



MAS NOTE

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MARINE CAREERS: The Scientist

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Like people who work at other Sea Grant Colleges and marine institutions, we receive many calls from people who want to find out more about careers related to the ocean. Some are interested in careers like commercial fishing or diving, but most callers want to know how to become marine scientists.

Many people associate marine science only with marine biology. However, marine science, or oceanography, includes many other exciting careers. There are several thousand marine scientists at work in the United States today. Approximately 40% are employed with state and federal government, 30% in universities and colleges, and 30% in private industry.

If you think you'd like to be a marine scientist, the following information should help you prepare for your future career. If you find out that marine science isn't for you, but you still want to work on or near the ocean, don't give up. There are dozens of rewarding careers related to the sea. Check out our video called "Marine Careers" and the other resources listed at the end of this note for information about work in other marine fields.

Launching a Career in Marine Science

Ocean careers are usually extensions of land careers, and oceanography is no exception. Remember, oceanography is a *science*. Marine scientists are physicists, chemists, biologists,

geologists, and engineers who specialize in the ocean. The marine scientist's job is to rigorously gather and analyze information about the ocean. Like all scientists, marine scientists need a lot of training and should possess a good supply of curiosity and perseverance.

Aspiring marine scientists should start preparing for their careers in junior and senior high school by taking math through calculus and whatever science courses are available, including computer science. It's also not too early to begin seeking experience in the marine environment. Programs offered by organizations such as the National Audubon Society, Outward Bound, universities, regional environmental centers, or Sea Explorers, a co-ed branch of the Boy Scouts, can provide many valuable experiences, often over the summer. If you live near an aquarium or seaside park, try volunteering in their education programs. Talk to people with scientific or marine-related careers whenever you can.

When choosing a college, high school students shouldn't be concerned with whether or not the institution has a program in oceanography. Most major marine science programs are taught only at the graduate level, so you can make that decision later. Select an undergraduate school based on the merits of its science and math programs. Graduate schools seek students with diverse backgrounds in math,

physics, chemistry, biology, geology, or engineering, so you'll want to major in one of these subjects and include coursework in the others. If you've been well-prepared in at least one of these areas, graduate schools know they can teach you marine science. It won't hurt, however, to choose electives related to the ocean whenever possible to help prepare for your graduate career.

Graduate schools are dynamic institutions whose natures depend heavily on the interests and abilities of the faculty who work there. If possible, visit the schools you're interested in and meet some of the faculty and students. You might ask questions like these: What courses are offered, and how will they help me pursue my research interests? What kind of jobs do the alumni of the program have? What kind of financial assistance is available? Most graduate students are supported through teaching or research assistantships or scholarships.

Your first goal in graduate school will be to gain a solid base of knowledge in marine science. But then you will shift from finding out what others have already learned about the ocean 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, a master's thesis, or a doctoral dissertation (so don't ignore your English classes!) You'll work closely with a single faculty advisor for two to five years, depending on the degree you're seeking. Choose your advisor with care since his or her guidance is critical to your career. Look for someone whose interests match yours, whom you feel comfortable with, who has a good reputation among other scientists and a demonstrated ability to garner research funding and produce results.

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. As a student, you'll be required to specialize in one of these areas, but they are highly interconnected, so knowledge in one or more of the other areas is usually necessary.

Marine Biologist. Marine biologists study the plants and animals of our estuaries, coasts, and oceans, ranging from giant marine worms that inhabit hot, deep-sea hydrothermal vents to microscopic algae and bacteria that inhabit the sea's surface layer. 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. Opportunities for marine biologists are as varied as the life in the sea, but also as specialized. This field is the most competitive of the marine sciences 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 whales and dolphins. Don't let that stop you from pursuing this field if it's your true dream. Just maintain a realistic view and a backup plan.

Marine Chemist. You might think of the ocean as a big test tube containing many organic and inorganic compounds dissolved in water. These compounds may interact, or be used by ocean life, or precipitate to the bottom, or have any number of different fates. Assessing their fate is the marine chemist's work. Ocean pollution offers new challenges to this profession. Other marine chemists and biochemists are searching for natural products from the ocean for food production, industrial applications, and the prevention and cure of diseases. Opportunities for marine chemists are good and probably will improve as the search for natural products continues and we try to ascertain our impact on the oceans.

Marine Geologist. The bottom of the ocean, 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 historical information 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. Recent concern about global warming and related sea-level rise and coastal erosion has benefited from the work of coastal and marine geologists. The outlook 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, like an estuary. As with many areas of the marine sciences, the physical oceanographer is sometimes part of a team composed of other specialists, such as marine biologists or chemists. These scientists may work together on a project involving circulation and how it influences the presence of certain species of fish or the pollution of an estuary. Physical oceanographers have the most enviable position of all marine scientists. This is where the most jobs and research money are available.

Ocean Engineer. Whether it's solving a beach erosion problem or designing an offshore drilling rig, ocean engineers face unique challenges. The engineer's job is to find solutions that will enable humans to work with or

live in the marine environment. Marine structures and machinery encounter situations and environments not present on land. Corrosion, water pressure, sedimentation, storms, and a host of other variables challenge not only design, but also materials and construction. One of the main concerns of ocean engineers 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 engineers work with satellite systems that gather information about the oceans from the vantage point of space, a process called remote sensing. Others work to 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 with the ocean.

Marine Policy Specialist. Some graduate schools also offer training in a related area—marine policy, or the study of how government decisions regarding the management and use of marine resources are made. Since good policies depend on accurate scientific information, marine science and marine policy intertwine. Marine scientists are often called upon to make policy recommendations, and those employed with the federal government may advance to levels where they make important national policy decisions. Policy study can therefore add an important dimension to your work as a marine scientist or could become a career choice in itself.

A career in marine science, a related field like marine policy, or one of the many other marine fields can be both challenging and satisfying. A list of resources that can help you learn more about these fascinating careers follows on the next page.

Sources of Marine Careers Information

Information Sheets and Packets

Careers in Marine Science. Available free from the National Aquarium in Baltimore, Dept. of Education and Interpretation, Pier 3, 501 East Pratt Street, Baltimore, MD 21202-3194. People who request information on marine careers from the aquarium usually receive this fact sheet and a packet of other materials, too.

Careers in Oceanography and Marine-Related Sciences. Available free from the Oceanography Society, 1124 Wivenhoe Way, Virginia Beach, VA 23454. This booklet, produced with help from the U.S. Navy, includes information for people with disabilities.

Marine Education. This bibliography of educational materials available from the nation's Sea Grant College Programs includes listings pertaining to a variety of marine careers. Single copies are available for \$2.00 from Sea Grant Marine Education Bibliography, Gulf Coast Research Laboratory, J.L. Scott Marine Education Center and Aquarium, P.O. Box 7000, Ocean Springs, MS 39564-7000; (601) 374-5550. Your local Sea Grant College Program is also a good source of information on university programs in marine science, summer internships, and educational opportunities. All 30 programs are listed in this publication.

Planning a Career in Fish and Wildlife Management. Available free from the New Jersey Dept. of Environmental Protection and Energy; Division of Fish, Game, and Wildlife; CN 400; Trenton, NJ 08625-0400; (609) 292-2965.

Training and Careers in Marine Science: An Information Packet. Available for \$5.00 from the International Oceanographic Foundation, 4600 Rickenbacker Causeway, Miami, FL 33149. Includes a recommended reading list and many sources for more information on science, engineering, and related careers.

Articles

Chase, Valerie. "I'll Do Anything to Work with Whales or Dolphins!" *Current* 11(1): 31-33. This article is one in a series by the same author

that has appeared in *Current* since 1991. Consult back issues of this journal for profiles of other marine careers.

Rosendahl, Bruce. "Becoming an Oceanographer." *Sea Frontiers* 36(May-June 1990): 3.

Books

Heitzman, William Ray. *Opportunities in Marine and Maritime Careers.* 2nd ed. Lincolnwood, IL: National Textbook Company, 1988. An excellent, comprehensive book on marine careers which offers extensive lists of contacts and resources. Includes careers in transportation, industry and technology, recreation, military service, science, and others.

U.S. Dept. of Labor. Bureau of Labor Statistics. *Occupational Outlook Handbook.* Washington, DC: GPO, 1992. This document is updated every two years and can be found in the reference department of most libraries.

The following two books may be ordered from the Marine Technology Society, 1828 L St., N.W., Suite 906, Washington, DC 20036; (202) 775-5966.

Burtis, William S. *Ocean Opportunities.* Washington, DC: Marine Technology Society, 1991. \$3.00.

University Curricula in Oceanography and Related Fields. Washington, DC: Marine Technology Society, 1991. \$5.00.

Audiovisuals

Marine Careers. VHS, 18 min. 1992. University of Delaware Sea Grant Marine Advisory Service. Available for purchase (\$15.00) or rental (\$5.00 plus \$25.00 refundable deposit). Send check payable to the "University of Delaware" with request to the Marine Communications Office, University of Delaware, Newark, DE 19716. Call (302) 831-8988 for more information.