



Smithsonian

Sonar and Submarine Technology



Table of Contents

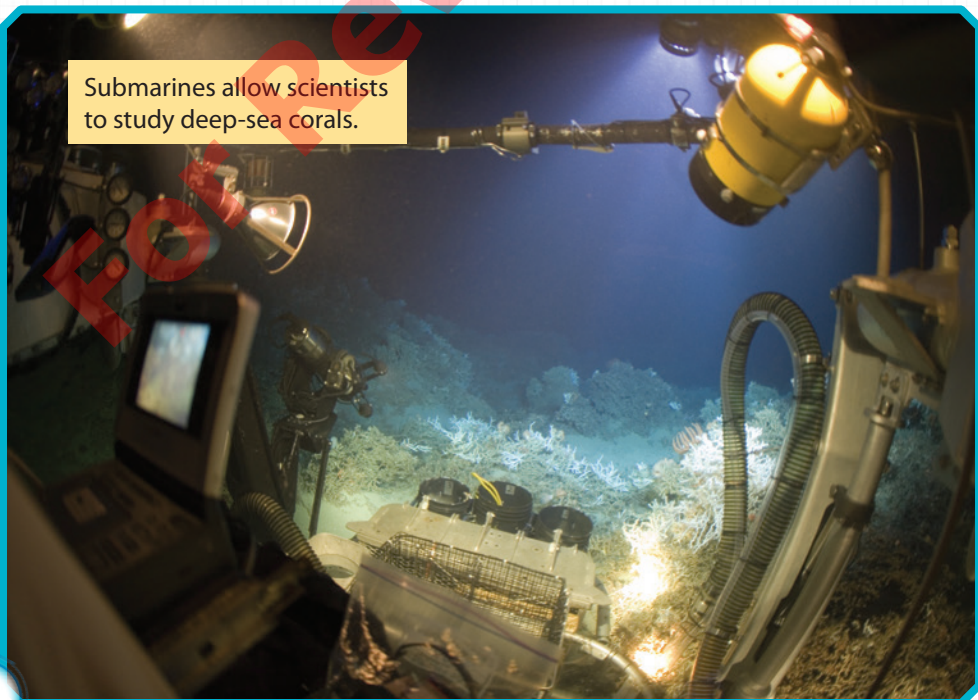
The Darkest World	4
Take a Deep Dive	6
Deep-Sea Corals.	14
Humans Make Noisy Neighbors	20
Researching a Better Future	26
STEAM Challenge	28
Glossary.	30
Index.	31
Career Advice	32

The Darkest World

Imagine that you are a **marine** biologist. You want to learn about underwater life and see what the seafloor looks like. So, you put on your wet suit and plunge into the icy waters to look around. But there's just one problem. As you sink, it gets darker and darker, until you can't see your hand in front of your face! How are you supposed to study the plants and wildlife if you can't even see them?

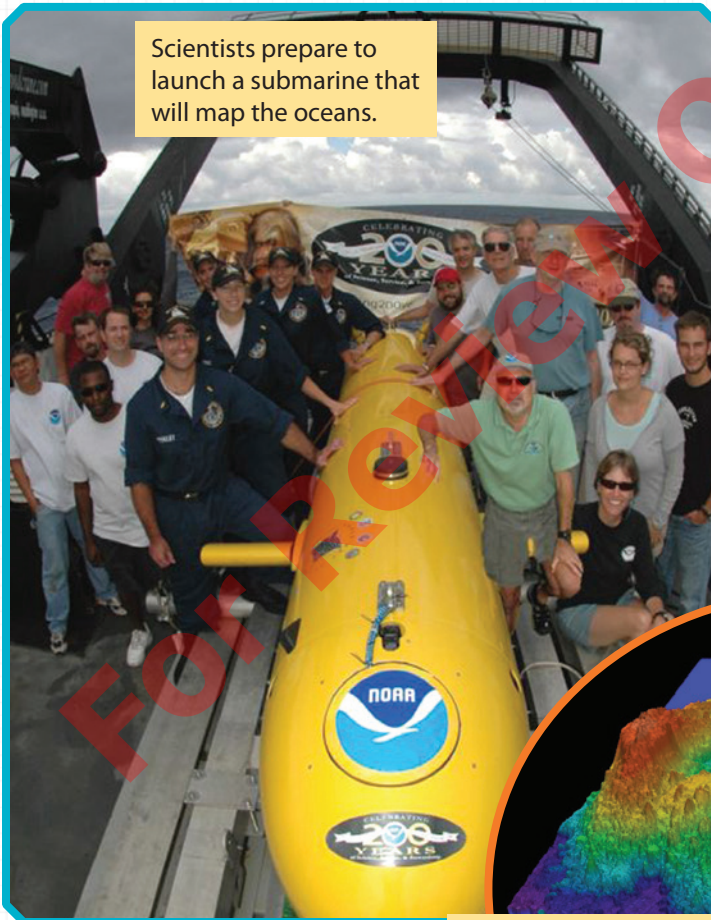
The answer is a type of technology called *sonar*. Scientists all over the world use sonar to learn about what they can't see with their own eyes. First, they send sound waves into the water. When the sound waves hit an object in the water or on the ocean floor, they bounce back. Computers record the bounces and produce a video or image that scientists can study. This allows scientists to identify fish and mammal species and track their movements and sizes. Scientists can also learn about predator and prey interactions.

Submarines allow scientists to study deep-sea corals.

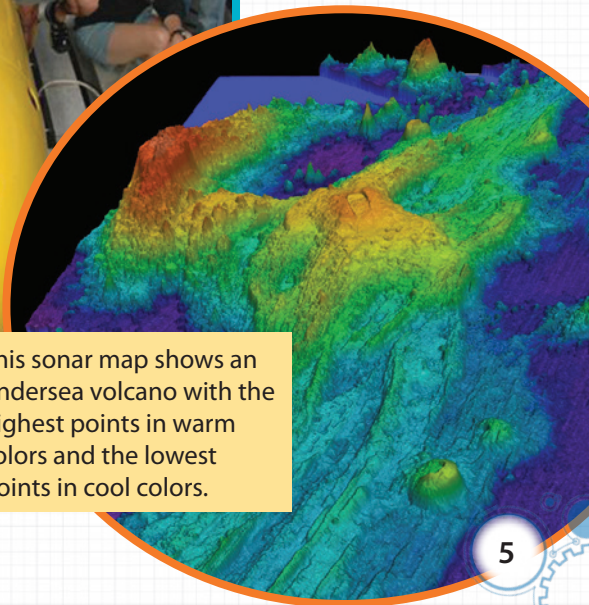


Sonar can be **deployed** from different vessels, such as boats or **submarines**. When sonar is combined with submarine technology, it allows scientists to unlock many secrets of our oceans. For example, sonar and submarines have been used to map the seafloor, study deep-sea **corals**, and examine how humans affect whales.

Scientists prepare to launch a submarine that will map the oceans.



This sonar map shows an undersea volcano with the highest points in warm colors and the lowest points in cool colors.

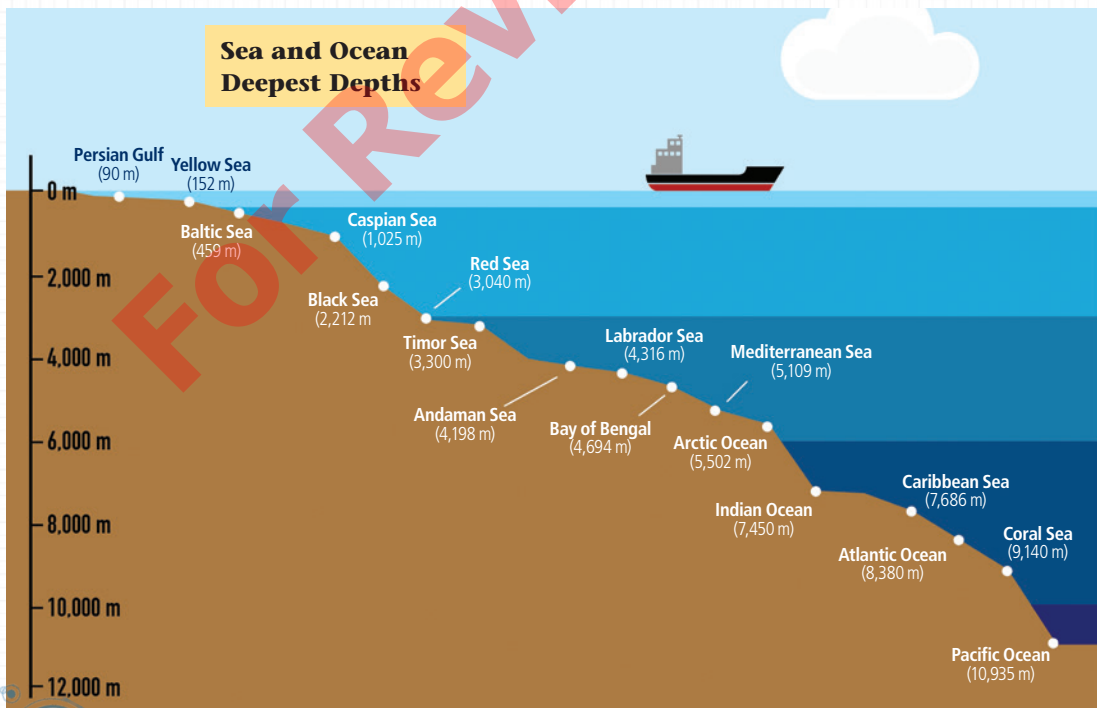


Take a Deep Dive

You may know that oceans cover more than two-thirds of Earth's surface. But did you know that they make up about 95 percent of Earth's living space? That's because they're so deep. A vast and mysterious world lies beneath the oceans. Humans have only been able to explore a very tiny part of it.

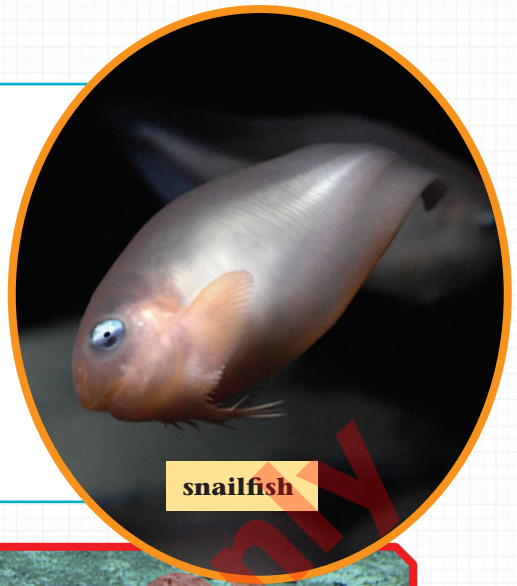
It's easy to see why most of the oceans have gone unexplored. Near the surface, some sunlight penetrates the water. But go deeper, and the light quickly begins to fade. The deepest that light has been seen is 700 meters (2,297 feet). Go deeper still, and the pressure of the water is a massive force. It takes great protective measures to withstand that force. The average depth of the oceans is 3,729 m (12,234 ft.). The water here is colder than the temperature of your refrigerator. The deepest parts of the oceans are more than 10,973 m (36,000 ft.) below the surface. That's almost 11 kilometers (7 miles)!

Sea and Ocean Deepest Depths

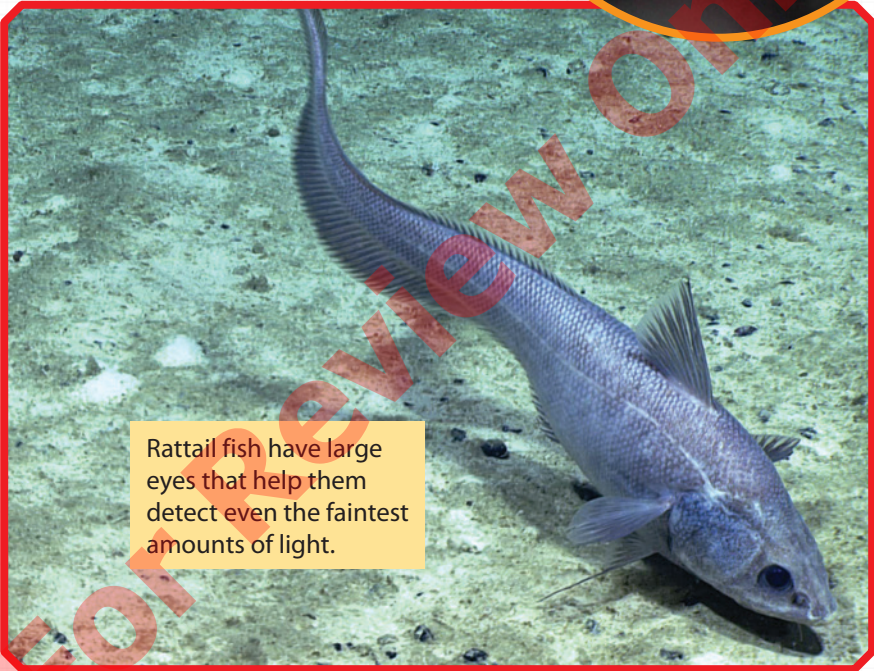


Deepest Known Creature

Scientists discovered a snailfish swimming 8,178 m (26,832 ft.) below sea level. These pink, slimy fish are about 22.6 centimeters (8.9 inches) long. Their skulls have evolved to withstand the incredible water pressure at that depth.



snailfish



Rattail fish have large eyes that help them detect even the faintest amounts of light.

The farther away the water's surface is, the less food and light are available. However, life finds a way to exist in these depths. Animals that can stand the pressure include certain octopuses, sharks, rattail fish, and angler fish. Countless **microscopic** creatures survive there, too. And many creatures, such as sea cucumbers, can create their own light. This is done through a chemical reaction in their cells.

Studying Marine Life

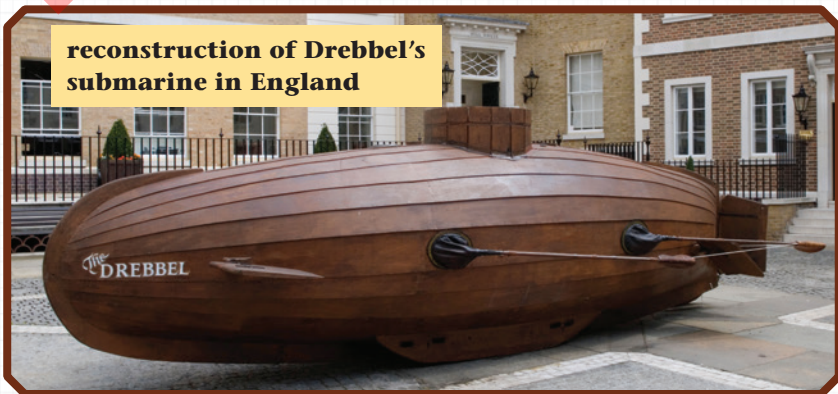
Scientists study the oceans and marine life for many reasons. Scientists can learn about the **adaptations** of deep-sea creatures and how species in the oceans live. Learning about the oceans can also teach us to better manage the resources they provide. That helps us make sure they are still around for future generations. Finally, the oceans can reveal new plant and animal species.

What else can the oceans teach us? We won't know unless we explore them. But the deepest parts of oceans are distant, alien worlds. They are very hard to explore. This is where underwater vehicles come in. They allow people to safely explore the depths.

The world's first submarine was created by a Dutch inventor named Cornelis Drebbel in 1620. It was a rowboat that was covered with greased leather to seal it against the water. Tubes that went up to the surface provided air. Drebbel used it to dive about 3.7 to 4.6 m (12 to 15 ft.) below a river's surface.

Submarine technology has come a long way since then. Since the late nineteenth century, motor-powered submarines have been navigating the seas. Today, scientists use a variety of technologically advanced underwater vehicles to help them explore the deepest parts of the oceans.

reconstruction of Drebbel's submarine in England





These parts are commonly found in all submarines.



ENGINEERING

Seaweed Savior?

Scientists in Iceland are growing seaweed on buoys in the ocean. They think it might help fight **climate change**. That's because seaweed absorbs carbon from the atmosphere. Eventually, the buoys will be sunk to the seafloor. If everything goes according to plan, the carbon will be stored underwater for at least 800 years!

STEAM CHALLENGE

Define the Problem

Submarines travel throughout the oceans, sinking and rising to different depths. But their engines can have a negative effect on marine life due to the sound waves they create. So, marine biologists are partnering with naval architects to address this problem. They want to create a new protective material that can be used to make submarines. They want this material to help reduce engine sound waves from bouncing off submarines and spreading. Now, they've asked you to test your ideas for a sound-reducing submarine.



Constraints: You may only use the materials that are provided for you.



Criteria: Your submarine must be large enough to fit a cell phone inside but small enough to carry in your hands. The submarine must open and close.



CAREER ADVICE

from Smithsonian

Do you want to work with sonar or submarines?

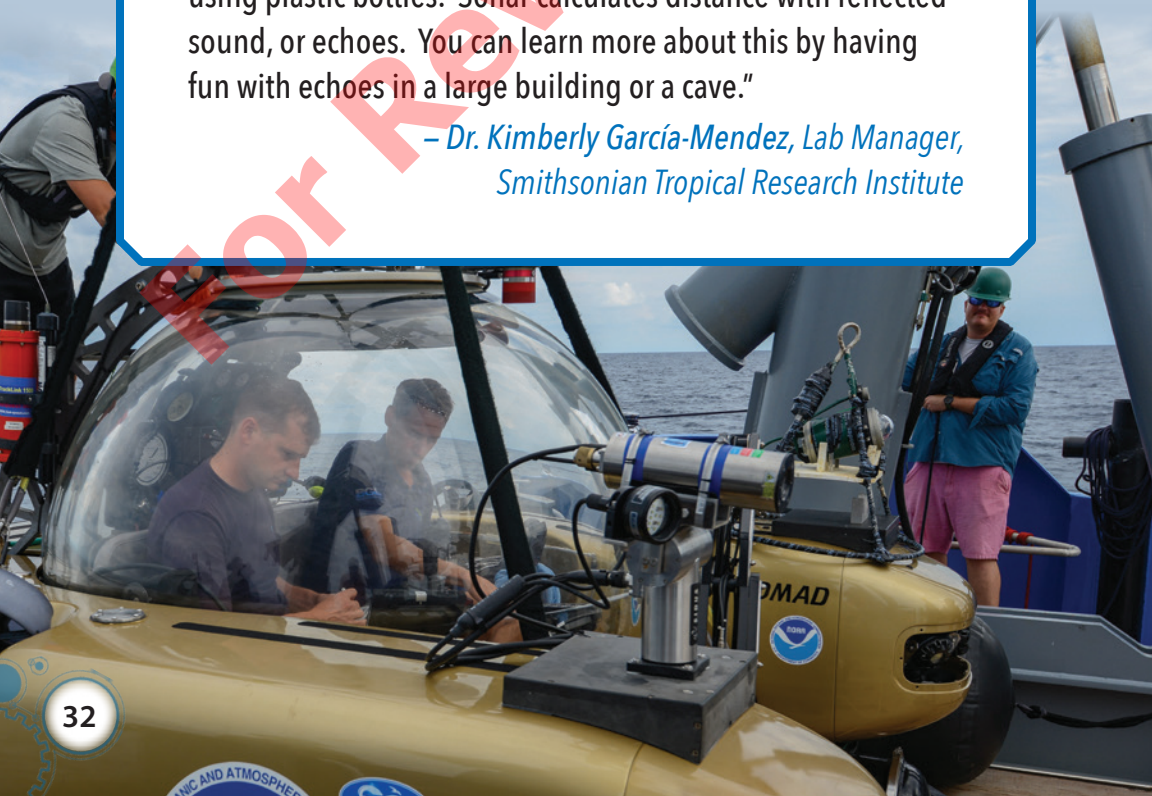
Here are some tips to keep in mind for the future.

"Read as much as you can about the ocean and its creatures. Books open up the world hidden beneath the waves. Plus, YouTube has countless wonderful documentaries that inspire a passion in the oceans."

– Dr. Jonathan Cybulski, Postdoctoral Researcher,
Smithsonian Tropical Research Institute

"Explore how submarines work by building your own models using plastic bottles. Sonar calculates distance with reflected sound, or echoes. You can learn more about this by having fun with echoes in a large building or a cave."

– Dr. Kimberly García-Mendez, Lab Manager,
Smithsonian Tropical Research Institute



Read and Respond

1. What are the three types of underwater vehicles, and how are they different?
2. How do animals use echolocation?
3. How are the deepest parts of oceans different from areas closer to the surface?
4. What are three reasons why deep-sea corals are threatened?
5. How are humans using sonar, and why do they use it?
6. How has human noise affected marine life?

