



The Eye-In-The-Sea Camera System

The deep sea makes up about 78% of the planet's inhabitable volume, but little is known about most of its inhabitants because of a lack of ocean exploration and study and less-than-ideal traditional research methods. The usual methods scientists use to learn about these strange creatures cause many problems. Nets are the most common sampling tool, but nets only capture the slow, the stupid, and the greedy. Deep-towed nets can shred animals such as jellyfish or damage captured animals to the point that their natural behaviors cannot be observed in the lab. Submersibles and Remote Operated Vehicles (ROVs) -- which are essential to deep sea research -- reveal much that nets miss, especially the vast numbers of fragile gelatinous organisms that nets destroy. But these vehicles use bright headlights and noisy thrusters that are likely to scare animals away or frighten them into unnatural behavior.

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Dr. Widder wanted to find a solution to these challenges. She dreamed of, then created, an innovative camera system to record life in the abyss. She called it Eye-in-the-Sea. The Eye is a battery powered video camera system designed to sit quietly on the bottom for 24 hours at a stretch. It uses red light that is invisible to the animals and a very sensitive camera that can see that dim red light as well as the dim blue bioluminescence that the animals produce. Also, it uses an innovative lure, an electronic jellyfish that imitates a bioluminescent scream for help and designed to attract large predators. "The very first time we used the e-jelly on an expedition in the Gulf of Mexico, we recorded the attack of a large (over 6 ft.) squid, I couldn't have asked for a better proof of concept. We are now developing a new version of the Eye-in-the-Sea that will be deployed on the first deep-sea cabled network in Monterey Canyon off the coast of California. Instead of the brief glimpses that the Eye now affords, we are about to create a window into the depths that will be open 24/7. It is my dream we will eventually have an Eye-in-the-Sea on every new cabled network installed in the ocean."



Map: Marie Tharp

Websites

- www.biolum.org/ Website developed by Edith Widder explains bioluminescence and has many pictures
- www.oceanexplorer.noaa.gov/explorations/04deepscope/background/eyeinsea/eyeinsea.html about eye in the sea
- www.yoto98.noaa.gov/kids.htm
- www.home.earthlink.net/~boytan/oceans/kids.htm
- www.epa.gov/owow/oceans/kids.html
- www.calacademy.org/research/library/biodiv/biblio/kidsocan.htm
- www.kathimitchell.com/ocean.htm
- www.nceas.ucsb.edu/nceas-web/kids/biomes/marine.htm
- www.atozkidsstuff.com/ocean.html
- www.oceanrecon.org

Books by Edith Widder

- The Bioluminescence Coloring Book
- Lucinda's Lamps: A Mermaid's Guide to Lights in the Sea

Film

- "Bioluminescence: Secret Lights in the Sea" by Edith Widder



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The Art of Exploration

EXTRAORDINARY EXPLORERS AND CREATORS INSPIRE US ALL TO REACH OUR OWN POTENTIAL



• bioluminescence • submersible • depth • robot • marine • remote operated vehicle • abyss • organism • reef • electron • orbit • photon • incandescent •

Dr. Edith Widder

Dr. Edith Widder is a scientist who studies creatures living at the very deepest depths of the ocean. The problems she faces are the water pressure and the lack of light and air. To study animals, biologists normally spend many hours watching them and recording what they do. It is impossible for Dr. Widder to spend so much time on the ocean floor, so she invented a robot called Eye-in-the-Sea that can watch for her. It records what is happening in places very difficult for us to go.

Dr. Widder's specialty is animals that can make their own light. This light is called bioluminescence. She has found that most marine animals can make their own light just as the fireflies do during a Texas evening. Exploring the deep ocean, Dr. Widder has made amazing discoveries about creatures few people have ever heard of, imagined, or seen.

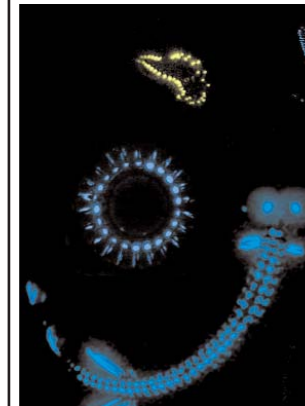


A New Frontier To Explore

More than 71% of our planet is covered by water, yet scientists and explorers have only explored about 5% of it. Why? Because exploring the ocean presents many challenges. Humans can't breathe underwater without carrying air either inside special submersibles (vehicles created for ocean exploration) or in SCUBA (tanks strapped to our backs). Movement in the ocean is different than moving on land. Not only are you floating in water, but also you are moving in three-dimensional space. Explorers move horizontally as we do on land and also move up and down through the different layers of water. Marine animals live in different layers or depths of water. For humans, the deeper we go the more difficult it is for us to protect ourselves from the crushing pressure of all that water pressing down on us. Also, the deeper we go towards the ocean floor, the less light there is until finally below 3,000 feet no light from the sun is visible.

BIOLUMINESCENCE --FROM GREEK "BIOS" FOR LIVING AND THE LATIN "LUMEN" FOR LIGHT

What Is Bioluminescence?



Bioluminescence is light. While most of the natural light we see comes from the sun, actually all light comes from the same process. When an electron absorbs energy, it moves to a higher orbit. When the electron falls back down to a lower energy state, a packet of energy, known as a photon, is released. Electrons can get energetically excited in a number of different ways. In the sun, a candle flame, or an incandescent light bulb, the electrons are thermally excited, which is why we tend to associate heat with light. In bioluminescence, the electrons are excited by a very efficient chemical reaction that generates virtually no heat. This is why bioluminescence is sometimes called "cold light."



• submersible • depth • robot • marine • remote operated vehicle • abyss • organism • reef • electron • orbit • photon • incandescent • thermal energy •

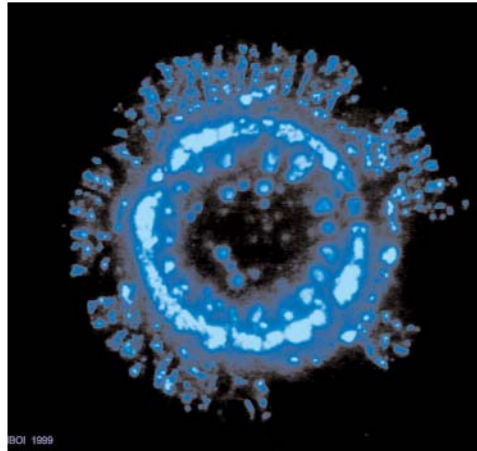
thermal energy • chemical energy • bacteria • chemiluminescence • SCUBA • camouflage • illumination • prey • predator • bioluminescence •

Meet Edith A. Widder

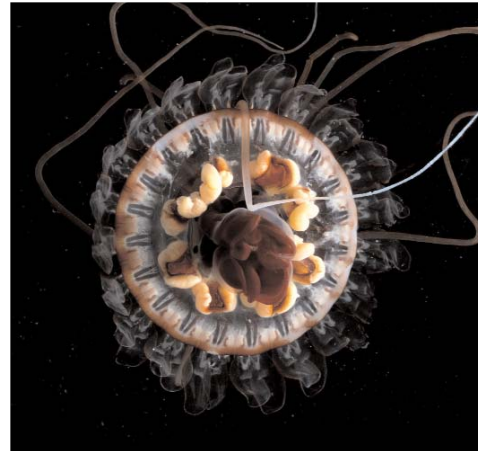


Edie Widder was born and raised in Arlington, Massachusetts. When she was 11, her parents took her on a family vacation to the South Pacific when she saw coral reefs for the first time, she then realized she wanted to study the oceans. She went to college at Tufts University and then to the University of California at Santa Barbara for her Ph. D. She has worked as a marine scientist in some of America's top research institutes, including Harbor Branch Oceanographic Institution, Bigelow Laboratory for Ocean Sciences, Johns Hopkins University, Monterey Bay Aquarium Research Institute, and the Marine Science Institute at UC Santa Barbara. She has recently co-founded a marine research institute her own research institute, Ocean Research & Conservation Association (ORCA). Her specialty is bioluminescence. She is a qualified pilot for the single person submersibles Wasp, Deep Rover, and Deep Worker, and she has been on 59 expeditions to the deep ocean making many important discoveries. In 1984, she made the first video recordings of bioluminescence in the ocean. She developed Eye-in-the-Sea, a deep-sea observatory designed to record bioluminescence behaviors. Dr. Widder has written many scientific articles and two children's books -- *The Bioluminescence Coloring Book* and *Lucinda's Lamps: A Mermaid's Guide to Lights in the Sea*. Her award winning film is *Bioluminescence: Secret Lights in the Sea*. She won the Wings WorldQuest 2006 Women of Discovery Sea Award.

What Creatures Bioluminesce?



While most animals that can make light (like squid, lanternfish, krill, decapod shrimp, jellyfish, and plankton) live in the oceans at all depths from the surface to the bottom, some land organisms (like fireflies, a fungus called firefox, New Zealand glow worms, insect larvae, earthworms, spiders, mushrooms, and bacteria) are able to make their own light.



Light Sticks - When you crack a light stick, you are creating chemiluminescence. Bioluminescence is a form of chemiluminescence where the chemicals are produced by living creatures.

Milky Sea - a large area of bioluminescent bacteria that causes the sea to glow. It is actually blue, but we see it as white. Astronauts and pilots can see this from space.

An Interview with Edith Widder

1. Your life today is focused on the deep sea and the creatures that live there. How did you as a girl from Massachusetts get there? Who and what led you to the ocean?

I always loved anything to do with studying animals and natural history, both above water and beneath the waves. My parents were wonderful about encouraging my interests and fostering a love of learning. They even remained enthusiastic when I decided I wanted to learn to SCUBA dive at age 14, a rather young age in those days. Much later, when I was in graduate school and began diving in single person submersibles, my father began to express concerns. However, by then it was way too late. I was hooked.

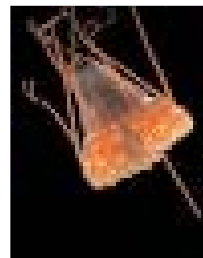
2. Tell us about your first dive alone into the deep sea. What was it about the creatures there that so fascinated you?

My first dive into the depths was in a deep diving suit called Wasp because that is what it looked like with its yellow body and bubble head. That suit was not a comfortable ride! It was sort of like being in a large, cold yo-yo as the tether attached to the surface ship yanked the suit up and down and the metal shell sucked body heat away into the numbing chill of the deep sea. But when I turned out the suit's headlights, the discomfort evaporated as I found myself surrounded by the greatest living light show on the planet. Bioluminescence is everywhere in the oceans, and it's something that must be seen to be believed. That light show changed the course of my career.



3. What are some of your discoveries?

My favorite discoveries are those related to finding new animals or new and unexpected behaviors in animals. A recent, very exciting discovery was made with the Eye-in-the-Sea. I developed a lure to use with it that imitates a certain bioluminescent jellyfish that I believed might attract large predators. The very first time we turned on that lure we recorded video of a very large squid, over 6 feet long, and so new to science that it can't be placed in any known family. Just imagine an animal that large, and we didn't even know it existed! How many other animals are there out there that we haven't seen because our methods of exploring the oceans scare them away?



4. Why do marine animals use bioluminescence? Do you think this is a form of communication, defense, or a feeding lure? Why is this important to understand?



Bioluminescence may be the most important form of communication in the ocean. To understand and protect our ocean planet, it's important that we understand its inhabitants' vocabulary. Animals use the light they produce to find

food using built-in flashlights or glowing lures. They have specialized light organs and species-specific flash patterns to attract mates. Most of all, they use light for defense. For some it is used for camouflage called counter illumination that allows them to hide in the open ocean where there are no hiding places. For others, their light serves as a scream for help to attract larger predators that may attack their attacker when they are caught in its jaws. Or it may be used for blinding and distraction as the prey releases a cloud of light-producing chemicals into the face of a predator. The importance of bioluminescence to survival in the open ocean explains why, when one drags a net from 1000 meters to the surface, typically 80-90% of the animals that are brought up in that net will be bioluminescent.



5. What advice do you have for future explorers?

To future explorers I say, "Don't let anyone tell you there's nothing left to explore. We have explored less than 5% of the world's ocean!" And to present explorers I say, "Share the excitement any way you can. People only protect what they love, and they only love what they understand." So I'm hoping we can teach people about all the amazing things there are to love in the ocean before it's too late.

