

PREPARING FOR A CAREER IN Oceanography



SCRIPPS INSTITUTE OF
OCEANOGRAPHY

UC San Diego

The future of oceanography will require that our nation's brightest minds apply themselves to issues of global concern, the environment, climate change, biodiversity, and sustainable resources.

Scripps Institution of Oceanography at UC San Diego leads the world in basic ocean and earth science research and in the education of the next generation of oceanographers.

As a research and teaching institution, Scripps is engaged in oceanography on a worldwide basis. The multidisciplinary nature of global oceanography makes it one of the most exciting science careers imaginable. In addition, the ocean provides aspects of intrigue and mystery in almost every scientific field.



History

For more than a century...

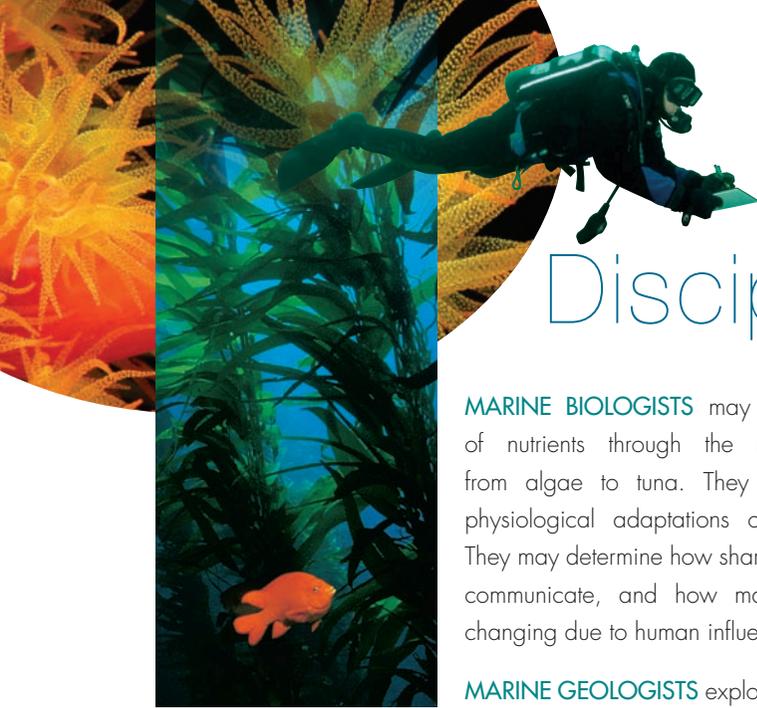
Scripps Institution of Oceanography has conducted a continuous search throughout the global ocean and in the laboratory for knowledge about the environment. A part of UC San Diego, Scripps is one of the oldest, largest, and most important centers for ocean and earth science, education, and public service in the world.

An independent biological research laboratory when it was founded in 1903, Scripps became a part of the University of California in 1912, and was renamed in recognition of the support of E.W. Scripps and his sister Ellen Browning Scripps.

The scientific scope of the institution has grown to include physical, chemical, geological, climate, and geophysical studies of the ocean, as well as biological research. Hundreds of research programs are under way today in a wide range of scientific areas, including studies of global warming and long-term climate change, the marine food chain, earthquake studies, drugs from the sea, and coastal ocean processes. Scripps maintains a staff of about 1,300 and the annual budget is more than \$160 million, from federal, state, and private resources.

The future site of Scripps in 1905.





Disciplines

MARINE BIOLOGISTS may examine the cycling of nutrients through the marine food chain, from algae to tuna. They may investigate the physiological adaptations of marine organisms. They may determine how sharks behave, how fishes communicate, and how marine ecosystems are changing due to human influence.

MARINE GEOLOGISTS explore the ocean floor – its mountains, canyons, and valleys. Study of seafloor sediment cores can reveal the history of oceanic circulation and climates over the past 150 million years. The study of the rocky crust beneath the sediments sheds light on the origin of volcanoes, as well as the processes of seafloor spreading and continental drift.

GEOPHYSICISTS ask such questions as why the earth’s magnetic field has reversed itself at least three times in the last million years. These scientists are beginning to understand what causes earthquakes and can now measure them with great accuracy. They also search places where heat escapes from the crust of the earth for clues to fundamental processes deep in the planet’s interior.

MARINE CHEMISTS study how the oceans were formed eons ago, and what determines their composition today. They identify ocean resources that may be beneficial, such as natural products with medicinal properties, and investigate means to protect the oceans from the effects of pollution.

PHYSICAL OCEANOGRAPHERS study the circulation of seawater and the exchange of energy and matter across the surface of the ocean. They examine the transport of sand on and off beaches and the processes of coastal erosion. Physical oceanographers also measure deep currents such as those flowing from Antarctic waters into the Pacific Ocean.



ATMOSPHERIC SCIENTISTS AND CLIMATE RESEARCHERS investigate how the relationship among the ocean, atmosphere, and land affects the world's climate systems. They seek to forecast climate trends through the use of increasingly sophisticated computer models. They also study the buildup of pollutants and greenhouse gases in the atmosphere and how they affect clouds, precipitation, and the potential for climate change.

BIOLOGICAL OCEANOGRAPHERS are concerned with the complex interactions of groups of marine organisms with one another and their environment. They seek to understand how factors such as warm and cold currents affect the availability of food fishes.

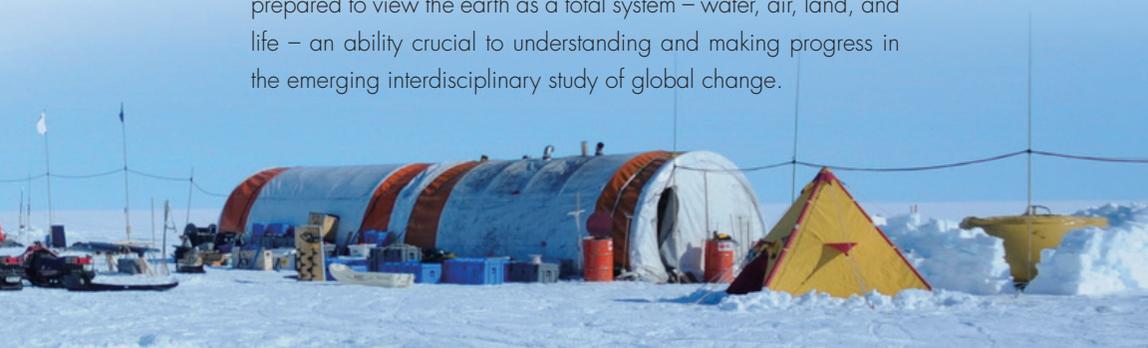
MARINE PHYSICISTS develop the means to interact with the oceans. They design and build many specialized research tools, including remotely operated vehicles, sophisticated seafloor instruments, and innovative remote-sensing systems such as acoustic-imaging devices for exploring the oceans. They also develop mechanisms for controlling sand on beaches.

AN INTERDISCIPLINARY APPROACH

It's easy to understand why, at Scripps, a student is considered first a physicist, a chemist, a biologist, a geologist, a mathematician, or a geophysicist who then applies his or her special skills to studying how the global ocean, atmosphere, and Earth really work.

During their course work at Scripps, students come to realize that working with other students and with the faculty on an interdisciplinary basis is essential because knowledge of one area is necessary to the solution of problems in another. At Scripps, a balance is sought between developing individual competence and an ability to understand and interact with those having other areas of specialization.

Equipped with their own special backgrounds to supplement their knowledge of the broad field of oceanography as a whole, scientists can help give a historical, economic, and practical view of how the ocean, atmosphere, and Earth affect mankind and how mankind affects the ocean, atmosphere, and Earth. They are also prepared to view the earth as a total system – water, air, land, and life – an ability crucial to understanding and making progress in the emerging interdisciplinary study of global change.



Preparation

HIGH SCHOOL STUDENTS

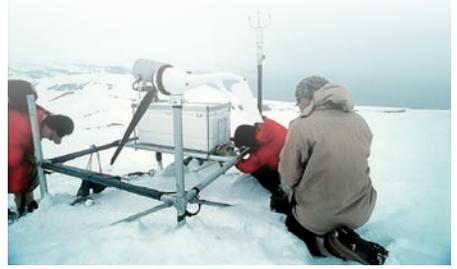
Because it merges many disciplines, oceanography requires a greater breadth of knowledge than most sciences. To satisfy eligibility requirements for graduate study at Scripps, a high school student should plan his or her college undergraduate curriculum to provide a solid foundation in science and mathematics. At the same time, high school students should become familiar with admission requirements at accredited colleges and universities. Eligibility at UCSD is covered in a free brochure entitled "Introducing the University" available from

Office of Admissions

UC San Diego
9500 Gilman Dr., Dept. 0021
La Jolla, CA 92093-0021

COLLEGE UNDERGRADUATES

Two general choices are open to undergraduates interested in ocean and earth science. They may plan a curriculum aimed at becoming an oceanographic technician with a bachelor's degree, or they may work toward admission to a graduate school such as Scripps and an advanced degree. In the latter case, lower-division courses should be taken in physics, chemistry, biology, geology, and mathematics, augmented by a strong major in any one of the sciences.



Undergraduate work in the marine sciences or general oceanography is possible at a few schools, including UC San Diego. Most graduate schools recommend, however, undergraduate preparation in basic science without specialization in oceanography.

UCSD offers a B.S. degree and a contiguous B.S./M.S. degree in earth sciences and an academic minor in marine sciences. The minor in marine sciences is designed to complement the strong disciplinary training of UCSD basic natural science and engineering majors by providing a broad interdisciplinary perspective with an applied environmental focus.

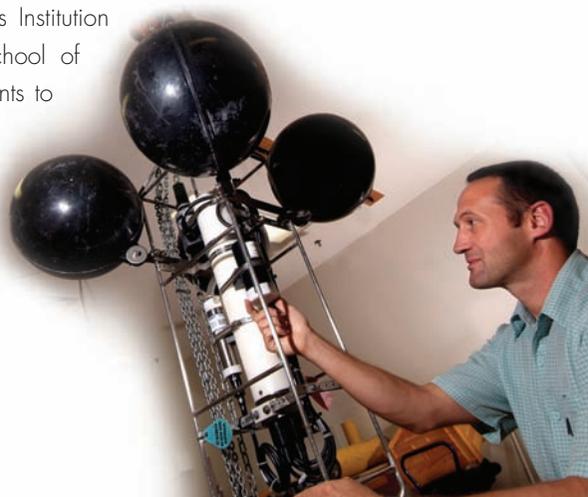
UNDERGRADUATE PREPARATION FOR OCEANOGRAPHY

Scripps Institution of Oceanography offers a Master of Advanced Studies in marine biodiversity and conservation. It is a full-time, 12-month program that is a fully accredited master's degree. It starts each summer and continues through mid-June of the following year.

Scripps provides graduate instruction leading to a Ph.D. in oceanography, marine biology, or earth sciences. Students therefore enter a doctoral program. Candidates for admission to this program must have an outstanding grade point average and a bachelor's or master's degree in one of the physical, biological, or earth sciences, with a degree in mathematics or engineering science acceptable in some cases.

In addition to meeting the requirements of the selected major, basic undergraduate work should include the following subjects: mathematics, through integral and differential calculus; at least one year of physics with lab, using calculus in its exposition; at least one year of chemistry with lab; and one additional year of physics, chemistry, or mathematics. Applicants are required to submit scores on the aptitude tests of the Graduate Record Examination (GRE) given by the Educational Testing Service of Princeton, New Jersey. Applicants planning to pursue marine biology also are required to take the advanced biology test of GRE.

A collaboration between Scripps Institution of Oceanography and the Rady School of Management at UCSD enables students to pursue a Ph.D. at Scripps and an MBA at Rady in a coordinated, concurrent program. The program was developed for students interested in careers where the combination of scientific expertise and management knowledge is particularly important.





STUDENTS AT SCRIPPS TYPICALLY CONCENTRATE ON ONE OF SEVERAL CURRICULAR PROGRAMS WITHIN THE INSTITUTION. EIGHT CURRICULA ARE OFFERED AND HAVE RECOMMENDED UNDERGRADUATE PREPARATIONS.

APPLIED OCEAN SCIENCES is a multidisciplinary program focused on the application of advanced technology to ocean exploration and observation. The emphasis is on the resolution of key scientific issues through novel technological development. Instruction and research focus on mechanical, electrical, and physiological problems operating within the ocean, and upon applied marine environmental science.

PREPARATION: Strong background in physical science, engineering science, or mathematics. Three years of physics or applicable engineering and three years of college-level mathematics.

BIOLOGICAL OCEANOGRAPHY focuses on the interactions of populations of marine organisms with one another and with their physical and chemical environment. This is an interdisciplinary program of study, including physical oceanography, marine chemistry, and marine geology, in addition to biology.

PREPARATION: Two years of chemistry, including general and organic. One course in geology and one year in either general biology, zoology, or botany. One course in each of the following disciplines: systematics (e.g., invertebrate zoology), population biology (e.g., ecology), functional biology (e.g., physiology).

CLIMATE SCIENCES concerns the study of climate systems with emphasis on the physical, dynamical, and chemical interactions of the atmosphere, ocean, land, ice, and terrestrial and marine biospheres. Researchers study changes on seasonal to interannual time scales and those induced by human activities, as well as paleoclimatic changes on time scales from centuries to millions of years. Graduates understand the climate system as a whole, crossing boundaries of traditional Earth science disciplines.

PREPARATION: A major in physics, chemistry, or other physical science is preferred. Geology or biology majors should also have a strong background in mathematics and physical science.

GEOCHEMISTRY AND MARINE CHEMISTRY concentrate on the chemical processes operating within the marine environment – the oceans, atmosphere, and seafloor. Studies are typically interdisciplinary and involve integration of chemical concepts with information about physical, biological, or geological processes that influence natural systems.

PREPARATION: A major in chemistry, geology, biochemistry, or related field.

GEOLOGICAL SCIENCES emphasizes the application of general principles of geology, geochemistry, and geophysics to problems in marine and terrestrial environments.

PREPARATION: A major in one of the earth sciences and undergraduate physical chemistry and calculus are required. Preparation beyond the minimum mathematics, physics, and chemistry requirements is strongly recommended.



GEOPHYSICS emphasizes the application of general principles of mathematics and experimental physics to fundamental problems of the oceans, oceanic and continental lithosphere, and crust and deep interior of the earth.

PREPARATION: A major in physics, mathematics, earth sciences, or equivalent training.

MARINE BIOLOGY is the study of marine organisms, their development and adaptations, as well as physiological and biochemical processes, genetic relationships, and ecology. Several prominent areas of modern biology are encompassed and interpreted through an understanding of the physical and chemical dynamics of the oceans.

PREPARATION: A major in one of the biological sciences with basic course work in botany, microbiology, or zoology; two years of chemistry, including organic, with biochemistry and physical chemistry. Also recommended is knowledge of several of the following: cellular biology, molecular biology, comparative physiology, genetics, developmental biology, ecology, comparative anatomy, vertebrate and invertebrate zoology, microbiology, and/or botany.

PHYSICAL OCEANOGRAPHY deals with the mechanisms of energy transfer through the ocean and across its boundaries, and with the physical interactions of the ocean with its surroundings, especially the influence of the seas on atmospheric phenomena.

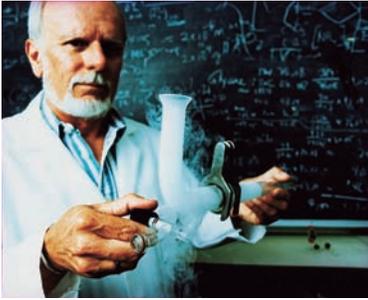
PREPARATION: A major in a physical science, including three years of physics and mathematics.

Graduate Students

At Scripps, students combine graduate courses with independent research. There are departmental and qualifying examinations. Generally, students spend at least four years of full-time graduate study for the Ph.D. degree. All international applicants whose native language is not English and whose undergraduate education was conducted in a language other than English must take the TOEFL and submit their test scores to the UCSD Office of Graduate Admissions.

About 240 graduate students are currently enrolled at Scripps. These men and women come from diverse backgrounds, and from all parts of the United States and the world. One thing they all have in common is a very strong motivation to learn science.





ADDITIONAL INFORMATION

Admission to Scripps does not depend upon undergraduate attendance at any University of California campus, nor does attendance at UC San Diego result in special advantages when applying to Scripps. In selecting an undergraduate college, the applicant should make certain that it is accredited, that it offers the required courses, and that it provides an atmosphere in which students can work well.

It is not necessary that undergraduate work include marine sciences for a student to be considered for admission to Scripps. In fact, such work should not be undertaken if it detracts from study in the basic sciences. Scripps admits an average of 15 percent of those who apply for entrance.

PLACEMENT AND SALARY

Although the demand for new positions in oceanography is small, scientists are needed to replace the present teachers and researchers in ocean and earth science who are retiring or leaving the field. Traditional employment in academia or government service is supplemented by industrial employment.

The average yearly salary for an oceanographer with a bachelor's degree (in 2009) was \$33,254. Postdoctoral researchers average salary ranged from \$37,400 to \$49,452. Academic salaries for assistant professors ranged from \$53,200 to \$80,300 while tenured professors can make between \$100,000 to \$150,000. The average yearly government salary (in 2009) for oceanographers was \$105,671.



Campus

SELECTED FACILITIES AND OCEANOGRAPHIC COLLECTIONS

PRESERVED MARINE VERTEBRATES

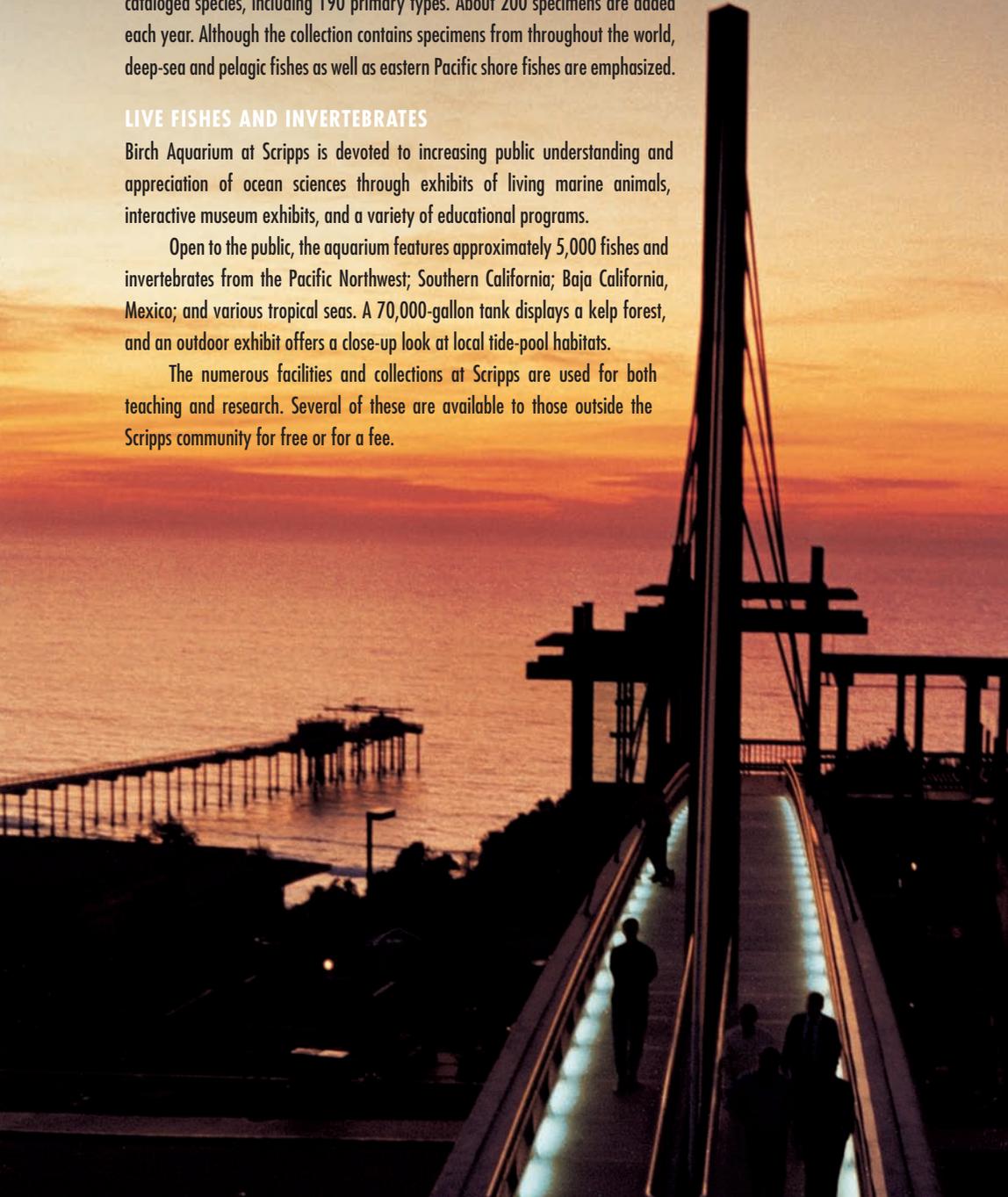
This collection contains approximately two million specimens, with more than 5,400 cataloged species, including 190 primary types. About 200 specimens are added each year. Although the collection contains specimens from throughout the world, deep-sea and pelagic fishes as well as eastern Pacific shore fishes are emphasized.

LIVE FISHES AND INVERTEBRATES

Birch Aquarium at Scripps is devoted to increasing public understanding and appreciation of ocean sciences through exhibits of living marine animals, interactive museum exhibits, and a variety of educational programs.

Open to the public, the aquarium features approximately 5,000 fishes and invertebrates from the Pacific Northwest; Southern California; Baja California, Mexico; and various tropical seas. A 70,000-gallon tank displays a kelp forest, and an outdoor exhibit offers a close-up look at local tide-pool habitats.

The numerous facilities and collections at Scripps are used for both teaching and research. Several of these are available to those outside the Scripps community for free or for a fee.



Campus

BENTHIC MARINE INVERTEBRATES

The collection contains some 40,000 lots of specimens sorted into major taxonomic groups. All are cataloged with collection data, and more than 35 percent are identified to species.

PELAGIC INVERTEBRATES

One of the world's preeminent collections of marine zooplankton, it includes approximately 110,000 whole zooplankton samples representing most sectors of the global oceans. Particular geographic strengths are the North and South Pacific, Indo-West Pacific oceans, and Antarctic waters. Approximately 31,000 sorted, identified reference specimens of some of the major planktonic taxa are available.

GEOLOGICAL CORES AND DREDGE COLLECTIONS

The dredge collection has more than 4,000 dredge hauls including rocks from the deepest parts of the world's oceans. There are more than 6,000 sediment cores from all the oceans and Scripps has the world's most extensive collection of deep-sea radiolarian microfossil slides. Preserved under refrigeration, the sediment cores provide an excellent record of faunal distributions and geological and climatic events. The dredge collection includes igneous rocks, manganese nodules, and lithified sediments.

RESEARCH FLEET

Scripps operates a large fleet of ocean-going research vessels, one research platform, and several smaller craft. Since the institution's first major ocean expedition in 1950, Scripps scientists and students have logged millions of nautical miles on expeditions all over the world.

DIVING FACILITY

The diving program offers support to the Scripps scientific diving and diver-training program, and provides facilities for dressing rooms, equipment storage, and air compressors, as well as an overhaul and repair shop.

SCRIPPS PIER

The 1,090-foot Scripps Pier provides a stable platform for observations, data gathering, collections, and other scientific work, in addition to being a launch station for small boats. It also houses pumps that supply seawater to laboratory aquariums and the display tanks at Birch Aquarium at Scripps.



UNDERWATER RESEARCH AREAS

The nearshore waters adjacent to the Scripps campus include areas that have been set aside specifically for research. More than 530 acres near the campus are designated as a marine ecological reserve.

SCRIPPS LIBRARY

One of the world's largest marine science collections, Scripps Library's collection and services support research and teaching at the institution. A collection of more than 224,000 volumes, more than 1,000 active print journals, and access to more than 20,000 licensed electronic journals emphasizes oceanography, marine biology, marine geology, marine technology, geophysics, and climatology with extensive resources in ecology, zoology, fisheries, and seismology. Scripps Library has an exceptional collection of scientific ocean expedition reports and a large map collection focused on hydrographic/bathymetric charts.

UCSD'S ELEMENTAL AND STABLE ISOTOPE ANALYTICAL UMBRELLA CORE FACILITY

Instruments include an environmental scanning electron microscope (ESEM), an ICP mass spectrometer, ICP optical emission spectrometer, stable isotope mass spectrometer, and elemental analyzer. Both instrument time and operator services are available. The facility is also equipped with a clean laboratory for ICP sample preparation.

EXPERIMENTAL AQUARIUM

Used for studies of living plants and animals, the experimental aquarium is provided with ambient and chilled seawater and is equipped with rooms for controlled environmental studies, tanks, and seawater tables.

HYDRAULICS LABORATORY

The Hydraulics Laboratory offers many testing facilities including a wind-wave channel, two flow channels, three pressure testing vessels, a deep tank, and a temperature/pressure calibration facility. Fresh and salt water are available throughout the laboratory and can be chilled or filtered as needs require.



Our Future

THE OCEANOGRAPHER OF TOMORROW

Scripps Institution of Oceanography is dedicated to the study of the oceans, atmosphere, and Earth. The institution's goal is to train professional oceanographers to be teachers, independent researchers, or both. But opportunities are not limited to these two directions. Ships require crews; libraries must be staffed; and electronic, biological, and chemical technicians are needed. Positions for specialists are available, and opportunities occasionally exist for those already out of school to move up through on-the-job training.

Opportunities for scientists at all levels may be found in governmental laboratories and in the academic or industrial communities.

With more than a century of exploration and discovery in global sciences, Scripps Institution of Oceanography is the world's preeminent center for ocean and earth science research, teaching, and public education.

A graduate school of UC San Diego, Scripps leadership in many scientific fields reflects its continuing commitment to excellence in research, modern facilities and ships, distinguished faculty, and outstanding students – and our horizons continue to expand.



Scripps Mission

To seek, teach, and communicate scientific understanding of the oceans, atmosphere, and Earth for the benefit of society and the environment.

GENERAL INFORMATION

Scripps Communications Office
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Tel: (858) 534-3624
Website: scrippsnews.ucsd.edu
Email: scrippsnews@ucsd.edu



scripps.ucsd.edu

GRADUATE ADMISSION INFORMATION

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University of California, San Diego
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Tel: (858) 534-3206
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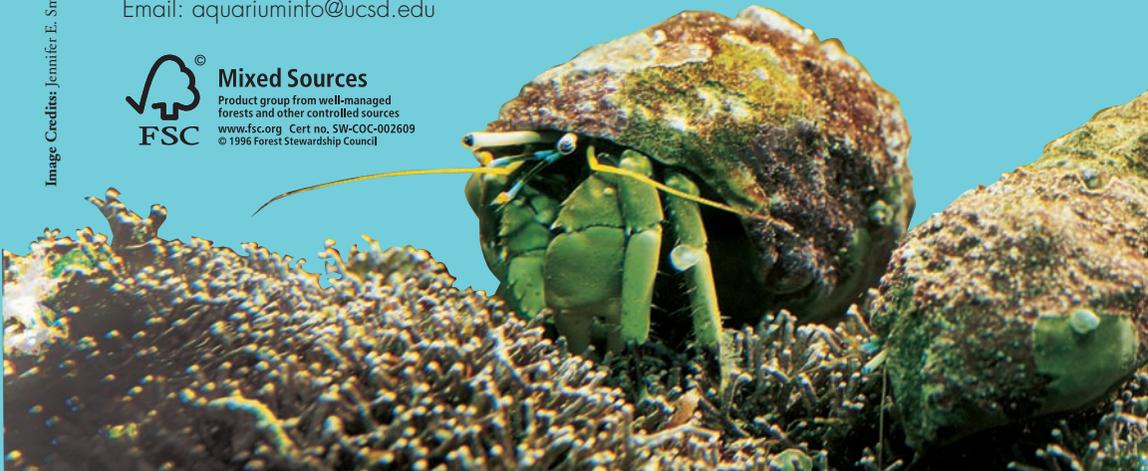
REFERENCE MATERIALS, BOOKS, AND GIFT ITEMS

Birch Aquarium at Scripps Book and Gift Shop
Scripps Institution of Oceanography
University of California, San Diego
9500 Gilman Dr., Dept. 0207
La Jolla, CA 92093-0207
Tel: (858) 534-8753
Website: aquarium.ucsd.edu/Plan_a_Visit/Bookshop/
Email: aquariuminfo@ucsd.edu



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"It is now more true than ever that oceanography is the meeting place of all the sciences, and that much of the fun of it – the sheer excitement of oceanography – comes when people of different backgrounds talk together about common problems in which ideas and knowledge of biologists, geologists, chemists, physicists, mathematicians, and engineers must be combined if a solution is to be found."

—ROGER REVELLE

FORMER DIRECTOR OF SCRIPPS INSTITUTION
OF OCEANOGRAPHY



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UC San Diego