PAPER

OceanCareers.com: Navigating Your Way to a Better Future

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ABSTRACT

The ocean attracts and inspires thousands of students every year to pursue degrees in science, engineering, and technology. Yet, in spite of all the attention paid to the oceans, students often lack the information needed to make wise decisions about choosing an ocean-related career. The Center for Ocean Science Education Excellence - California [1] (COSEE California) and the Marine Advanced Technology Education (MATE) Center[2] have responded to this problem by developing a user-friendly interactive Web site on ocean careers (www.OceanCareers.com).

Introduction

COSEE California and the MATE Center believe that one of the most valuable services we can offer is to provide students and workers with accurate and comprehensive information about ocean careers and employment opportunities so that individuals can make informed choices concerning their educational pathways and future careers.

It is estimated that over twenty percent of our national economy is based on ocean-related activities and that one in six jobs is ocean-related (Gore, 1998). Yet, in spite of all the attention paid to the oceans, individuals have a hard time making wise decisions about their career options and determining how to acquire the knowledge and skills needed to obtain fulfilling employment. There are a variety of reasons for this.

1. Current trends in research and industry are not well reflected in many educational programs.

In recent years, progress in ocean research has increasingly occurred at the intersections of traditional marine disciplines. Comprehensive large-scale studies in areas such as marine fisheries and El Niño have required multidisciplinary approaches with technology playing a key role, and projects such as the Integrated and Sustained Ocean Observing System depend heavily on technology (Ocean.US, 2005). Recent trends in technology in support of science include the increased use of remote sensing, computer processing power, microelectronics, and biotechnology, all of which are widely used in industry. However, this multidisciplinary, technology-based approach is not reflected in the majority of our educational programs (Martellor, 1995). The bottom line is that the evolution of educational programs tends to be much slower than trends in research and industry. Therefore, students who specialize in any one subject to the exclusion of others, or who do not have some level of technical knowledge and skills, may have a problem finding a job. The ability of the U.S. workforce to remain internationally competitive depends on the ability of U.S. workers to work efficiently in multidisciplinary and technology intensive settings.

2. Clear links are missing between educational programs, marine careers, and the marine economy.

In many schools and colleges, relatively little information is available to students about specific marine careers (especially those in industry), the knowledge and skills (KSs) they will need in order to be employable in those careers, and what programs are available to help them acquire those KSs. Almost all the currently available information on marine careers fails to comprehensively link careers to the KSs required to enter those careers, to the educational centers that help students develop

[1] COSEE California is funded by the Ocean Sciences Division of the National Science Foundation and COSEE CA partners include: MARE, at the Lawrence Hall of Science on the campus of the University of California at Berkeley; Scripps Institution of Oceanography, University of California San Diego; California Sea Grant; and the Marine Advanced Technology Education (MATE) Center at Monterey Peninsula College in Monterey, California. The goals of COSEE are to promote the development of effective partnerships between research scientists and educators; to disseminate effective ocean education programs and best practices; and to promote ocean education as a vehicle for creating a more scientifically literate workforce and citizenry.

[2] The MATE Center is funded by the National Science Foundation's (NSF) Advanced Technological Education (ATE) and has been in existence since 1997. The MATE Center is a national network of community colleges, high schools, universities, research institutions, marine industries, professional societies, and working professionals all working to improve marine technical education and in this way help to prepare the nation's future workforce for ocean-related occupations.

those KSs, and, lastly, to the employers who hire people with those skills. This means that most students do not receive adequate career advice in schools and colleges.

The amount and quality of career advice students receive from their advisors is low. Roughly half of the respondents to a survey of marine science graduate students stated they received no advice on careers during their graduate school experience. Of the other half, 50% did not consider the advice helpful (CORE, 1998). It has been noted many times that students should be more broadly prepared for diverse scientific careers (Austin and Kennedy, 2005; Benderly, 2005; Nerad and Cerny, 1999). Graduate students often feel that advisors focus on training students for academic careers, sometimes to the exclusion of other options (Smaglik, 2001). Part of the reason for this may be that many professors have spent little to no time in the private sector and are unfamiliar with opportunities outside of academia.

Undergraduate advice can vary widely. Many of the problems associated with graduate programs are common among undergraduate programs. However, in undergraduate programs that have strong ties to business and industry, such as two-year occupational programs, career advice tends to be better. Additionally, there is a growing number of multidisciplinary, applied science and technology, four-year degree programs. For example, California State University at Monterey Bay's Earth System Science and Policy Program has a strong watershed and marine focus that emphasizes technologies such as GIS, electronics, and seaflooring mapping within a multidisciplinary curriculum. Even some new graduate programs are becoming very application focused, such as Texas A&M's new Master of Geosciences Degree in Ocean Observing Systems.

3. There is a lack of readily available information about careers in non-academic marine science and technology positions.

The ocean economy is made up of many large and small companies that include such diverse activities as natural resource extraction (e.g., energy, fish, minerals), transportation, communications, national security, weather and climate forecasting, recreation, education, and research. However, our reviews of Web-based information on ocean careers show that over 90% of it focuses on marine science in academic and research settings. There is no comprehensive Web site providing detailed information about marine science and technology careers in the private and academic sectors, especially about the marine technology that is essential to research, government, and industry. (We define marine technology as the application of science and engineering knowledge, skills, tools, and techniques to the understanding and use of the marine environment). Furthermore, many people with an interest in pursuing a marine career are unaware of the marine related professional societies and the services they provide, such as scholarships, internships, and mentors, and other ways of learning more about marine professions (e.g., conferences, Web sites, and publications). The net result is that there is a significant gap in information concerning careers in major parts of the ocean economy.

4. Many ocean occupations are not classified by the Department of Labor.

The U.S. Department of Labor is responsible for keeping track of the approximately 10 million employers and over 100 million workers in the U.S. However very few Standard Industrial Classification (SIC) codes (used to describe industries) and Occupational Employment Statistics (OES) codes (used to describe occupational titles) are assigned strictly to marine activities. For example, it is hard to distinguish marine and coastal construction from on-land construction. Because of this, many marine occupations are not classified and are essentially hidden from most students, educators, and counselors, and do not show up in standard queries of career opportunity databases. This lack of standardized recognition of marine occupations, especially technology-based occupations, hinders students in their efforts to learn about career opportunities, industry in its efforts to recruit employees, and educational programs in their efforts to get recognized by students and employers. These problems also make it difficult to describe, monitor, and assess the marine economy and its workforce.

For example, searches for marine-related occupations using college career databases typically produce the following results: marine biologist, marine engineer, first mate, sea captain, and ship architect. Many marine positions, such as ROV technician, marine technician, aquarist and hydrographic survey technician do not appear. This means that many careers that support both science and industry (e.g., oil and gas exploration and extraction, telecommunications, transportation) are not easily identified or tracked. And, contrary to what many might think, these careers often pay very well, with many in industry paying much more than corresponding careers in research-oriented science.

5. Problems with career guidance lead to inappropriate career choices.

A recent study revealed that typical workers change their career course three times throughout their working life (Christiano, 2005). The career choices made at a younger age may not reflect one's interests later on. To prepare for their next occupation, many people return to college. Increasingly, community colleges are seeing more and more students with Bachelors degrees returning to college. In the past, many people with Bachelors degrees went to graduate school to improve their career prospects. Now, more and more, they are going to community colleges to get the technical KSs they need to increase their employability in their current careers or to pursue new careers. In this way, community colleges are becoming America's new form of graduate school (Arnone, 2001). A good example of this is provided by Monterey Peninsula College (MPC) in Monterey, California. In MPC's Geographical Information Systems (GIS) courses, 60-80% of the students have Bachelors degrees or higher. In addition, the average student in MPC's marine science and technology program is over 30 years old. Many report that they always had wanted to enter the marine field but

were discouraged by teachers, counselors, and parents, and a perceived lack of well-paid professional-level job opportunities. These students, after ten to twenty years of not being fulfilled in their employment, have returned to school to follow their marine-related passions. They come from all walks of life: teachers, factory workers, bartenders, military personnel; we even had a physician. Many of these sorts of career changes could be avoided with better career guidance at an earlier stage in life.

OceanCareers.Com

To correct the problem of inadequate information concerning ocean occupations, COSEE California and the MATE Center have developed an interactive ocean career Web site that helps users find answers to questions such as:

- What careers allow me to work in and around the ocean?
- What knowledge and skills will I need to enter those careers?
- Who might hire me if I have those knowledge and skills?
- Where can I go to get those knowledge and skills?
- What professional societies can provide more information and guidance for the career I'm interested in pursuing?

This user-friendly interactive Web site on ocean careers describes: 1) the knowledge and skills needed to work in ocean-related careers; 2) the educational institutions that help students prepare for these careers; 3) the employers who offer employment in these careers, and 4) professional societies that support these careers.

OceanCareers.com is composed of five databases.

Database 1: Educational Institutions and Training Centers

This database describes over 300 ocean educational and training institutions, and the number continues to grow. The database contains information on each educational institution's location, contact information, degrees offered (type and level), and a link to each Web site. This database will ultimately include an institutional profile and a list of ocean-related courses for each institution.

Database 2: Ocean Careers/Occupations

This database contains a list of more than sixty ocean careers and occupations. Each occupation that is classified by the Department of Labor (DOL) references the Bureau of Labor Statistics Occupational Handbook and other government occupational listings. Ocean occupations not classified by the DOL are defined, described, and profiled in a format similar to that used by the DOL to provide a seamless listing of all relevant occupations. For instance, the MATE Center has developed knowledge and skill guidelines for the following four occupations that are not recognized by the DOL: marine technician, ROV technician, hydrographic survey technician, and aquarists. These guidelines help describe an occupation by clearly outlining what it takes to be hired and to advance within the occupation; many have profiles and interviews with people who work in those occupations. Other organizations have also developed occupation-specific guidelines that have been added to the database. One of the most unique and important aspects of this database is the link it provides between the occupations and the main, or core, knowledge and skill areas for the occupation. Examples of knowledge and skill areas are: computer systems, electronics, fluid dynamics, GIS, hydraulic equipment, safety and seamanship, small boat operations, hydrographic surveying, and technical writing (for more information, see the description of Database 4, below). The MATE Center has identified these core areas for most marine occupations. This identification requires the involvement of a wide range of individuals working in each field and their consensus on the core areas for each occupation.

Database 3: Ocean Employers

This database lists marine employers with their contact information, Web site links, and their line, or type, of business. Careers are referenced to the appropriate line of business. Currently, we have close to 10,000 employers in this database.

Database 4: Core Knowledge and Skill Areas

This database contains a list of core knowledge and skill areas with corresponding competencies. The competencies give more detailed descriptions of what people must be able to do in order to become qualified in a specific core area for a specific occupation. The MATE Center has developed competencies for twenty-four knowledge and skill areas that are currently on line (see: http://marinetech.org/marineworkforce/pdf/educational_comps.pdf). These competencies were developed and validated with a wide range of educators, workers, and employers. To date, these knowledge and skill areas include: chemistry, computer systems, data processing, electronics, fluid dynamics, GIS, hydraulic equipment, instrumentation, machining and fabrication, mathematics and statistics, meteorology, navigation, oceanography, physics, propulsion systems, safety and seamanship, small boat operations, submersible technology, hydrographic surveying, teamwork and interpersonal relations, and technical writing. Sullivan et. al. (2001) provides additional information about the competencies and especially their role in developing marine educational programs.

Database 5: Professional Societies

This database contains over 200 professional societies that represent occupations in support of the ocean economy.

The following section provides examples of the types of information that can be found at the OceanCareer.com Web site. These examples are for marine technicians who work aboard research vessels. The examples illustrates a key feature of the OceanCareers site—its integrated perspective on careers, in which knowledge and skills, competencies, educational institutions, employers, and professional societies are all linked together to provide comprehensive views of each occupation from both educational and workforce perspectives.

Career

Marine Technicians
who work aboard research vessels

Job Description

Individuals who apply basic seamanship, science, computing, and engineering skills to the marine environment – including the open ocean, coastal regions, estuaries, rivers, swamps, and lakes. They may work aboard ships or other vessels, directly underwater (e.g., diving, in submarines), remotely underwater (e.g., ROVs), in a marine laboratory or onshore support facility, or in many other marine and coastal settings.

Examples of Job Duties

- Coordinate pre- and post-cruise logistics, including installation and removal of equipment required for individual cruises.
- Collect data while underway. Collect and monitor data from various oceanographic, geophysical, meteorological, biological, and geochemical sensors.
- Maintain and manage computers and computer networks.
- Direct deck operations, such as launching and retrieving equipment.
- Inventory equipment and order replacement supplies required for individual cruises.
- Store and properly handle hazardous materials.
- Operate small boats.
- Complete post-cruise data analyses and write post-cruise reports.
- Facilitate interactions between scientists and ship's crew.

Core Knowledge and Skill Areas

- Chemistry
- Small Boat Operations
- Safety and Seamanship
- Physics
- Computer Systems
- Oceanography
- Meteorology
- Marine Biology
- Electronics
- Mathematics and Statistics

(abridged)

Basic Knowledge and Skills for Safety and Seamanship

- Demonstrate personal at-sea emergency procedures, including operation of personal safety and survival equipment.
- Participate in basic vessel familiarization and safety drills (e.g., crew member overboard, collision, and fire emergency procedures).
- Perform first aid, CPR, and other basic emergency medical procedures.
- Demonstrate basic vessel fire prevention and fire fighting techniques.
- Identify critical environmental factors affecting ship operations.

Example of a Career Profile

Steven Hartz is the senior marine technician for the Alpha Helix, a multi-disciplinary oceanographic research vessel owned by the National Science Foundation and operated by the University of Alaska's Seward Marine Center in Seward, Alaska. As the ship's senior marine technician, Hartz acts as the liaison between ship personnel and the science teams who hire the vessel. He works with the scientific team prior to, during, and after a cruise to ensure that the Alpha Helix meets all the team's needs. Hartz's duties are extremely wide-ranging. He operates and maintains all the ship's research equipment and must see that a visiting science team's equipment can interface with his, if needed. Additionally, his responsibilities include keeping abreast of advancements in scientific equipment to maintain the ship as a viable research platform, handling chemicals that may be difficult to ship, and collecting samples for the science teams. [See the rest of the profile at the OceanCareers.com Web site.]

FIGURE 1

Student intern aboard a research vessel prepares an oceanographic instrument for deployment.

Examples of Educational Institutions Offering Marine Technology Related Programs

To date, 27 institutions listed in the database offer some type of program related to Marine Technology. Here are the six closest matches.

- Alvin Community College—AS Marine Robotics Technology
- Cape Fear Community College—AAS Marine Technology
- California Maritime Academy—BS Marine Engineering Technology
- Kingsborough Community College—AS Maritime Technology
- Monterey Peninsula College—AS Marine Science and Technology
- Santa Barbara City College—AS Marine Diving Technology

Examples of Professional Societies Related to Marine Technology

- American Academy of Underwater Sciences (AAUS)
- Association of Diving Contractors (ADC)
- American Geophysical Union (AGU) Ocean Sciences
- American Society of Limnology and Oceanography (ASLO)
- Consortium for Oceanographic Research and Education (CORE)
- IEEE Oceanographic Engineering Society
- Marine Technology Society (MTS)
- National Marine Electronics Association (NMEA)
- National Association of Marine Laboratories (NAML)
- Society of Naval Architects and Marine Engineers (SNAME)
- The Hydrographic Society of America (THSOA)
- The Oceanography Society

Example of a Marine Technology-Related Employer Profile

Oceaneering International provides engineering services and hardware to customers who operate in marine, space, and other harsh environments. Customers come from the oil and gas, telecommunications, aerospace, and marine engineering and construction industries, as well as government agencies. Founded in 1964, Oceaneering has grown from an air and mixed gas diving business in the Gulf of Mexico to a diversified organization operating around the world. Today its activities involve ROVs, mobile offshore production systems, built-to-order specialty hardware, engineering and project management, subsea intervention and installation services, non-destructive testing and inspections, and manned diving. The company has been involved in many high-profile projects, from recovery efforts for TWA Flight 800 and the space shuttle Challenger, to Universal Studios attractions, such as the Jaws and Jurassic Park rides. (See the rest of the profile at the OceanCareers.com Web site.)

Conclusion

The OceanCareers Web site helps users identify the connections between marine careers and the knowledge and skills required to enter these careers. We anticipate that the comprehensive and interactive nature of the Web site will help facilitate much needed reforms in the way we prepare people for employment in the nation's marine workforce. Students who have access to complete and accurate information will be more empowered to take control of their education and make wise choices about the courses and programs they choose. Educational institutions can use the site to improve their programs of study by more closely linking the education and training they provide to the knowledge and skills needed for specific marine careers. Employers can use the site to provide information about specific jobs, and to improve their employee recruitment and professional development programs. Our hope is that, through this Web site, we will help make the educational system more efficient and responsive to workforce needs. For more information please go to www.OceanCareers.Com.

Oceancareers.com is a new site that is undergoing rigorous testing, and adjustments will continue to be made to the site to optimize its utility. Still, OceanCareers.com is enjoying substantial increases in unique visits each month. Over the past year, unique visits have more than quadrupled from 2950 in December of 2004 to over 13,000 in November of 2005[3]. A unique visit is defined as a visitor that views six or more pages before departing the site. Please stay tuned and watch for more exciting changes and developments to the site.

Related Web sites and Publications

A number of tremendous efforts have been undertaken to identify and define marine careers. OceanCareers.com is working to build upon many of these efforts, rather than duplicate them. These efforts include:

- Sea Grant's *Marinecareers.net* http://marinecareers.net/
- Marine Technology Society's 1995 publication *Education and Training Programs in Oceanography and Related Fields*
- The Oceanography Society's 1995 publication *Careers in Oceanography and Marine-Related Fields*
- *Marine Science Careers: A Sea Grant Guide to Ocean Opportunities*. Adams, S., Crago, T.I., and DeRosa, S. 2000, 32 pp. University of New Hampshire Press.
- *Opportunities in Marine and Maritime Careers*. Heitzmann, W.R., 1999, 142 pp.

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[3] If we count "hits," this number is nearly 498,000 for the month of November 2005.

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