

College Guild
PO Box 696 Brunswick, Maine 04011

Marine Biology

Ocean Environments

Unit 1 of 5

Welcome to the College Guild course Marine Biology.

Overview: Explore the fascinating world of the sea – the ocean environment, sharks, mammals, birds, and strange sea creatures!

Guidelines for all College Guild courses:

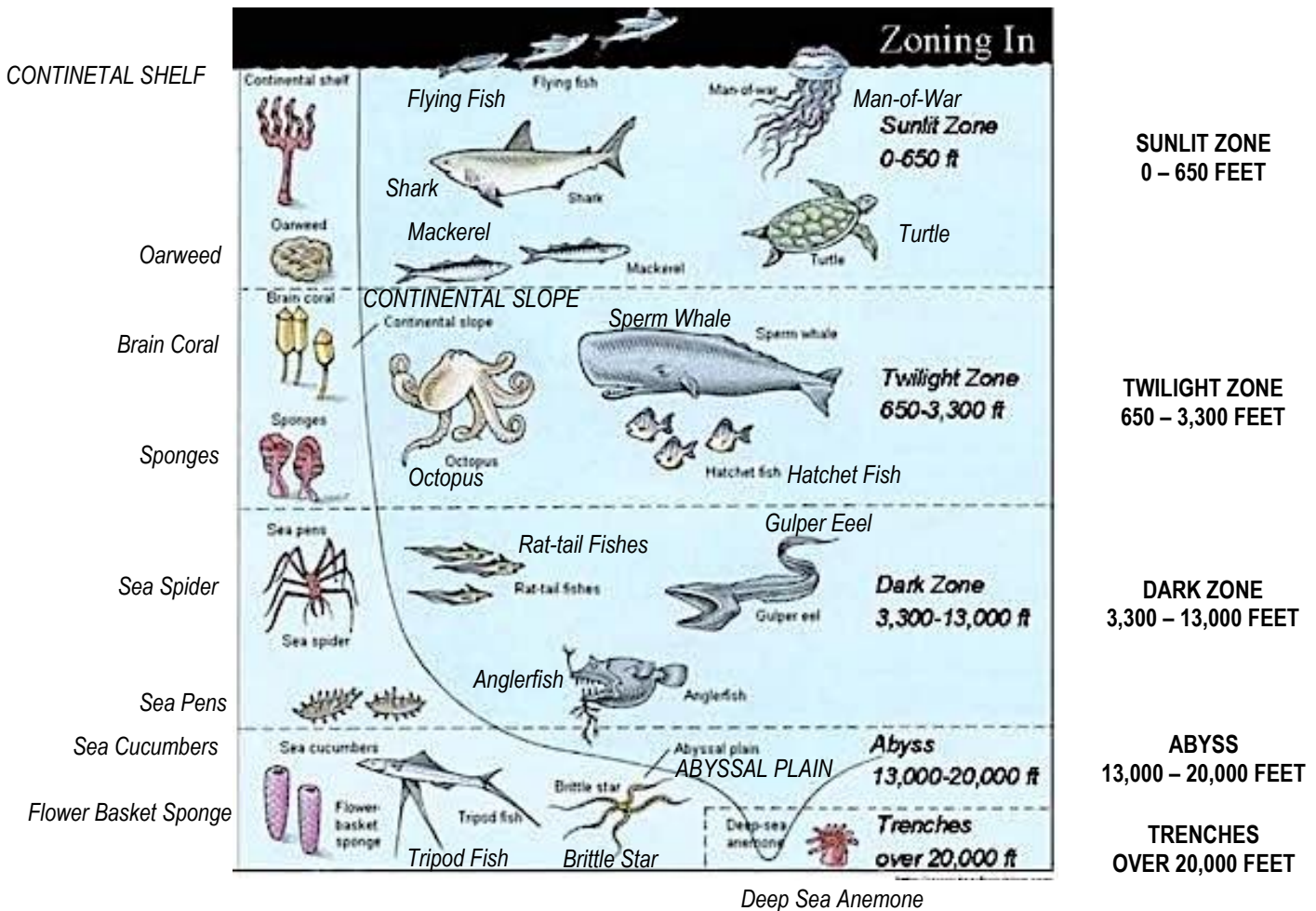
1. **Answer all the questions that are in bold print, using black or blue ink or dark pencil if possible.** After we receive and review your completed Unit, we will send you feedback from your reader along with your original work and the next Unit. You don't need to return the questions – it saves us both postage.
2. There is no **specific deadline** to complete any Unit, but we would get concerned if we hadn't heard back from you after two months.
3. Remember how often the mail service loses things. **If you don't hear back from us after a month, please write to make sure we received your Unit** and sent out the next one.

Let us know if you need a dictionary, free to students who complete the first unit.

Ocean Zone

The ocean covers about 72% of Earth's surface and is home to a plethora of organisms: from single-celled phytoplankton to the blue whale, a rich diversity of species survives beneath the surface. First, let's explore the ocean zones, each categorized by certain depths, temperature, and types of marine life.

1. The *epipelagic* or *sunlit zone* is full of life because sunlight can easily permeate through this top layer of water. Because photosynthesis (the process allowing plants to grow) can occur here, bits of organic matter float down to the mesopelagic zone to provide sustenance for its creatures.
2. The *mesopelagic* or *twilight zone* is named as such because the water becomes very dark as depth increases. Because little sunlight can reach this layer, some fish that lurk here rise to the epipelagic zone at night to feed. Other creatures in this zone eat fish larger than themselves: bizarre, monster-like features like sharp teeth and easily expandable stomachs allow them to do so. Common species are the big scale fish, the hatchet fish, and the snipe eel.
3. In the *bathypelagic* or *dark zone*, animals either feed on detritus (matter from decaying organisms) or the other species lurking here. The species found here are most commonly black or red, but coloring cannot be detected due to the absence of light. Shrimp, jellyfish, squid, and predatory fish call this home. Some types of whales may plunge down from the mesopelagic zone in order to feed.



4. The *abyssopelagic zone* or *abyss* is known for its frigid temperatures and extreme pressure: only a few well-adapted species can survive here. These include the deep-water squid and octopi. Other creatures are echinoderms -- organisms like sea stars and sea cucumbers. Some of these species can even live off of mud!

5. The *hadalpelagic zone* or *layer of trenches* represents the most extreme depths of the ocean. "Hadal" derives from the Greek god Hades, fabled keeper of the underworld. There are only twenty-one trenches on Earth's oceanic surface. While much is still to be discovered about these regions, an astounding 400 species inhabit these depths.

1. Can you think of any other systems or structures, either in the natural or man-made world, which are organized in layers? Name one of these and describe its organization.

2. Nicknamed "the twilight zone", animals in the mesopelagic zone have strange features like spikes, sharp teeth, tentacles, luminescent (lit-up) antennae, or alien-like eyes. Draw your own mesopelagic zone creature and briefly describe what and how it eats.

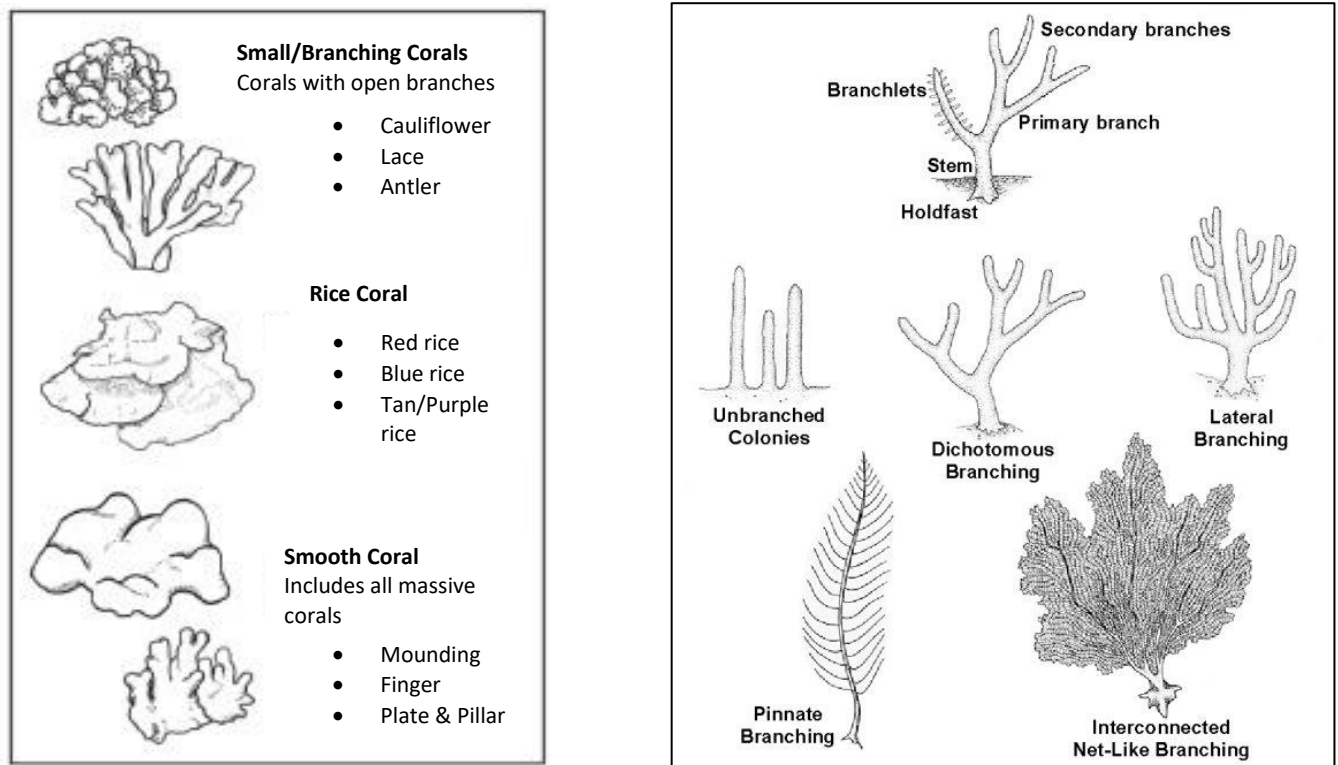
3. If you were an organism in the ocean, which layer would you choose to occupy? What kinds of adaptations or features would you need to survive?

4. What types of gear and technology might humans require in order to explore and learn more about the deepest layers of the oceans?

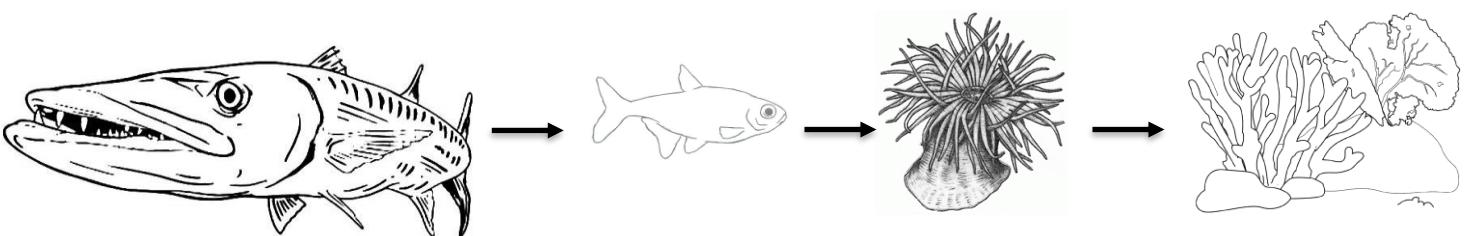
There are also several types of marine biomes or environments. These include the rocky seashore, coral reefs, and estuaries. Let's take a look at each of these.

Coral Reefs

Coral reefs can be found in the ocean near the warmest geographic areas, often near the shallow shores of landmasses near the equator. These tropical marine "forests" contain one quarter of all plant and animals species found in the ocean, including more than 4,000 types of fish. Polyps, the organisms that create the coral structures, require ample sunlight to survive. These cylindrical creatures are no longer than a centimeter and work together in colonies of thousands to build coral: limestone structures designed for protection. Depending on the species of polyp, the resulting coral may vary by shape and color. here are some variations:



The small spaces found amongst the structures allow small fish to hide, and colonies of polyps allow for excellent snacking! Larger predatory fish blend in as well, waiting to snatch their prey. The coral reef food web flows from plants that rely on sunlight to small plants (phytoplankton), tiny animals (zooplankton), small fish, anemones, other echinoderms, and polyps to larger larger fish and predatory creatures. A simple example of such a food web might look like this: the barracuda preys on the tetra fish, which eats the polyps, which feed on plant matter.



Coral reefs are also popular environments to recreate in domestic aquariums (think of fish tanks with fake coral and vibrantly colored backgrounds) and even in the media: Disney/Pixar's *Finding Nemo* is a movie that creates a developed story between various species in the Great Barrier Reef.

5. The following quotation notes that a city is like a coral colony. How is a city like a coral reef, in your opinion?

"The cities are the principal home and seat of the human group. They are the coral colony for Man, the collective being." - Alfred Doblin

6. Considering the simple food chain above,

- a. What might happen to the barracuda and tetra fish populations if the water temperature increases and begins to "bleach" (kill off) the polyp colonies?
- b. What might happen if the barracudas went extinct? (Hint: it would affect the populations of the tetra fish, polyps, and plant matter.)

7. With the knowledge that coral reefs are located closer to shore in shallow, warm, and accessible waters, what are some threats to this delicate environment? How exactly might each type of threat be harmful?

8. Before the scientific knowledge pool could provide explanations for most natural phenomena, some cultures (such as Native Americans) used storytelling to create legends about how certain things came to be. These tales often take inanimate objects like trees, stars, the sun, and moon, and personify them as characters. Write the legend titled, "How the Tides Came to Be," using elements of the rocky seashore environment as your characters.

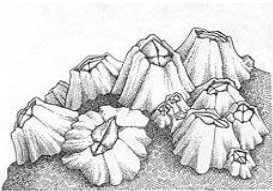
9. Write a Haiku poem describing some aspect of coral reefs: it might be about the overall environment, a specific species, comparing something else to a coral reef, etc.

A Haiku poem is three lines with a 5-7-5 syllable structure. Here's an example:

***The sky is crying
Tears from the sorrowful clouds
They heal the earth's wounds.***

The Rocky Seashore

The rocky seashore environment is characterized by sharp, rocky ledges, and a boulder -- and pebble -- filled water's edge. The changing tides form shallow pools of water, home to species that are well adapted to the rough conditions. Tidal movements occur gradually, with the water receding to a low point or reaching a high point on the shore about every six hours. The zone about where the waves reach at high tide is affected only by sea spray: very few species live here due to the constant exposure. The middle shore hosts the majority of species native to this environment, as they are perfectly suited to being covered and uncovered by the ocean water. The most delicate species -- those that aren't suited for exposure -- dwell in the lower shore, where they are nearly always submerged underwater. Let's look at some of these species up close.



Barnacles emit a sticky substance that hardens into a protective casing. They stick fast to a partially submerged object: a rock, a larger shell, a boat, or even a whale! When they are exposed, they seal off the tiny opening near the top of their protective cover. When submerged, they reach their tiny arm-like flagella through the opening and capture bits of detritus as it floats through the water.



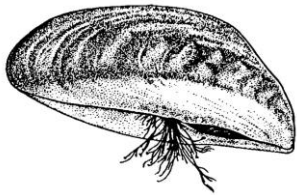
A type of predatory snail, dog whelks prey on smaller seashore organisms. They force apart the top plates of barnacles and inject a poison, allowing them to feed. They also use their pointed tip to drill holes into the shells of mussels and limpets and acquire the soft flesh underneath.



Sand dollars are covered by tiny hairs ("tube feet") that allow them to feed on detritus in the shallow water. Their exoskeletons feature holes in the shape of a flower: the organism pushes seawater in and out in order to scoot along the sand. Finding the bleached skeleton washed up on shore is said to be good luck.



Shore crabs scuttle sideways across the sand. They are nimble enough to squeeze in the cracks between rocks for protection from the strong force of the waves. Their greenish-brown coloring allows them to blend into the rocks - an effect called camouflage - so gulls and other birds don't see them.



Mussels are small creatures that live between two identical shells. These shells open slightly when submerged to allow the organism to feed on detritus and plankton. When uncovered, they are sealed tightly. They live in colonies for added protection: they emit thread-like substances (called a beard) that allow them to join together and attach to a stable structure.

10. Using the simple coral reef food chain as an example, create one that includes at least three rocky seashore organisms.
11. Describe some of the similarities between the seashore creatures above. (They could be adaptations that make them well suited for the environment, methods of movement, or ways of eating, for example.)
12. Based on what you know about the rocky seashore, create a creature that could survive in this harsh environment. Draw your organism and describe how its features allow it to live here.
13. Write a brief story (at least one paragraph) about someone who finds a sand dollar while walking on the beach. Be sure to include how the find is significant to the character.

Estuaries

This marine environment is partially surrounded by land and is characterized by the joining of salty ocean water and fresh water from rivers and streams. Although the changing tides affect estuaries, the land surrounding them provides protection against strong forces. Estuaries produce more organic matter than any other ecosystem on earth. Migratory birds often stop to rest here; they find ample food in the plethora of fish species that spawn in the calm waters. A delicate balance of nutrient-rich earth and native plants absorb floodwaters and buffer against storm surges.

The Environmental Protection Agency reports that human communities are quickly expanding near waterfront areas like estuaries. This is concerning because fertilizer, chemicals used in homes and gardens, and other refuse seep into the nearby water, threatening the tender ecosystem.

The drawing below illustrates some of the species that live in this environment as well as a cross-section of what it looks like.



14. How might chemicals and other domestic poisons threaten the estuary ecosystem?

15. With your answer to Question 14 in mind, imagine yourself as a lawmaker. What kind of legislature (policies) might you suggest in order to protect this environment?

16. Write a letter from an estuary animal to the head of a household that is participating in polluting the nearby environment. Explain the importance of the estuary (your home), pinpoint harmful practices on the part of the household members, and suggest new practices for the family that would allow for the protection of your ecosystems.

17. Considering each of the three marine biomes (coral reefs, the seashore, and estuaries), which would you like to learn more about? Why, and what exactly would you like to learn?

Remember: First names only & please let us know if your address changes

Citations

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