thinking:
What propelled the ducks forward?
Why didn't they all stay together?
What can we learn from these ducks about how debris moves through our oceans?

This phenomenon was also the subject of a lesson developed by a group of lead science teachers in San Diego, who were working with experts from UCSD and the Scripps Institute of Oceanography.

Follow the directions on this lesson:

Plastic Duckies are Floating Around the World

ACTIVITY 1.9—The Great Garbage Patch

"The Great Pacific Garbage Patch" is a collection of marine debris in the North Pacific Ocean, estimated to be the size of the entire state of Texas.

To understand how all that debris, plastic and garbage ended up there, you only have to read back through the Fundamental Concepts associated with the first Ocean Principle:

"one big ocean"

- The ocean is the defining **physical feature** on our planet Earth…
- There is one ocean with many ocean basins…
- The "global ocean conveyor belt" moves water throughout all of the ocean basins, transporting energy (heat), matter, and organisms around the ocean.
- The ocean is connected to major **lakes, watersheds, and** waterways…
- All major watersheds on Earth drain to the ocean…
- Rivers and streams transport nutrients, salts, sediments, and pollutants from watersheds to coastal estuaries and to the ocean.

Discuss:

• How do currents and gyres work naturally to trap so much trash and plastic debris in the open ocean? Where is all that trash coming from? What is the source? What kinds of debris is found in the garbage patch?
• If the Garbage Patch is way out in the middle of the Pacific Ocean, what can it hurt? Isn't that better than burying it in landfills?
• What is "rafting," and how is it effecting organisms in the ocean?
• Which countries are most responsible for mismanaging their garbage?
• Where can you find answers to these questions?

Innovators:
There are many efforts to "clean up" the Garbage Patch, including the impressive work of an organization called Ocean Clean-Up. Read about what they are doing and how they are collecting debris.

Follow-up:
While the clean-up seems like a good thing to do, there is this phenomenon first reported by scientists in the journal *Nature Ecology and Evolution*: "Surprising Creatures Lurk in the Great Pacific Garbage Patch."

Explain this quote from *Scientific American* on the same story:

> *"The sea surface is probably one of the least-known environments," said Martin Thiel, a marine biologist. "It's a very, very particular community that we are disturbing now at a massive scale."*

Critical Thinking:

What is the downside… the risk to natural ecosystems… if we are not careful in how we clean up massive debris fields like the Great Garbage Patch?"

Jump Ahead to ***Activity 3.9*** and learn about the spooky phenomenon of "Ghost Gear" and its effect on ocean creatures.

Resource:

• **National Geographic Resource Library**: Great Pacific Garbage Patch
• **Eradicate Plastic:** 10 Interesting Facts About the Great Garbage Patch

ACTIVITY 1.10— Sustainability

In 1987, the United Nations Brundtland Commission defined **sustainability** as:

> *"Meeting the needs of the present without compromising the ability of future generations to meet their own needs."*

Today, there are almost 140 developing countries in the world seeking ways to meet their needs, but with the increasing threat of climate change, serious progess must be made to ensure that decisions we make do today do not negatively affect future generations.

The Iroquois went even further with their definition:

> "The decisions we make today must result in a sustainable world seven generations into the future."

This is referred to as the **7th Generation Principle.**

Discuss:

• How do *you* define sustainability?

• What behaviors must all citizens engage in to ensure that we are preserving our planet's resources for future generations?

Jump Ahead to *Activity 9.9* and learn about the businesses that are committed to a mission of *sustainability*.

Unit One: Culminating Activity

This Unit features Ocean Literacy Essential Principal #1:

"The Earth has one big ocean with many features"

70% of the earth is covered by one large body of water which includes oceans, bays, rivers, lakes, and watersheds. The fact that they are all connected is exacerbating the spreading of plastics and garbage.

But it also creates an opportunity.

Design a system to remove plastics, microplastics, garbage and all materials that are not native to the ocean. You won't have time to build it. So create a brochure that describes your system and advocates that it be strategically installed in 7 critical areas around the world.