

## UNIT 6: FINDING NEMO

### Ocean Literacy Essential Principle of #5:

*“The ocean supports a great diversity of life and ecosystems”*

### 9 Fundamental Concepts that explain Principle #5:

5A. **Ocean life** ranges in size from the smallest living things, microbes, to the largest animal on Earth, the blue whales.

5B. Most of the organisms and biomass in the ocean are **microbes**, which are the basis of all ocean food webs. Microbes are the most important primary producers in the ocean. They have extremely fast growth rates and life cycles, and produce a huge amount of the carbon and oxygen on Earth.

5C. Most of the major groups that exist on Earth are found exclusively in the ocean and the **diversity** of major groups of organisms is much greater in the ocean than on land.

5D. **Ocean biology** provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.

5E. The ocean provides a vast living space with diverse and unique **ecosystems** from the surface through the water column and down to, and below, the seafloor. Most of the living space on Earth is in the ocean.

5F. **Ocean ecosystems** are defined by environmental factors and the community of organisms living there. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate, and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.

5G. There are **deep ocean ecosystems** that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps, rely only on chemical energy and chemosynthetic organisms to support life.

5H. Tides, waves, predation, substrate, and/or other factors cause vertical **zonation patterns** along the coast; density, pressure, and light levels cause vertical zonation patterns in the open ocean. Zonation patterns influence organisms' distribution and diversity.

5I. **Estuaries** provide important and productive nursery areas for many marine and aquatic species.

[Scope & Sequence: Adjust for your Grade Level](#)—

<u><a href="#">K - 2</a></u>	<u><a href="#">3 - 5</a></u>	<u><a href="#">6 - 8</a></u>	<u><a href="#">9 - 12</a></u>
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## SUGGESTED ACTIVITIES

### ACTIVITY 6.1— An Abundance of Life

Ocean Literacy Principle #5 speaks to one of the most magical elements of the oceans: the abundance of life!

*“The ocean supports a great diversity of life and ecosystems”*

Review the first three Fundamental Concepts.

**5A. Ocean life** ranges in size from the smallest living things, microbes, to the largest animal on Earth, blue whales.

**5B.** Most of the organisms and biomass in the ocean are **microbes**, which are the basis of all ocean food webs. Microbes are the most important primary producers in the ocean. They have extremely fast growth rates and life cycles, and produce a huge amount of the carbon and oxygen on Earth.

**5C.** Most of the major groups that exist on Earth are found exclusively in the ocean and the **diversity** of major groups of organisms is much greater in the ocean than on land.

There is another name for this great diversity of life: BIODIVERSITY.

**Define** Biodiversity.

**Read** about the World Wildlife Federation (WWF) and their work in protecting biodiversity in ecosystems all over the planet: [What is Biodiversity?](#)

**Critical Thinking:**

In the context of this article, what does the closing paragraph mean to you?

*“To protect the iconic wildlife we all love, we must rebuild the web of biodiversity that supports it. We do this by rethinking how we’re using natural resources, easing the pressure, and allowing ecosystems to recover. In the process, all life benefits: plants, insects, fish, birds, mammals, and even people.”*

## ACTIVITY 6.2— The Documentary

There are a number of acclaimed documentaries that study life in the oceans, but *The Blue Planet* and *The Blue Planet 2* are frequently regarded as the very best. You don't have to show every episode from beginning to end to get the impact you want- short clips could be just as useful in bringing life to biomes in the farthest reaches of the sea.



### Resource:

Google the “Top 10 Ocean Documentaries” and you will find varied and interesting lists of extraordinary resources about the oceans.

Find a few particularly good documentaries (like *My Octopus Teacher*), and watch at least part of it as a class.

- [The 10 Best Ocean Documentaries](#)
  - [10 of the Best Ocean Documentaries to Stream at Home](#)
  - [Miss the Sea? These Documentaries about the Oceans Go Beneath the Surface.](#)
- How do these documentaries reinforce the idea that the ocean is a large and very fragile system, teeming with life?

## ACTIVITY 6.3— A Fragile Balance

*“Without biodiversity in nature on land and marine life in the oceans, we have nothing; nature allows us to live on this planet, and it may be gone in twenty years.”*

*“Humanity has now killed more life on Earth (75%) than the last meteorite that ended the age of dinosaurs 66 million years ago.”*—[GOES Global Oceanic Environmental Survey](#)

*“96% of all mammals on Earth are now human or farm animals, and more than 50% of all life on Earth has been destroyed.”*—Howard Dryden, GOES, Roslin Innovation

Biodiversity Loss refers to the number of genes, individual organisms, species, and ecosystems in a given area.

The [5 Main causes of Biodiversity loss](#) are:

- Habitat loss
- Invasive species
- Overexploitation (Overfishing)
- Pollution
- Climate Change associated with Global warming

Each of these are a product of human activity.

### **Groups Present:**

Assign students to one of 5 research groups that will dig deeper into the issue of Biodiversity Loss. Each group will take one of the topics above and research the causes, effects, mitigation strategies, innovations, etc. Use data and visuals and present your findings to the rest of the class.

**Take a trip** to the San Diego Zoo, the Living Coast Discovery Center, the Birch Aquarium at Scripps Institution of Oceanography, or other local estuaries or lagoons. Students should begin to recognize and respect the abundance, uniqueness and fragility of all the species on our planet.

### **Discuss:**

- How are different species discovered and studied?
- How are they categorized?
- How do we know which species are endangered?
- What are the various ways in which species evolve within their habitats?
- How has the waste and pollution left behind by humans forced species to adapt and evolve?
- What percentage of species in the oceans have been discovered?
- Which of the 8 Scientific Practices are most valuable in answering these questions?
- What are some ways in which humans can protect vulnerable species? For example: [National Marine Sanctuaries](#)



## Resource:

**Ocean Tracks Website:** [Tracking Ocean Creatures in the Deep Sea](#)

- **TOPP Video:** [Beneath the Horizon](#)
- **Nautilus Live Video:** [Highlights from Nautilus Live](#)
- **Nautilus Live Video:** [A Chance Encounter: The Giddy Sounds of Discovery](#)

## ACTIVITY 6.4— Blackfish

**Watch** excerpts from the documentary *Blackfish*. What happened at Sea World that was documented in *Blackfish*? How has the *Blackfish* documentary damaged Sea World's reputation?

- Is Sea World a zoo or an amusement park? What's the difference between the two? What research do they each conduct?
- How is Sea World like the San Diego Zoo or Scripps Aquarium?
- How is it different?
- If you live in San Diego, visit Sea World. Have they changed their philosophy? Are the animals safer now? Are their practices more humane?

### **Critical Thinking:**

Are animals better left in the wild or living in zoos and theme parks? Make a case for both and then defend your opinion.

## ACTIVITY 6.5— Marine Bio 101

**5D. Ocean biology** provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.

In this unit, students should review the critical concepts introduced above: biology, biodiversity, microbes, diversity, ecosystem, biome, adaptation, symbiosis, photosynthesis, zonation patterns, etc.

Take the time to review these terms.

**Careers in the Blue Economy:** What is Marine Biology? What do Marine Biologists do? How can you become a Marine Biologist?

## ACTIVITY 6.6— From the Shoreline to the Deep Blue Sea

**5E.** The ocean provides a vast living space with diverse and unique **ecosystems** from the surface through the **water column** and down to, and below, the seafloor. Most of the living space on Earth is in the ocean.

### **Definition:**

The Water Column is the space between the ocean's **surface** and **floor**. It comprises between 95 to 99 percent of the total livable volume of our planet. It is a massive and still-mysterious habitat that is underexplored because it is *so big*.

**Watch:** [“Exploring the Water Column”](#)

### **Illustrate:**

Draw and label the [5 Zones of the Water Column](#) from the surface to the deepest sea floor:

- What are some of the characteristics of each zone?
- What depth does each zone begin with?
- What animals live in each zone?
- How can researchers function in the **deepest** parts of the ocean? What is it like there?



### **Resource:**

NOAA: [Introduction to Water Column Investigations](#)

**5F.** **Ocean ecosystems** are defined by environmental factors and the community of organisms living there. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients,

pressure, substrate, and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.

Review the last two sentences in Fundamental Concept 5F:

*Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate, and circulation.*

### **Research:**

- How do each of these *abiotic factors* influence the life forms that exist within an ecosystem?
- How are they measured?

### **Critical Thinking:**

The last line says:

*A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.*

- Which Ocean Zones “*support the most abundant life*”?
- Which Ocean Zones support the least amount of living things?

**5G.** There are **deep ocean ecosystems** that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps, rely only on chemical energy and chemosynthetic organisms to support life.

### **Exercise:**

After examining the Ocean Zones, now zoom out to map [twelve marine ecosystems](#): Abyssal Plain, Antarctic, Arctic, Coral Reef, Deep Sea, Hydrothermal Vents, Kelp Forests, Mangrove, Open Ocean, Rocky Shore, Salt Marsh, and Sandy Shore. Map their location, who lives there, and unique characteristics that separate each ecosystem apart from the others.

### **Discussion:**



Some scientists say that we have only explored 5% of the oceans. This speaks to how vast the oceans really are. One particularly mysterious component is the deep ocean floor, in regions thousands of feet down, where the sun doesn't shine and the water is freezing cold.

But lately, it seems like there is a lot of interest in the deep sea.

The International Seabed Authority, a branch of the United Nations, has been negotiating with companies and governments who are interested in pursuing **deep sea mining**. Ironically, the polymetallic nodules they desire, contain minerals believed to be essential for our conversion to clean energy. The problem, of course, is that the threat from mining to deep sea ecosystems is acute—even if it is not fully known. Ancient plains could require millennia to recover from human machines gouging away at the deep ocean floor.

The philosophy of “Seventh Generation Planning” holds that “the decisions we make today should result in a sustainable world seven generations into the future.”

**VIDEO:** Watch the video [“In Too Deep”](#)

Based on what you have learned about the fragile and ancient world of the deep sea...should we allow [deep sea mining](#)?

## ACTIVITY 6.7— The 8 Scientific Practices #8: *Communication*

The *Next Generation Science Standards* identify 8 Scientific Practices used by scientists, teachers, and students. The last one is **Obtaining, Evaluating, and Communicating Information**:

*Scientists and engineers must be able to communicate clearly and persuasively about their findings. They also must work cooperatively in groups sharing ideas and assisting others!*

### **Citizen Scientist:**

*Activity 4.10* introduced the toxic state of the Tijuana River and its effects on San Diego's coastal waters. Revisit the crisis presented every day by the toxins and raw sewage that are flowing into our oceans.

As a “citizen scientist,” you can use your phone camera as a means of communicating the seriousness of an environmental problem in a nearby ocean, bay or waterway. Gather essential information that will get people’s attention. Determine the degree to which this problem is threatening our beaches.

Create a public service announcement that clearly describes the problem and its impact on our coast.

What message would you deliver... and how would you deliver it... so that masses of the general public become more aware of the environmental crisis in our own community?

If that same message was intended for the residents of Tijuana, what elements might be different? What would be the most important issues to consider?

## **ACTIVITY 6.8— Saving the Great Whales**

- Provide an overview the Great Whales: The Blue Whales, Humpbacks, Grey Whales, etc.
- Split students into groups and have each group research a different whale: esp, how many are left? Are they endangered? Who is there biggest enemy? What do they eat? How do they have babies?
- What would they like to learn about their whale? What new learnings would they like to share? What would be a dynamic, multi-media method to present their research to others.
- Study the migration route of the Grey Whales. Notice how close they come to the coast of San Diego. Take a trip out on a whale watching boat to see them in the wild.

### **Critical Thinking:**

Why are the Great Whales so essential to **carbon sequestration**, and thus, balancing the Earth’s Climate? ( For a hint, jump ahead to *Activity 7.4* and the discussion about [Blue Carbon](#).)

### **Class Discussion:**

- How could such enormous creatures be endangered?
- Has the campaign to *Save the Whales* succeeded?
- Who is Greenpeace? Research the role they played in saving the whales.
- Are Killer Whales like Shamu... really whales?

- How is the shipping industry a particular threat to whales?



### Resource:

- Ocean Conservancy: [Why is an Orca Not a Whale?](#)
- Ocean Conservancy: [All About Sperm Whales](#)
- Oceanic Society: [The Grey Whale Migration in California and Beyond](#)

## ACTIVITY 6.9— The Living Sea

*The ocean is home to the largest number of living things on Earth.*

5D. **Ocean biology** provides many unique examples of life cycles, adaptations, and important relationships among organisms (symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.

Ask every student to select a *different* ocean creature and research it in the context of Fundamental Concept “d”.

- Describe its life cycle.
- Describe its adaptations.
- Describe its relationships among other organisms (especially with regard to symbiosis, predator-prey dynamics, and energy transfer) that do not occur on land.
- Describe anything else you would like to share about your creature.
- What have you learned from **Unit 6** about the importance of maintaining biodiversity in our oceans?

Prepare a creative presentation that introduces your creature to others: a TED Talk, animation, multi-media project, water color, etc.

## ACTIVITY 6.10— The Documentary: “My Octopus Teacher”

Watch the Academy Award-winning documentary “**My Octopus Teacher.**” The film runs two and a half hours, so it may not be practical to watch it all during class time. Consider showing it :30 minutes at a time during lunch—and invite other students to join in. Or encourage students to watch it at home on Netflix and give them a few weeks to finish the film.

**Background:**

- **Sea Change Project:** [My Octopus Teacher](#)
- **CNN:** [Oscar Winner Explores Unique Human-Octopus Friendship](#)
- **The Documentary:** [My Octopus Teacher](#)