

# The Biotechnology Porthole

Biotechnology and molecular biology can shed light on the innermost life processes of the organisms that live in the sea's deep, dark, inhospitable places. Here are a few techniques that give us a peek through that porthole.

## Proteins and Enzymes

All organisms produce proteins to build cells and perform the functions of life. Certain proteins, called *enzymes*, carry out biochemical processes within cells.



Scientists are studying these and other organisms for their scientific and medical value.

### Top to bottom, left to right

**Coral Reefs** are to the sea what tropical rain forests are to the land: teeming with species that may have medicinal value, yet vulnerable to destruction by human activity.

**Puffer Fish** secrete a deadly poison that scientists use to study neuromuscular transmission in people.

**Striped Bass** could help feed a hungry world. But they are declining in the wild, and they are hard to breed in fish farms. Genetic research may overcome these difficulties. (Pages 8 – 9.)

**The Sea Sponge** has defense mechanisms that could someday help you reduce inflammations, fight bacterial and fungal infections, and perhaps cure cancer. (Pages 6 – 7.)

**Sharks** live in a microbe-infested world, so they secrete a steroid disinfectant that kills germs on contact. Some sharks contain a substance "squalamine" that cuts off the blood supply to tumors and is being tested for treating cancer.

**Crabs and Shrimp** have molecules with many uses in every day life and science. (Page 7.)

**Sea Turtles** are exposed to chemicals that may interfere with their egg development. These chemicals may harm mammals as well. (Pages 10 – 11.)

**The Squid's** nerve axons serve as a model system in neuroscience.

**Submersible Vessels** help us explore the deep and collect samples for further study. We can also learn about past climates and geological events on earth.

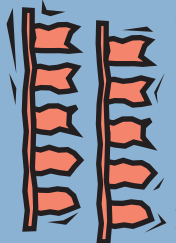
**Thermophiles** thrive near the volcanic heat of these deep-sea vents, and we might be able to use these unusual organisms for medicine and industry. (Pages 12 – 13.)

We use the proteins and enzymes as ingredients in everything from medicines to soap. Analyzing their chemistry teaches us about their roles in the organism's biology – and their potential benefits to us.



### DNA and Genes

DNA is the information molecule that tells each organism how to develop, giving each cell its special characteristics. DNA forms genes, which are sequences of codes that “spell out” the recipes for proteins. We can learn about a protein by analyzing its DNA sequence. In addition, we can study which genes become active in response to a threat from a predator, or a change in temperature and nutrients, or pollution. By tracking the molecular activity of marine organisms, scientists can study their interaction with the environment and gain insights into changes in global climate and pollution.



### Classification

We classify organisms to tell how they are related to each other. Scientists used to focus on how organisms looked. If they looked similar, they were probably related. Genetic comparison gives us more accurate classifications. It relies on the fact that all organisms share some common genes, such as a gene involved in

assembling proteins. Variations in that gene provide a yardstick for how closely organisms are related. This yardstick gives us a new panoramic view of the world's “family tree.” It also gives us a shortcut to identifying unstudied marine organisms and screening them for useful products.



### PCR (polymerase chain reaction)

Single fragments of DNA are too tiny to manipulate in the laboratory. They need to be *amplified* just as a stereo needs an amplifier to make a sound signal loud enough to hear. PCR is a way of making many exact copies or *clones* of a tiny section of DNA, which can be used for further research.



### Fermentation

Scientists can insert a gene that produces a valuable marine protein into the DNA of an easy-to-grow bacterium like *E. coli* or a yeast cell. These “workhorse” microorganisms then reproduce in fermentors and act like mini-factories, churning out the protein. Fermentation allows us to produce the valuable natural products even when we cannot grow the whole organism – or when we do not want to harvest proteins from a rare creature living in a fragile marine ecosystem.



### Antibodies

When a bacterium or virus invades your body, your immune system produces an antibody that latches onto that microbe to destroy it. Scientists use antibodies to “see” a hard-to-detect marine microbe: They tag the antibodies with special labels that identify the microbes when the antibodies lock onto their target.💧

Swim through this porthole to see how scientists use these techniques to stock the shelves of the ocean superstore on the next page!

