



# Marine Science Careers

Presented by the University of Delaware Sea Grant College Program ♦ [www.ocean.udel.edu/seagrant](http://www.ocean.udel.edu/seagrant)

by Dr. William Hall, Marine Education Specialist

**T**oday, several thousand marine scientists are busy at work in the United States dealing with a diversity of important issues — from climate change, declining fisheries, and eroding coastlines to the development of new drugs from marine resources and the invention of new technologies to explore the sea. Approximately 40% of these scientists are employed by state and federal governments, 30% by universities and colleges, and 30% by private industry.

What is the outlook for future marine science careers? There's a huge potential for growth in this field during the next few decades as we learn more about the global ocean and its interactions with the land and atmosphere, how humans affect the ocean, and the impact of ocean resources on our quality of life. Additionally, new opportunities in marine science are being created as the need for specialized technology to work in the demanding ocean environment increases.

Many people associate marine science only with marine biology, yet marine biology is far from being the only science associated with the ocean. Marine scientists or oceanographers can be physicists, chemists, geologists, engineers, computer scientists, and biologists who have applied their trade to the world's oceans. And like any trade, there is an apprenticeship that begins with a curiosity and perseverance to learn more about the nature of things around us, especially the vast ocean that covers more than 70% of the Earth.



For more information about Delaware Sea Grant's research and educational programs, contact the University of Delaware

Marine Public Education Office, 222 S. Chapel Street, Newark, DE 19716-3530. Phone: (302) 831-8083 ♦ E-mail: [MarineCom@udel.edu](mailto:MarineCom@udel.edu)

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Bob Bowden

*Aboard a research vessel in Delaware Bay, scientists from the University of Delaware and the U.S. Naval Academy prepare to deploy a satellite drifter to track patches of baby blue crabs. The team is building a mathematical model that resource managers can use to forecast the fishery's size from year to year.*

## Launching a Career in Marine Science

Although marine science is typically thought of as a graduate program, it is never too early to begin preparing for a marine career. Starting in high school, for example, you should take as many math and science courses, including computer science, as you can.

To gain useful experience, consider volunteering with state agencies or private organizations that work with marine or aquatic systems. You will get the opportunity to not only work and form relationships with marine science professionals, but also develop interests that you may wish to pursue in college.

Educational programs also are helpful for aspiring marine scientists. Organizations such as the National Audubon Society, Outward Bound, Sea Explorers (a co-ed branch of the Boy Scouts), and various



*In her lab at the University of Delaware, oceanographer Katharina Billups uses geochemical tools to reveal the history of the ocean, and our changing climate, that's buried in deep-sea sediments.*

universities and regional environmental centers may offer summer programs that can provide valuable marine experiences. And never pass up a chance to talk to people who are involved in marine science such as at a school career-day presentation or at a local aquarium or science museum.

When choosing a college or university, select a school based on the merits of its science and math curricula and not on whether there is an undergraduate program in marine science. Strong undergraduate programs provide students with the solid foundation needed to advance to graduate study.

As an undergraduate, you will major in physics, chemistry, biology, geology, or engineering and include course work in the other sciences. Undergraduate electives in marine science, if available, are helpful to focus your area of future interest. It is critical that you do well as an undergraduate. Your achievement serves as an important indicator to graduate schools and their faculty that you have the ability to take your knowledge to the next level and succeed in marine science.

When you are ready to apply to graduate school, it will be helpful if you have an idea of the particular area in marine science that you wish to specialize in. Choose a graduate school that has one or more faculty who conduct research in your area of interest. These faculty are as important as the school you choose because their guidance is critical to your career. In addition, one of these faculty members most likely will serve as your adviser while you are in graduate school. Look for someone whose interests match yours, whom you feel comfortable with, who has a good reputation among scientists, and a demonstrated ability to garner research funding and produce results.

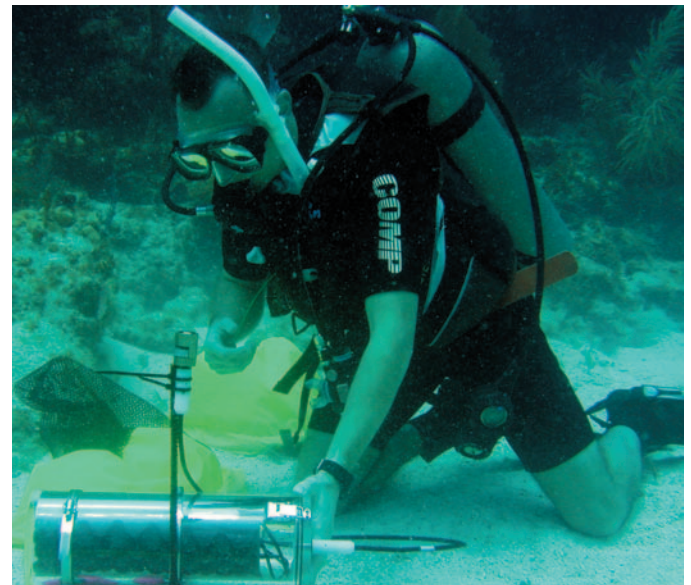
Your first goal in graduate school will be to obtain a solid foundation in marine science. But then you will shift from studying what others have already learned to finding out what no one else has yet learned. You will conduct experiments to gain new knowledge and write up your results in the form of research papers and a master's thesis or a doctoral dissertation depending on the degree you are seeking (so don't ignore your English classes!).

Most master's programs in marine science take two years of study, while the Ph.D. ranges from four to five years. Thus, you should be prepared to study for several years to achieve your goal of becoming a marine scientist.

## Specializations in Marine Science

Many graduate schools divide marine science into five major specialties: marine biology, marine chemistry, marine geology, physical oceanography, and ocean engineering. Although you'll specialize in one area, knowledge in one or more of the other areas is usually necessary because they are so highly interconnected.

**Marine Biologist.** Marine biologists study the plants and animals of our oceans, estuaries, and coasts, ranging from giant tubeworms that inhabit deep-sea hydrothermal vents to microscopic algae and bacteria that live in the surface layer of the sea. New marine species are discovered every year because so much of the ocean remains unexplored. Marine biologists want to know how these organisms work and how they interact with each other and their environment. The hottest area in marine biology right now is *molecular biology* — the study of the biochemical processes that take place inside living cells.



*In preparation for coral reef experiments, University of Delaware marine biologist Mark Warner sets up an underwater light meter and data logger on the sandy seafloor in the Florida Keys.*



Opportunities for marine biologists are as varied as life in the sea and also as specialized. This field also is the most competitive and the most difficult in which to secure a job. For example, only a handful of positions are available for those who want to study dolphins and whales. Don't let that stop you if it's your dream — just maintain a realistic view and a backup plan.

**Chemical Oceanographer.** The ocean can be visualized as a big test tube that contains many organic and inorganic compounds dissolved in water. These compounds may interact, be used by ocean life, precipitate to the bottom, or have any number of different fates. Assessing the fate of these compounds is the work of the chemical oceanographer.

Using the natural chemistry of the sea as a basis, these marine scientists also conduct research to understand how humans affect the chemistry of the environment, including climate change and pollution studies. Some marine chemists and biochemists search for natural products from the sea, marine drugs, or industrial applications. Opportunities for chemical oceanographers are good and probably will improve as we try to ascertain human impact on the ocean and as the search for natural products continues.

**Marine Geologist.** The bottom of the ocean — nearly three-quarters of the Earth — was once thought to be of little interest or value. But in the last few decades, we've begun to search the ocean floor for mineral wealth (oil, sand, gravel, metals, and, yes, even gold and diamonds), as well as for the information on the ocean's history and the Earth's changing shorelines that is preserved in the minerals' composition and structure.

Marine sedimentologists, paleontologists, and geophysicists can interpret sedimentary records to unravel the history of Earth's evolution and related changes in the global environment. Their work can provide valuable information on past climate changes and how global warming will affect sea level and coastal erosion. The career outlook in this field is good, particularly in the area of coastal studies.

**Physical Oceanographer.** Currents, waves, bay and coastal circulation, world climate, and the interaction between the atmosphere and the ocean all have one thing in common — they are studied by physical oceanographers. These scientists look at the physical properties and movement of the water in the sea and examine how they influence our environment. Some physical oceanographers take a global perspective, looking at the Earth as a whole, while others look at regional systems such as estuaries.

Often, the physical oceanographer is part of a team composed of other specialists including marine biologists or chemists. These scientists may work together on a project involving circulation and how it influences the distribution of certain species of fish or pollution of an estuary.



*Scientists at the University of Delaware have established the Delaware Bay Observing System, a network of sensors deployed from lighthouses, to collect sea and wind data on a continuous basis. This information will be used to improve weather forecasts, aid the shipping industry, and increase boater safety.*

**Ocean Engineer.** Whether it's solving beach erosion or designing an offshore drilling rig, ocean engineers face unique challenges. Their job is to find solutions that will enable humans to work or live in the marine environment. Marine structures and machinery encounter situations and environments not present on land. Corrosion, water pressure, storms, sedimentation, and a host of other variables challenge not only design, but also materials and construction.

A major research area is the development of instruments for gathering information from the sea, including underwater vehicles and sensors. In this regard, the work of the ocean engineer is invaluable to other marine scientists who depend on these methods of gathering the data they need. Some ocean engineers work with satellite systems that collect information about the oceans from the vantage point of space, a process called remote sensing. Others create models that predict the effects of wave action on the beach or devise ways of harnessing wave or tidal energy. Ocean engineers form a relatively new branch of marine science, but they will always be needed as long as there are problems to be solved in working in the ocean.

**Marine Policy Specialist.** Some graduate schools also offer degrees in marine policy, which is the study of how government decisions are made regarding the management and use of marine resources. Since good policies depend on accurate scientific information, marine science and marine policy intertwine. Marine scientists often are asked to make policy recommendations, and scientists employed with the federal government may advance to positions where they make national policy decisions. Policy study can add a new dimension to your work as a marine scientist or become a career choice in itself.

Marine policy specialists analyze public issues relating to the law of the sea, ports and shipping, marine minerals, ocean and coastal zone management, fisheries and aquaculture, naval affairs, marine biotechnology, ocean energy resources, and many other areas, frequently making recommendations for policy at the regional, national, and international level. Their job is to analyze the implications of development, conflicting uses, and interrelationships between physical processes such as sea-level rise and human activities.

### For More Information

*A career in marine science, marine policy, or a related field can be highly rewarding. The following resources can help you learn more about these fascinating careers.*

#### Books & Articles

Adams, S., T. I. Crago, and S. DeRosa. 2000. *Marine Science Careers: A Sea Grant Guide to Ocean Opportunities*. This 32-page booklet is available for \$5 from Sea Grant Communications, Kingman Farm, University of New Hampshire, Durham, NH 03824-3512 (please make checks payable to UNH).

Heitzmann, W. R. 2006. *Opportunities in Marine Science and Maritime Careers*. ISBN: 0844218383, McGraw-Hill Trade, \$14.95. A comprehensive book on marine careers including science, transportation, industry, technology, recreation, military service, and others.

*University Curricula in Oceanography and Related Fields*. This guide is available for \$6 from the Marine Technology Society, 5565 Sterrett Place, Suite 108, Columbia, MD 21044; 410-884-5330.

U.S. Dept. of Labor, Bureau of Labor Statistics. *Occupational Outlook Handbook*. Revised every two years, this document describes what workers do on the job,

Jonathan Lilley



*Marine policy specialists analyze legal, societal, and economic issues relating to humans and the sea. Willett Kempton, a professor at the University of Delaware, is examining the policy implications of offshore wind power and other alternative energy sources. He's shown visiting a land-based wind farm in Pennsylvania.*

working conditions, the training and education needed, earnings, and expected job prospects in a wide range of occupations. It's available in the reference department of most libraries and on-line at [www.bls.gov/oco](http://www.bls.gov/oco).

#### Web Sites

American Society of Limnology and Oceanography  
[aslo.org/career/aquaticcareer.html](http://aslo.org/career/aquaticcareer.html)

The Bridge: Sea Grant Ocean Sciences Education Center  
[www.marine-ed.org/bridge/career](http://www.marine-ed.org/bridge/career)

California Center for Ocean Sciences Education Excellence  
[oceancareers.com](http://oceancareers.com)

Gray's Reef National Marine Sanctuary (NOAA)  
[www.graysreef.nos.noaa.gov/student/careers.html](http://www.graysreef.nos.noaa.gov/student/careers.html)

OceanLink  
[oceanlink.island.net/career/career2.html](http://oceanlink.island.net/career/career2.html)

Scripps Institution of Oceanography  
[scilib.ucsd.edu/sio/guide/career.html](http://scilib.ucsd.edu/sio/guide/career.html)

Society for Marine Mammalogy  
[www.marinemammalogy.org/strat.htm](http://www.marinemammalogy.org/strat.htm)

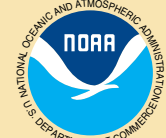
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[www.ocean.udel.edu/seagrant/education/careers.html](http://www.ocean.udel.edu/seagrant/education/careers.html)

U.S. Office of Naval Research  
[www.onr.navy.mil/careers/ocean\\_marine](http://www.onr.navy.mil/careers/ocean_marine)

Woods Hole Oceanographic Institution Sea Grant Program and New Hampshire Sea Grant Program  
[www.marinecareers.net](http://www.marinecareers.net)



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