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Oceanographers

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Occupational Subtitles:
- Biological Oceanographers

Work Classification Based Related D.O.T. Occupations:
- Geologists
- Geophysicists
- Hydrologists
- Petrologists
- Soils Engineers

Interests Based Related G.O.E. Occupations:
- Geographers
- Meteorologists
- Mineralogists
- Seismologists
- Stratigraphers

Skills Based Related O*NET Occupations:
- Atmospheric and Space Scientists
- Geological Data Technicians
- Marine Engineers
- Mining and Geological Engineers
- Petroleum Engineers

Noteworthy Quote:

"With over 70 percent of the Earth's surface covered by oceans, oceanographers have a large field site to study. The work requires dedicated scientists, but it allows them a lot of room to flourish. Above all, it is a fun and interesting way to earn a living."

–Jonathan T. Phinney, American Society of Limnology and Oceanography, Washington, D.C.

Oceanographers (ocean`og-raph-ers) use their knowledge of geology and geophysics, in addition to biology and chemistry, to study the world's oceans and coastal waters. They study the motion and circulation of the ocean waters and their physical and chemical properties, and how these properties affect coastal areas, climate, and weather.

The oceans, which cover slightly more than 70 percent of the surface of the earth, contain much of the major untapped resources of the planet. These resources are in increasingly short supply on the land. The diverse marine life supplies drugs, foods, and food additives. Vast amounts of oil and gas resources exist beneath the continental margins as well as beneath deep waters. The sea is also rich in mineral resources.

The protection and judicious use of these resources represent a growing concern. Yet only in the past few decades have people begun to chart the oceans, understand their influence on climate, and make better use of the ocean resources. Although the number of oceanographers is small, the work they do has wide-ranging effects on current issues, such as alternative fuels and supply sources, pollution, treatments for diseases, and global warming.

Work Performed

Oceanographers conduct scientific study to gain knowledge of the oceans. They study the physical, chemical, and biological makeup of the seas and the geological structure of the seabed. They analyze the waters, the atmosphere above them, the land beneath them, and the coastal borders. Most oceanographers work in one of the scientific specialties listed below.

Biological oceanographers (also called ***marine biologists***) study the organisms that live in the oceans. They may study distribution and abundance of plants and animals in the oceans and the ways they depend on each other and on their environment. They study the life cycles and migrations of fish and other marine organisms, and the habitats in which they live. They examine the cycling of nutrients through the marine food chain from algae to the largest fish species. Marine biologists investigate the physiological adaptations of marine organisms, how sharks behave, how fish communicate, and how some marine life lives in toxic, hot-water oases on the deep ocean floor. They also examine the effects of pollution on marine life.

Physical oceanographers study the circulation of seawater and the exchange of energy and matter across the surface of the ocean. These scientists study and map the tides, waves, currents, temperatures, salinity, density, ice formations, and sound propagation characteristics of the oceans. Physical oceanographers also measure deep currents such as those flowing from around Antarctica into the Pacific, Indian, and Atlantic oceans. They examine the interaction of ocean currents with the sediments on the ocean floor.

Geological oceanographers (also called ***marine geologists***) study the topographic features and the physical makeup of the ocean floor. They map underwater mountains, canyons, and valleys. The study of sediment cores taken from the ocean floor can reveal the history of oceanic circulation and climates over the past 150 million years. The study of the rocky crust beneath the sediments

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reveals information on the origin of volcanoes, and on the processes of sea floor spreading. The efforts of geological oceanographers are directed toward an understanding of the potential resources of oil, gas, and minerals in the oceans.

Chemical oceanographers (also called ***marine chemists***) study the chemical characteristics of ocean water and the sea floor, as well as the chemical interactions with the marine atmosphere. Chemical oceanographers study how the oceans were formed and what controls their composition today. They investigate ocean resources that may prove beneficial, such as products with medicinal promise. They advise on ways to help protect the oceans from global pollution from wastes.

Oceanographic engineers (sometimes called ***marine engineers***) design and build equipment and structures for both ocean research and commercial activities. They build remotely operated vehicles, ocean platforms, and complex sea floor instruments. They create systems for controlling sand on the beaches and sediments in waterways. They direct the installation of offshore structures, and they work on undersea projects such as the laying of cables, and the discovery of shipwrecks.

Oceanographers conduct their work from ships, aircraft and land-based labs using remote sensing equipment. They use drills, nets, dredges, samplers, acoustic devices, cameras, maps, and computers. Oceanographers may watch underwater activity on television. They may dive to great depths (two to three miles) in small submarines or use scuba gear to swim below the surface of ocean waters. Oceanographers also use satellites to measure things such as surface temperature and ocean color.

Oceanographers or their technical assistants use electronic instruments to take physical, geological, and chemical measurements. They lower instruments into the water to pick up samples of water, marine life, sediment, or rocks. They use cameras equipped with underwater lights. Echo sounders measure the distance to the ocean floor. Sonar devices measure the shape of the ocean floor, the thickness of sediment, and features beneath the sea floor. Corers pick up ocean floor samples in layers. Nisken bottles collect water samples at different depths. Heat-flow probes measure the flow of heat from the interior of the earth. Gravimeters measure the pull of gravity. Magnetometers measure magnetic variations.

Oceanographers sometimes fly in planes to observe the ocean surface, to follow the movements of schools of large fish or pods of marine mammals, and to gather facts on how the ocean and the weather interact. They gather data on sea levels, shorelines, and tides at the water edge and the continental shelf. They conduct coastal zone planning along the United States coastline to protect, preserve, and capitalize on the resources there.

Oceanographers in coastal zones use small boats and diving gear to study near-shore ecology, waves, and the transport of sediments, nutrients, and pollutants in the water. Some oceanographers and engineers use large tanks in test centers, like the David Taylor model basin near Washington, D.C., to acquire knowledge of waves and other ocean activity, and to test equipment.

Each cruise yields a huge mass of data to interpret. On shore oceanographers plan projects and record the details of tests conducted on cruises. They write reports and prepare scientific journals that add to the body of knowledge about the oceans.

Other oceanographers on land conduct experiments using models, or samples, or captive organisms in a seaside laboratory. They measure, photograph, and analyze marine animals. At other laboratories oceanographers make maps, prepare charts, and use computers to analyze large quantities of data and to test or to confirm ideas about the ocean.

Working Conditions

Some oceanographers are in the field for several months at a time on research vessels or at remote field stations. Others rarely leave the mainland and their home office. Those who work for colleges and universities often spend part of their time teaching in both classroom and laboratory settings, as well as in the field.

Oceanographers are required to do a lot of research in remote locations. Trips at sea are physically demanding. Most research ships are small. Oceanographers must adjust to rough seas, cramped quarters, and being away from home. Although oceanographers have a broad range of mechanical, electrical, and electronic gear, they often do heavy work. A few use scuba gear to dive and work underwater. Oceanographic ships on a long cruise often require in-port periods for a staff changeover about once a month.

Shore laboratories may be large, busy places. The staff at these facilities generally work indoors in a clean, comfortable setting. At times, oceanographers may conduct research in libraries or on college or university campuses. They also spend considerable time on computers, applying for research grants, analyzing and interpreting data, constructing theories and models based on experiments, and documenting their findings and conclusions.

Hours and Earnings

Oceanographers working in shore stations or who teach usually work forty hours a week. However, they work longer hours when conducting tests at sea because the daily costs of ship operations are very high. While researching at sea, work goes on around the clock.

Earnings vary with experience, education, responsibilities, industry, and employer. According to the Bureau of Labor Statistics, in 2002, the average income for oceanographers and related geoscientists was $78,690 a year. Listed earnings, however, ranged anywhere from

just under $36,000 a year to well over $133,000 a year. In the Federal Government the average salary for oceanographers in managerial, supervisory, and nonsupervisory positions was $79,023 a year in 2003.

According to the National Association of Colleges and Employers, beginning salary offers in 2003 for graduates with bachelor's degrees in geology and related sciences averaged about $32,828 a year. Graduates with a master's degree averaged starting salary offers of $47,981 a year, while those with a doctoral degree averaged $61,050 a year.

Education and Training

A bachelor's degree is the minimum requirement for entry-level jobs in oceanography. Graduate work in oceanography, however, is required for most jobs in research and teaching. A high academic standing in both high school and college is important. Oceanography is a competitive field, and only the best candidates are chosen.

The first two years of college should cover a broad program of basic sciences and mathematics. In the third and fourth years students may major in oceanography, biology, geology, chemistry, or physics. Courses often include physical, chemical and geological oceanography; marine geology; tectonics (plate movement); mineralogy; stratigraphy; cartography; geomorphology; hydrology; sedimentology; petrology; remote sensing; paleoecology; and structural and economic geology.

In preparing for graduate work in oceanography, students should take mathematics through differential and integral calculus, at least one year each of chemistry and physics, biology or geology, and enough of a modern foreign language to be able to read it well. The field of oceanography also relies heavily on computers, including supercomputers, networked workstations, parallel processors, and other configurations. Students should gain experience with computer modeling, data analysis and integration, digital mapping, remote sensing, and geographic information systems, including a knowledge of the Global Information System (GIS) and Global Positioning System (GPS)—a locator system that uses satellites.

Generally, at least two to four years of combined graduate courses and independent research in one of the sub-specialties are necessary to earn a master's or doctoral degree. Graduate students often spend some time aboard a research vessel. There they learn the techniques for gathering oceanographic data and conducting experiments.

Professional Societies

Oceanographers may belong to any of a number of professional and scientific organizations which promote oceanography and other marine and geological sciences. The American Society of Limnology and Oceanography, for example, works to promote research and education in the field of aquatic science and advance public awareness through its many products, services, and activities. It publishes several research journals, sponsors many interdisciplinary meetings and conferences, advocates for the field in government relations, and offers job and funding opportunity posting services. Other such organizations include the Marine Technology Society, the American Geophysical Union, and the Oceanography Society among others.

Personal Qualifications

Oceanographers, like most scientists, must have imagination, an inquiring mind, and logical thought processes. They should have the patience and the interest to collect data and carry out tests. They should be open-minded and objective in their observations. Those involved in fieldwork must also have physical stamina.

They must have excellent interpersonal skills because they often work as part of a team with other scientists, engineers, and technicians. They must express themselves well in speech and in writing in order to present their ideas and findings to others, both scientists and the public. Knowledge of a second language is also becoming increasingly important as more jobs require foreign travel.

Occupations can be adapted for workers with disabilities. Persons should contact their school or employment counselors, their state office of vocational rehabilitation, or their state department of labor to explore fully their individual needs and requirements as well as the requirements of the occupation.

Where Employed

Oceanography is a small field. There are only about 4,000 oceanographers. Most work in states that border the oceans. Almost half of all oceanographers work in California, Maryland, Florida, and Virginia.

About 40 percent of all oceanographers work for colleges and universities and scientific organizations. Some teach undergraduate work on campus. Others teach graduate studies and conduct research in cooperative extension facilities or scientific institutes such as the Woods Hole Oceanographic Institute or the Scripps Institution of Oceanography.

Another 40 percent work for the federal government. The largest employer in the federal government is the United States Navy in Meteorology and Oceanography Command. These oceanographers are employed mainly in determining the impact of the natural environment on navy systems and operations. Others in government work for the U.S. Coast Guard, the U.S. Fish and Wildlife Service, the Smithsonian Institution, the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, and the U.S. Department of Energy. The National Science Foundation also funds private and public oceanographic research.

Most of the remaining oceanographers work for industry. Oceanographers employed in private industry

work in oil exploration, construction, aquaculture, oceanographic instrument and equipment manufacturing, shipbuilding, marine surveying, and chemical fields. A small number are also engaged in independent consulting and writing.

Employment Outlook

According to the International Oceanographic Foundation, the long term employment outlook for all oceanographic occupations is very good. In fact, the Bureau of Labor Statistics expects employment for oceanographers to grow about as fast as the national average through the year 2012. The need to replace oceanographers who retire or advance will also result in many additional job openings over the next decade.

To this day, the ocean depths remain grossly uncharted, holding the vast majority of unexploited resources on earth. As resources become more and more scarce, humans are turning to the oceans for fuels, minerals, and food. As a result, there will be increased demand for oceanographers to uncover, locate, and extract these resources, as well as monitor the effects of this activity to preserve the viability of our oceans.

Oceanography graduates should have little trouble finding work as long as they are willing to move where the openings are. There is such a great overlap with marine sciences that oceanographers are equipped to enter almost any ocean-related field. Overall, opportunities will be best for those with a high academic standing, a degree in oceanography, and a background in a related science or engineering field. Qualified job seekers may find opportunities in government laboratories, in the academic community, and in industry. Only the best qualified are chosen.

Entry Methods

Graduates with a bachelor's degree can start as technicians in laboratories or research centers. They will do routine work such as collect data or do simple analyses. Those with a master's degree may begin working under the direction of more experienced scientists in environmental or research and development departments. Those with a doctoral degree may begin their career in basic research or in teaching.

Most colleges and universities have career services offices to help graduates find jobs. Membership in any of the professional and scientific associations may also lead to helpful contacts or job leads. Graduates may, for example, begin in pro bono work for one of the nonprofit environmental organizations. This kind of activity will give them the opportunity to network among those in the field. Information on applying for a job with the federal government may be obtained through the Office of Personnel Management.

Advancement

As oceanography expands, advancement will become easier. Those who can direct research and teach will advance the fastest. Experienced oceanographers may become administrators or supervisors in research labs. They may also direct surveys and research programs for government or military agencies.

For Further Research

American Society of Limnology and Oceanography, 5400 Bosque Boulevard, Suite 680, Waco, TX 76710-4446. Web site: www.aslo.org

National Sea Grant, 1315 East-West Highway, Silver Spring, MD 20910. Web site: www.marinecareers.net

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