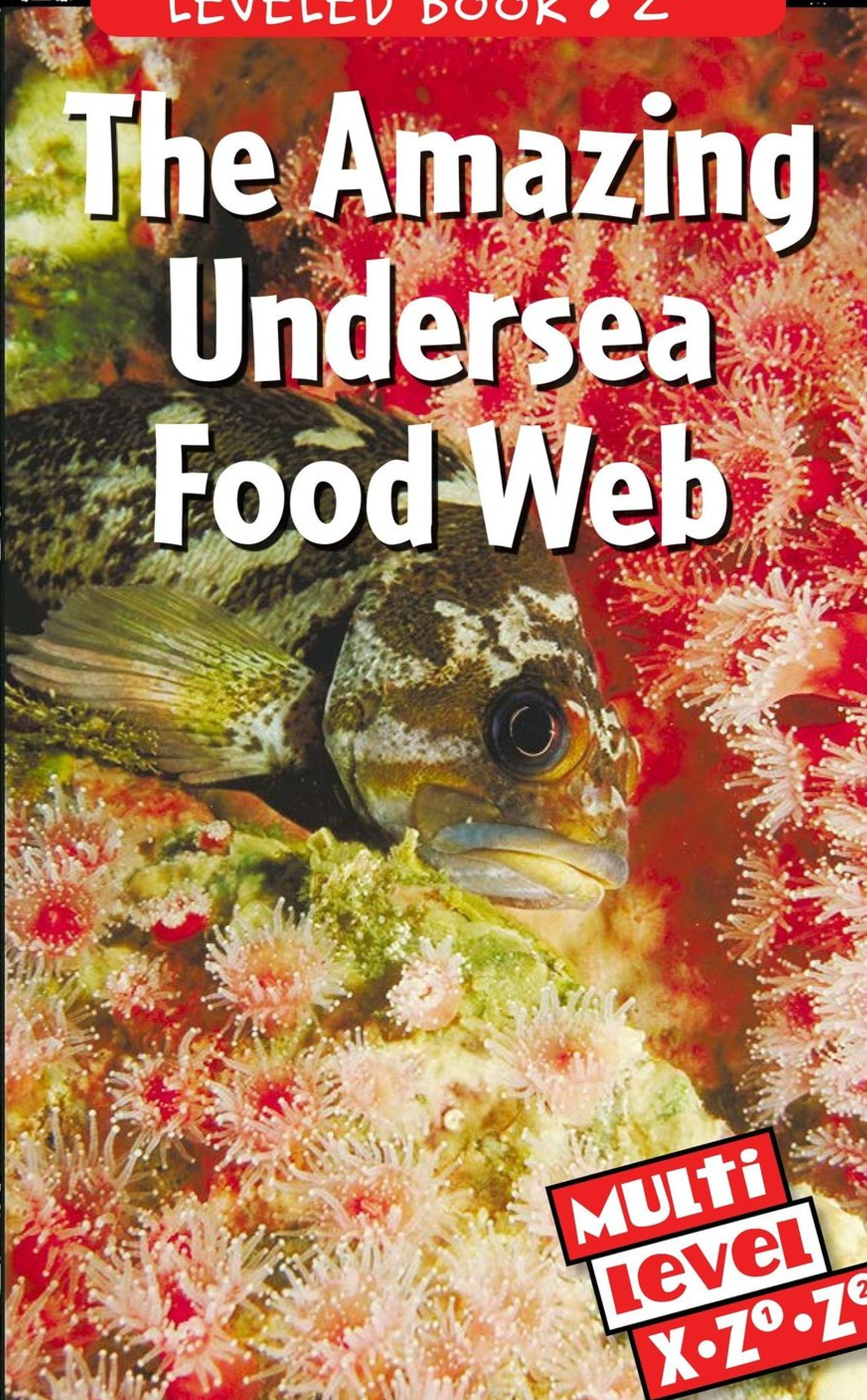
LEVELED BOOK • Z2

The Amazing Undersea Food Web



MULTI LEVEL X•Z1•Z2

Written by Penny Atcheson and Elizabeth Fox

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Focus Question

How are animals from the four ocean zones connected by the undersea food web?

Words to Know

abyssal zone	demise
accumulation	devastating
anemones	disphotic zone
aphotic zone	euphotic zone
biodiversity	faults
bioluminescence	photosynthesis
chlorophyll	phytoplankton
counterillumination	submersibles

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Level Z2 Leveled Book

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Correlation

LEVEL Z2	
Fountas & Pinnell	Y–Z
Reading Recovery	N/A
DRA	70+

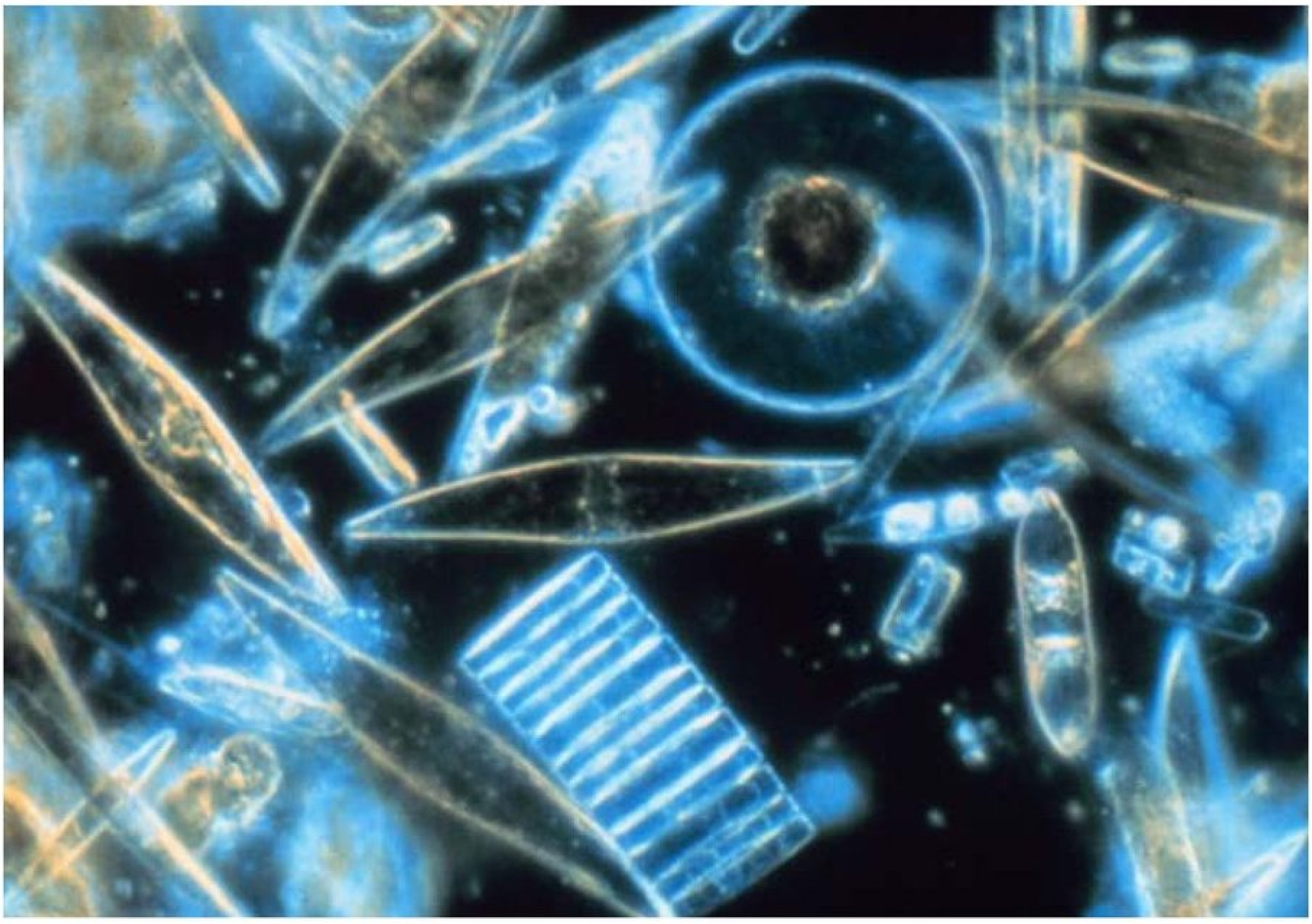
Table of Contents

Let Me Introduce Myself

The ocean is an enormous buffet table for its inhabitants and for many land dwellers as well. When you think of the ocean food web, you might think of fierce great white sharks devouring their prey, enormous blue whales gulping tons of krill, or giant stands of seaweed being devoured like an underwater salad bar. But did you know that more than 90 percent of all sea creatures are eventually consumed by another sea creature?

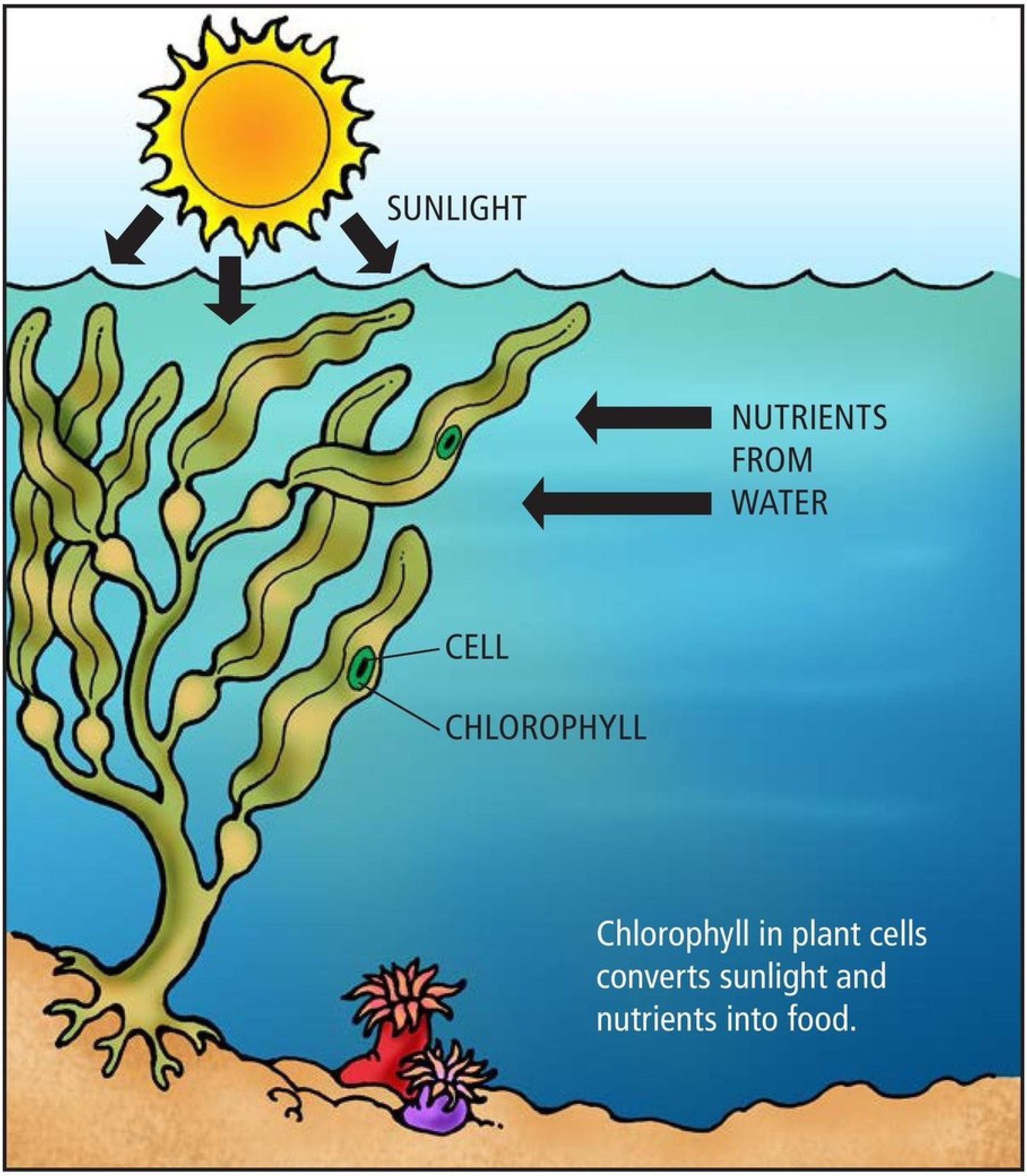
Interestingly, I represent the little organisms that almost always get eaten but do not actually eat anything themselves. These organisms are the most microscopic species in the ocean, yet they form the center of the ocean's vast and complex food web.

The blue whale is the largest animal on Earth.


These microscopic phytoplankton are called *diatoms.*

Phytoplankton is my name, and I'm an algae, which is similar to a very tiny plant. Unlike plants, however, I have no roots. Since I'm not attached to the ground or sea floor, I'm free to float around with the ocean currents near the surface of every ocean on Earth, basking in the sunlight.

Access to sunlight is critical for my survival, as I make food through a process called ***photosynthesis***. I contain green **chlorophyll**, which I use to capture the Sun's energy and convert minerals and nutrients from seawater into food. As part of this process, I send a byproduct of photosynthesis, oxygen, into the water and air around me.



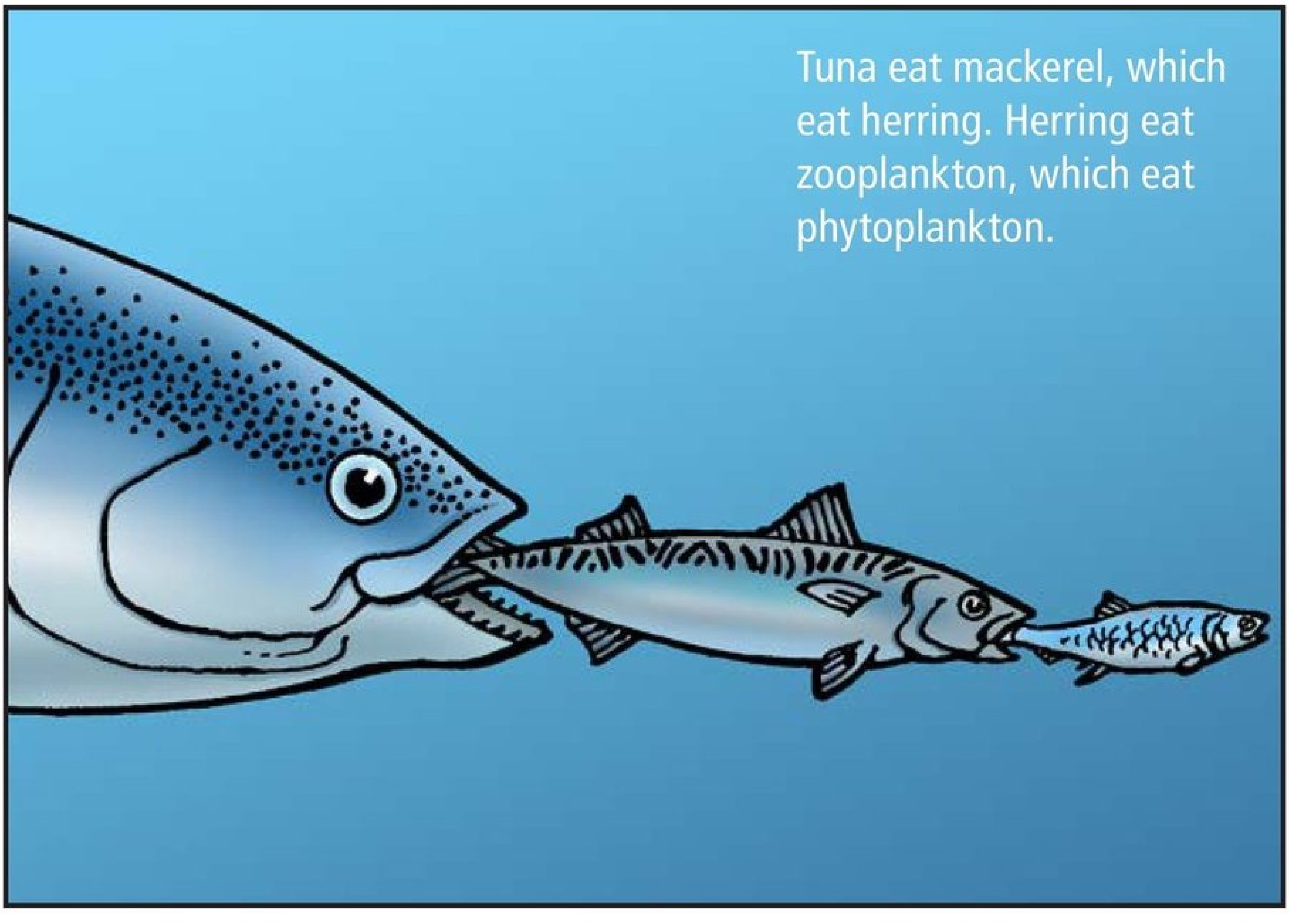
Because we phytoplankton are so tiny, you can see our green color only when there are billions upon billions of us together in one location. Fortunately for the rest of the world, there are billions upon billions of us; thousands of phytoplankton can be found in a single cup of seawater. All that phytoplankton photosynthesis taking place helps provide the Earth's atmosphere with well over half of its oxygen.

A phytoplankton and zooplankton bloom shows up as light streaks in this photo taken from space.

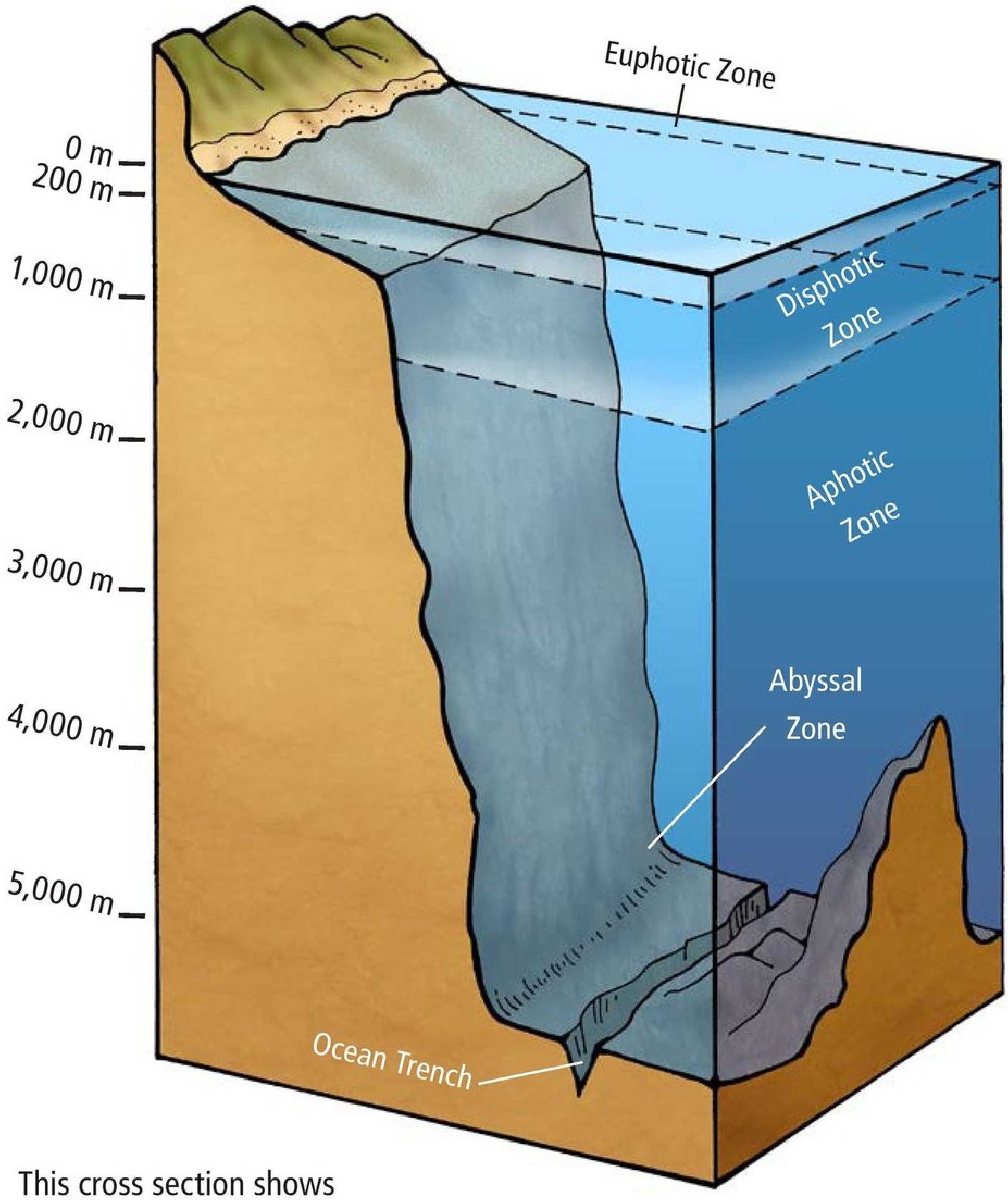
Phytoplankton populations are also good indicators of the ocean's health. Scientists can see large patches of phytoplankton, called *algal blooms,* from space. By monitoring the frequency and scope of green algal blooms, researchers can get information about pollution levels in ocean waters. Maintaining healthy populations of phytoplankton is especially important for other sea creatures since we are the center of the food web for the entire ocean. We feed all marine life forms directly or indirectly, from the smallest creature to the largest.

The Food Web

Here's how it works: think about a simple tuna fish sandwich. Tuna are relatively large fish, and they eat smaller fish called *mackerel.* To make 1 kilogram (2.2 lbs) of tuna flesh, the tuna had to eat about 10 kilograms (22 lbs) of mackerel. Those 10 kilograms of mackerel had to eat 100 kilograms (220 lbs) of an even smaller fish called *herring,* and those 100 kilograms of herring devoured a full 1,000 kilograms (2,200 lbs) of zooplankton. Zooplankton are microscopic animals that include tiny animals such as krill, which look like little shrimp, and the larvae and babies of crabs, jellyfish, shrimp, and other fish. Those 1,000 kilograms of zooplankton consumed 10,000 kilograms (22,000 lbs) of phytoplankton.



Tuna eat mackerel, which eat herring. Herring eat zooplankton, which eat phytoplankton.



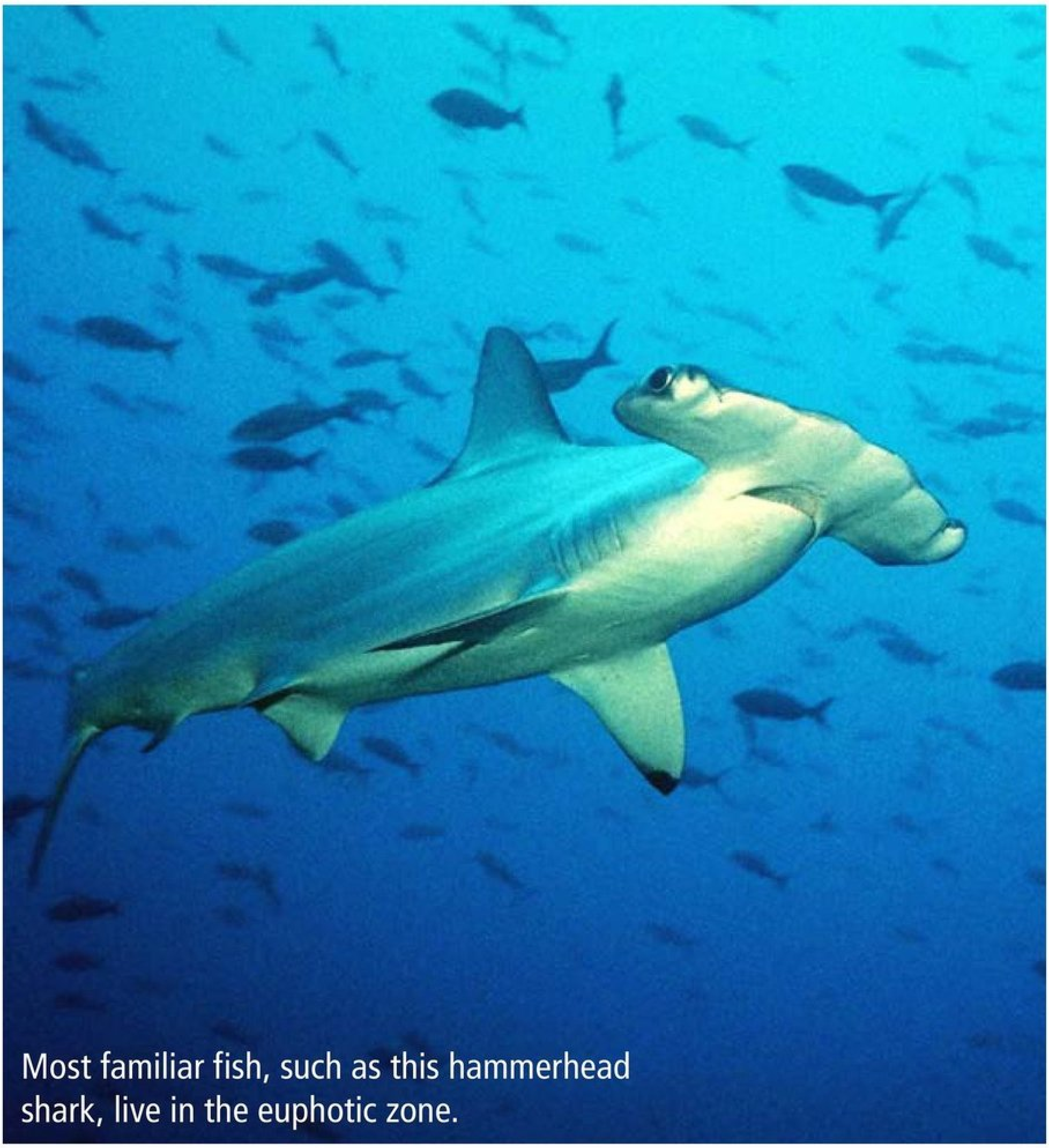
This cross section shows
the different zones of the ocean.

To give you an idea of just how much life I support, I'll take you on a brief tour of the ocean from the surface, where I live, down to the deepest trenches on the sea floor.

Life in the Sunlit Zone

The **euphotic zone**, or sunlit zone, is the topmost level of the ocean, extending about 200 meters (660 ft) down from the surface. The abundant sunlight makes this an ideal environment for phytoplankton and ocean plants. Consequently, most of the animal species in the ocean also live in the euphotic zone. Red and green seaweed cover much of the shallow ocean floor in the euphotic zone, and thick forests of giant kelp provide shelter for many sea animals, such as sea urchins. Sea otters feed on the urchins and also wind long strands of kelp around their bodies while they sleep in order to keep from drifting away.

Nearly all the seafood eaten by humans comes from the euphotic zone. Clams, mussels, and oysters live on shallow ocean floors, while lobsters and crabs scuttle about in coral reefs and among seaweed beds. Most species of fish, including salmon, tuna, mackerel, cod, and swordfish, inhabit the euphotic zone, where there is plenty to eat and good light for hunting. Most of the squid and octopuses that humans eat reside in these waters as well.

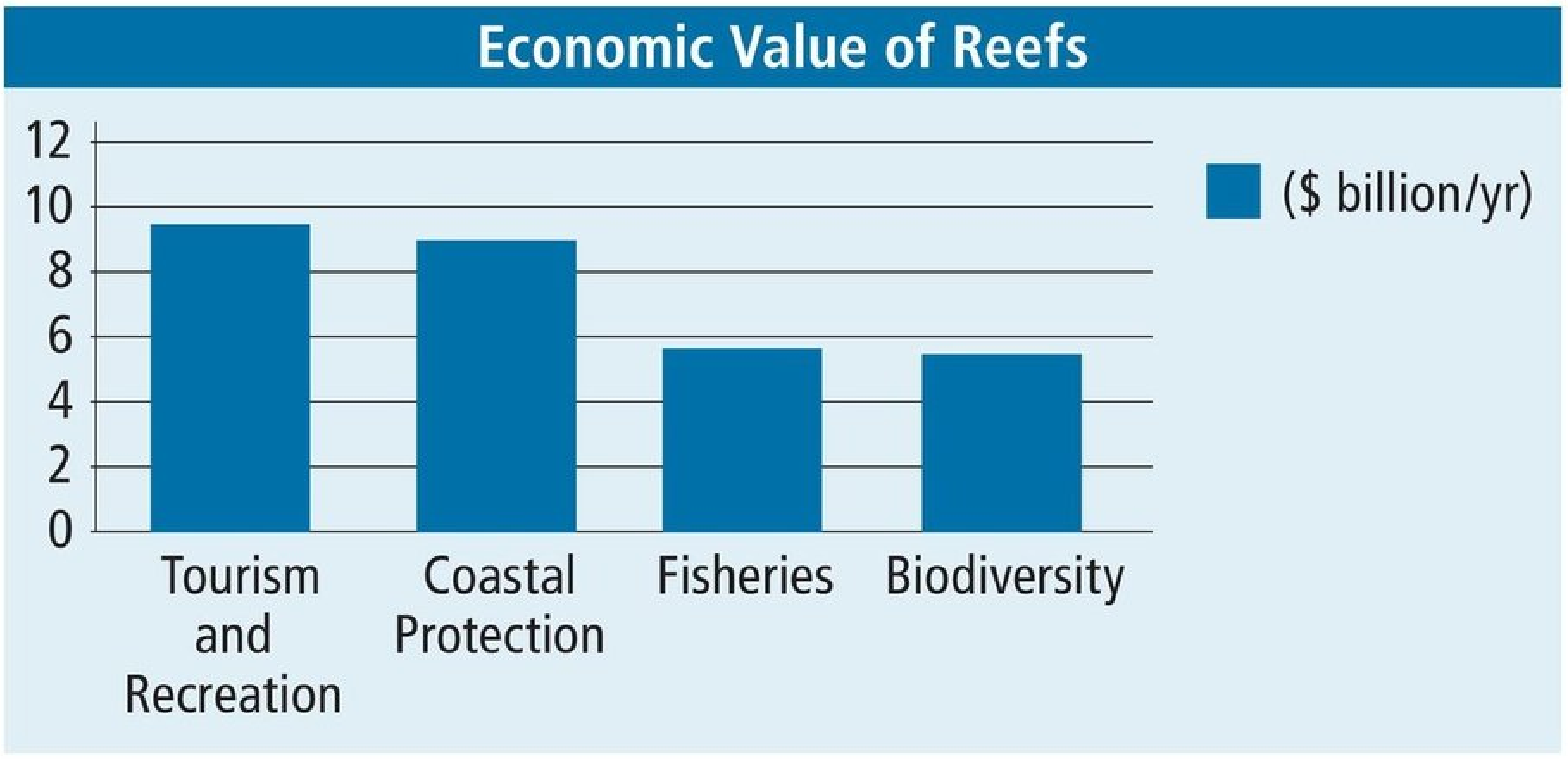


Most familiar fish, such as this hammerhead shark, live in the euphotic zone.

Colorful coral reefs are the sunlit zone's most popular areas.

The euphotic zone's coral reefs are home to most of the ocean's plant and animal species. The fragile and beautiful reefs are formed by the **accumulation** of the skeletons of small animals called *coral polyps* found in clear, tropical waters where there is plenty of sunlight. The reefs support a diverse population of sea life that includes sea fans, brain coral, clown fish, angelfish, lion fish, moray eels, sharks, shellfish, crabs, and lobsters. **Anemones**—animals that look like beautiful flowering plants—catch zooplankton with their stinging tentacles. Jellyfish swarm in massive numbers, attracting the sea turtles that love to eat them. Coral reefs provide a safe haven for many young sea creatures that will live in the open ocean as adults.

The incredible **biodiversity** of the reefs is a magnet for tourists and outdoor enthusiasts. Humans love snorkeling and diving in the euphotic zone, especially around coral reefs, and they take thousands of tons of fish, both for food and for pets in tropical aquariums, from these surface waters. Unfortunately, all this human activity, along with pollution, threatens the well-being of coral reefs and other areas in the euphotic zone. Coral polyps are often killed by pollution, boat engines breaking them, or divers stepping on them, and once the corals die, all the other reef life suffers as well. Their **demise** can have immediate and **devastating** effects not only on sea life in the euphotic zone but also on the coastal landscape. In addition to supporting sea life, coral reefs function as protective shields that prevent coastline erosion during severe storms. Because of the reefs' value, it is critical that they be preserved and maintained.



The Red Bird Reef

Is it possible to undo damage to undersea food webs? The Red Bird Reef off the coast of Delaware suggests it is—using old subway cars!

Since 2001, barges have dumped hundreds of cleaned-out Red Bird subway cars from New York City onto a barren sea floor in the Atlantic Ocean. The metal cars soon became home to a thriving community of underwater sea life. Their walls and floors are blanketed in sea grasses. Mussels and sponges cling to their sides, and a variety of fishes swim in and out of their windows. The Red Bird Reef project has been so successful that it's become a hot spot for recreational and commercial fishermen.

Damage to reefs can be reduced through less invasive exploration rather than underwater visits. One nondestructive way to sample ocean life in the euphotic zone is to simply look into a tide pool. You can find mussels, sea stars, urchins, clams, barnacles, and snails throughout the pools of water that remain onshore after the tide recedes. You might even see an octopus or spot a hermit crab scurrying about in another animal's shell. You don't even have to get wet to observe the various forms of euphotic zone life that depend, directly or indirectly, on me and my fellow phytoplankton.

The Twilight Zone

As you venture below the euphotic zone, the water begins to get darker, colder, and heavier. At about 200 meters (656 ft) in depth, you enter the twilight, or disphotic, zone, which extends to a depth of about 1,000 meters (3,280 ft). The pressure in this zone would crush a person, but the life forms that live here have adapted to this environment. The twilight zone doesn't have enough light to support photosynthesis and plant life, but some animals, such as octopus and squid, do make their homes here. Others, such as whales, visit from the euphotic zone.

The **disphotic zone**'s permanent residents include strange fish that look quite different from those in the euphotic zone. Many of them are black or dark red to blend in with their dark surroundings. Each of these species has special adaptations that enable it to thrive in the dim, chilly waters. The predatory viperfish, for example, has a somewhat frightening appearance, with big, curved teeth lining its gaping mouth. Because it is so hard to see at these depths, viperfish don't actively hunt. Rather, they simply hold open their fearsome mouths, waiting for something to swim close enough to be gobbled up.

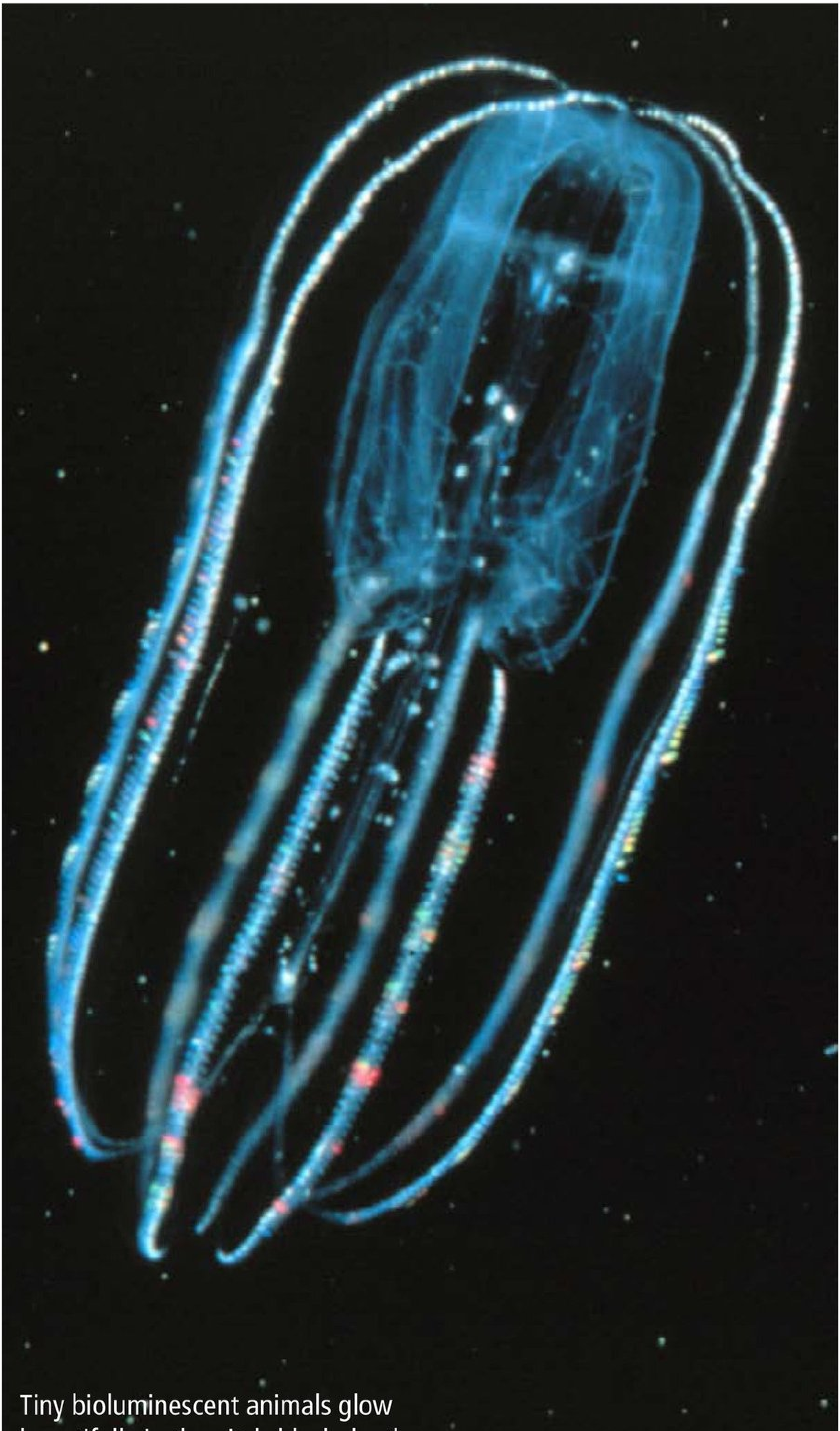
Hatchet fish are small fish that have thin, oddly shaped bodies covered in silvery scales that shine with the same intensity as dim light from the sea level above. This effect, known as **counter-illumination**, makes them very difficult for larger predators to see from below. Other disphotic dwellers have almost transparent bodies that make them equally difficult to detect.

The famous giant squid also lives in this zone. This creature inhabits waters near undersea canyons and is rarely seen. In fact, no giant squid had ever been seen alive until fairly recently. Squids' bodies occasionally washed up on shore or were found in the stomachs of sperm whales. In 2009, a research ship in the Gulf of Mexico caught a 47-kilogram (103 lb) squid in a net trailing the vessel at 457 meters (1,500 ft). Scientists hope the discovery will shed light on the biology and habits of this mysterious creature.

This angler fish is small but scary.

Octopuses live in both the euphotic and disphotic zones.

It may be hard to believe, but creatures in the disphotic zone dine on phytoplankton, too. Many animals in this zone depend on a diet of what scientists call “marine snow,” which is a nice name for dead phytoplankton and zooplankton! When we die, our bodies drift slowly down through the ocean layers to the bottom of the ocean like snow falling through the air. So even where we don’t live, phytoplankton are eaten.



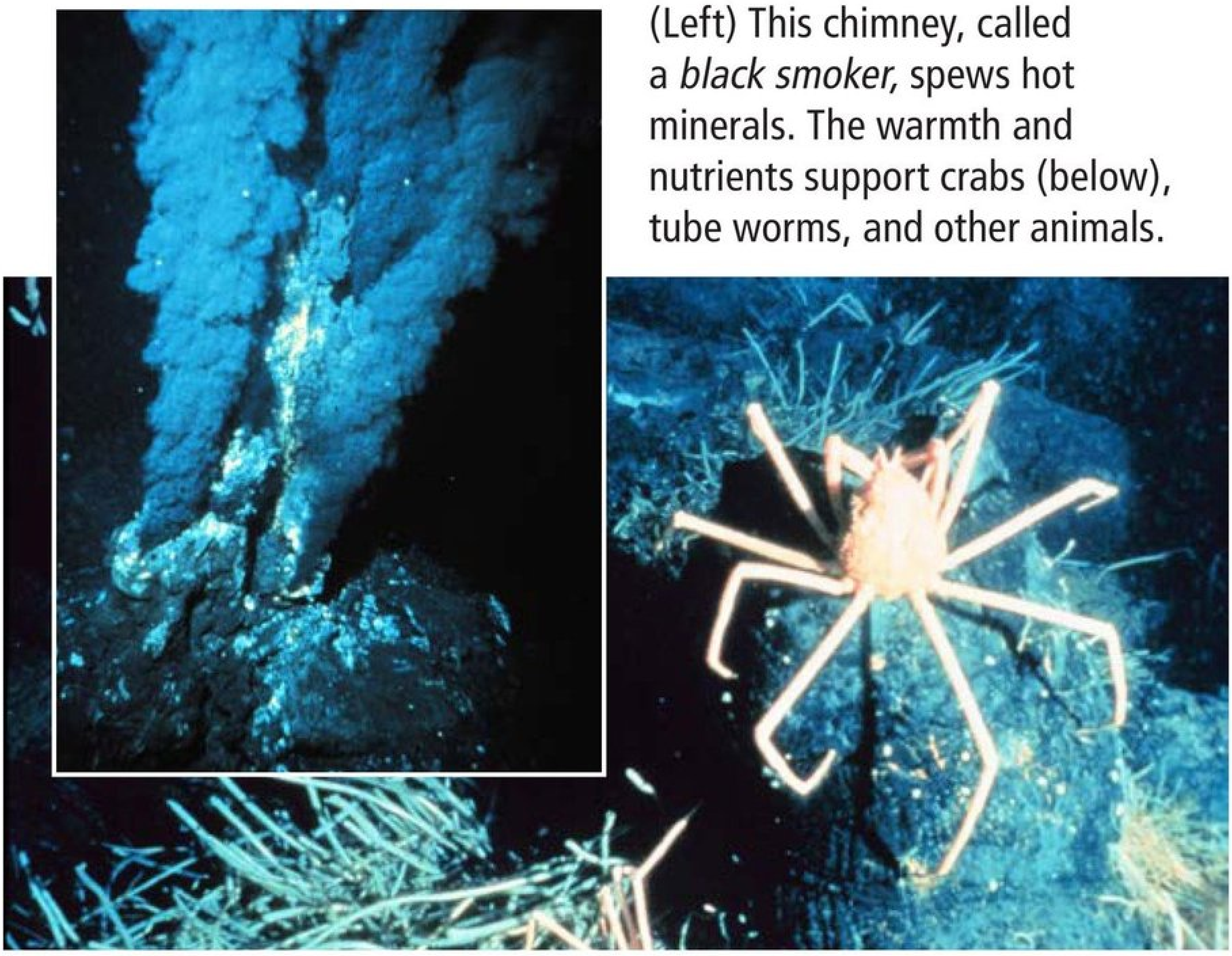
Tiny bioluminescent animals glow beautifully in the pitch-black depths.

The Midnight Zone

This totally dark region of the ocean extends from 1,000 to 5,000 meters (3,280–16,404 ft) and below and contains 90 percent of the ocean's water but almost none of its life. The pressure is so great that it can crush almost anything, including most submarines, and the temperature is near freezing. But there is some life in the midnight zone, or **aphotic zone**, if you look closely.

Many of the tiny animals that live here, such as the lantern fish, have little lights running up and down their bodies. The light comes from a special process called **bioluminescence**—the same process that produces light in fireflies. Jellyfish, squid, fish, and even bacteria that live in this zone have bioluminescent features to compensate for the lack of sunlight. These lights make it possible for animals to see and communicate with each other as well as to find mates and food.

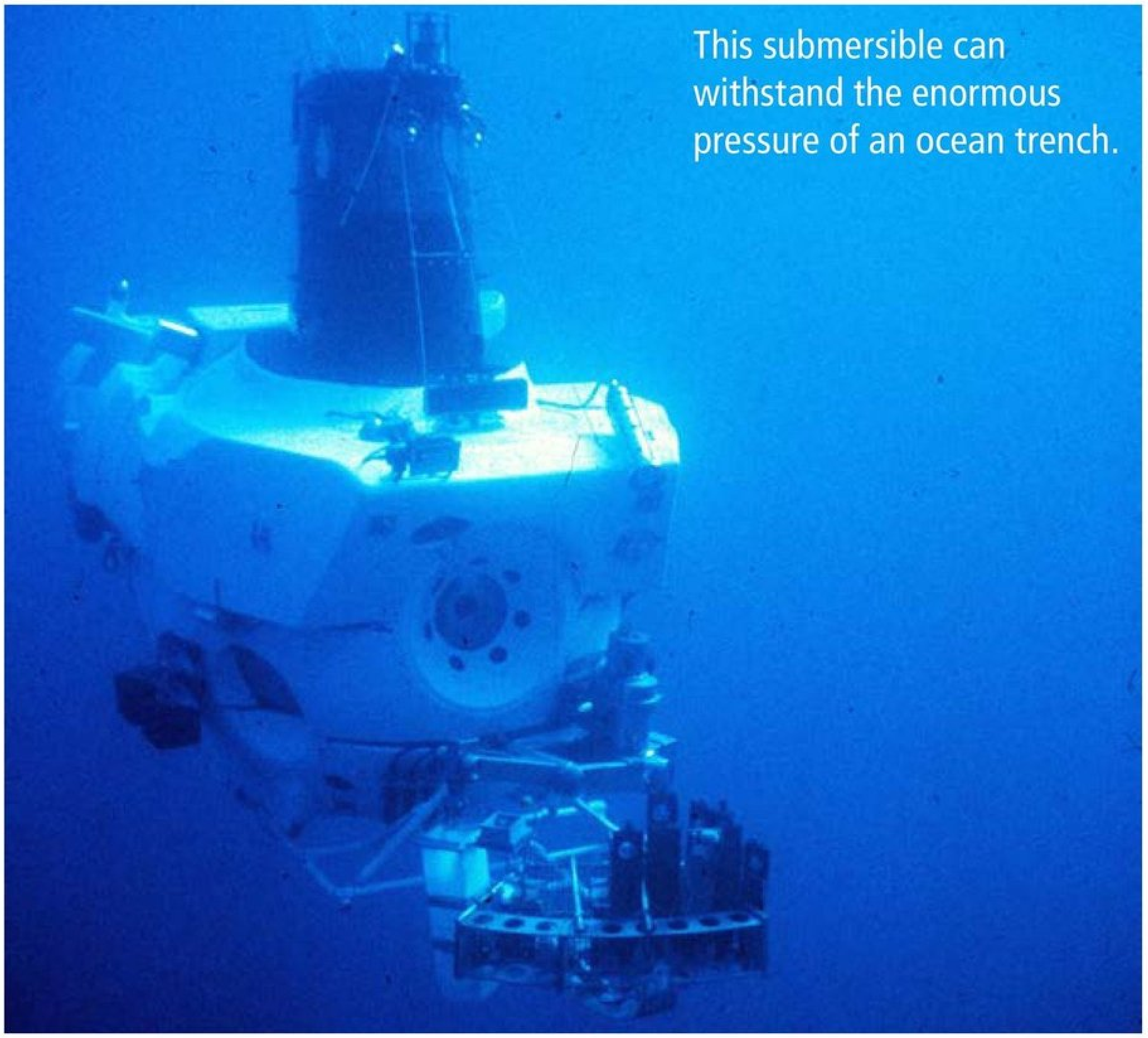
One of the best-known residents of the midnight zone is the aptly named deep-sea angler fish. The female angler fish has a stalk growing out of the top of its head. The end of the stalk is covered in bioluminescent bacteria that glow like a light bulb. The angler fish uses this glowing stalk as a fishing pole to lure prey close to its waiting jaws.



(Left) This chimney, called a *black smoker,* spews hot minerals. The warmth and nutrients support crabs (below), tube worms, and other animals.

Some oceanographers divide the midnight zone into two additional zones: the **abyssal zone** and ocean trenches. The abyssal zone is completely dark and covers much of the ocean floor, including vast plains, mountains, valleys, and canyons. Ocean trenches occur along **faults** where large plates of the Earth's crust come together. The colliding plates create canyons and cracks of up to 10,000 meters (32,808 ft) deep where the pressure is great and the water is very cold and totally black. You would think that nothing could survive in such a hostile environment, but openings at the bottom of the trenches spew hot water and minerals from deep within the Earth and provide life-sustaining warmth.

The openings form when seawater comes in contact with hot magma. Animals living in this zone take advantage of the warmth and nutrients from these openings in much the same way that phytoplankton use light from the Sun. Tube worms, shrimp, and giant clams can all be found feeding on these bacteria around the openings, or chimneys. These chimneys, called *hydrothermal vents,* were first discovered in 1977 by scientists exploring the ocean floor near the Galapagos Islands. Only a few **submersibles**, or submarines, have been built strong enough to withstand the enormous pressure at the bottom of a trench.



This submersible can withstand the enormous pressure of an ocean trench.

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So you see, even though phytoplankton are only at the top of the ocean, we're at the center of the food web, supporting all other life in the sea. In spite of our microscopic size, we have a significant impact not only on what other ocean creatures eat, but what you eat as well. Whether you enjoy the ocean for the beauty of coral reefs, the mystery of the abyssal zone, or some tasty fish and chips, you have us phytoplankton to thank.

Glossary

abyssal zone *(n.)*	the part of the aphotic zone that includes the deep ocean floor (p. 20)
accumulation *(n.)*	a piling up of material over time (p. 12)
anemones *(n.)*	plantlike, marine animals whose tentacles often look like flower petals (p. 12)
aphotic zone *(n.)*	the bottom ocean zone, which receives no sunlight (p. 19)
biodiversity *(n.)*	the variety of life forms on Earth or in a specific habitat or ecosystem (p. 13)
bioluminescence *(n.)*	the light or the emission of light created by a biochemical process within a living thing (p. 19)
chlorophyll *(n.)*	a substance in plant cells that can transform sunlight, water, air, and nutrients into food (p. 5)
counterillumination *(n.)*	a method of camouflage in which an animal uses light to hide against an illuminated background (p. 16)
demise *(n.)*	the end or failure of something; death (p. 13)

devastating *(adj.)*	causing great physical damage (p. 13)
disphotic zone *(n.)*	the middle ocean zone, which receives very little sunlight, and contains no plants and few animals (p. 15)
euphotic zone *(n.)*	the top ocean zone, which contains almost all of the ocean's life (p. 10)
faults *(n.)*	cracks in Earth's crust along which movement occurs (p. 20)
photosynthesis *(n.)*	the process by which chlorophyll in plant cells transforms sunlight, water, air, and nutrients into food (p. 5)
phytoplankton *(n.)*	single-celled algae that live in a body of water (p. 5)
submersibles *(n.)*	small vessels that can operate underwater, especially at deep levels (p. 21)

The Amazing Undersea Food Web

A Reading A–Z Level Z2 Leveled Book
Word Count: 2,027

Connections

Writing

Imagine being an oceanographer exploring the twilight zone. Write a journal entry about your findings, including details from the book.

Science

Choose one of the four ocean zones. Research to learn more about this zone and write a paper sharing your findings.