DIRECTORY OF ACADEMIC MARINE PROGRAMS IN CALIFORNIA

A Guide to Programs in the Marine Sciences at California Colleges and Universities

A Publication of the California Sea Grant College
Sea Grant is a unique partnership of public and private sectors, combining research, education, and technology transfer for public service. It is a national network of universities meeting changing environmental and economic needs of people in our coastal, ocean, and Great Lakes regions.

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Cover by Victoria Cypherd
Published on recycled paper
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Young people are naturally attracted to the sea, and early on may fantasize about a Cousteau-like career in oceanography.

For those who are serious enough to pursue the years of needed study, California’s public and private institutions of higher learning offer what is arguably the finest and most diverse courses of preparation available anywhere. Students come from all over the world to study plate tectonics at Stanford; fisheries at Humboldt State University; naval architecture at the University of California, Berkeley; marine pharmacology at the University of California, Santa Barbara; or sonar systems at Scripps Institution of Oceanography.

But even those students who don’t plan to pursue advanced study can prepare for a variety of marine-related careers at California colleges, ranging from underwater photographer or recreational diving specialist to marine transportation manager.

We trust that this guide to the academic marine programs in California will prove useful both to students and to the parents, teachers, and counselors who help to guide them in their exploration of possibilities in the wide (blue) world.

James J. Sullivan
Director
California Sea Grant College
EXPLANATION OF PROGRAM DESCRIPTIONS

The following is an explanation of the categories used to describe each program.

**Program**
Program titles are listed according to official degree titles, with a few exceptions. These exceptions are noted parenthetically and explained in the “Description” section. For example, “biology (with marine emphasis)” means that the institution officially offers a biology degree, and that students working toward that degree can develop an emphasis in marine biology by choosing several marine science courses. So, although the institution does not offer an official “biology with emphasis in marine biology” degree, the standard biology program allows students to concentrate in marine biology.

**Degree Offered**
To avoid ambiguity, degrees are listed according to the abbreviations used by each institution. In most cases, these are standard abbreviations. The exceptions are spelled out: “Certificate,” rather than C, and “Doctor of Engineering,” to distinguish from a “Doctor of Philosophy in Engineering” (Ph.D. is used here).

Standard abbreviations include A.A. (Associate of Arts), A.S. (Associate of Science), B.A. (Bachelor of Arts), B.S. (Bachelor of Science), M.A. (Master of Arts), M.S. (Master of Science), and Ph.D. (Doctor of Philosophy).

**Description**
For the first edition, program descriptions were gathered from college catalogs, program brochures, and telephone interviews. In order to develop this updated edition, campus contacts were asked to revise the descriptions that had appeared in the earlier version of the Directory.

**Number of Marine Science Courses**
Unless otherwise stated, this figure includes only those courses that are clearly marine science (or marine science related) and offered by the degree-sponsoring department. Such courses include those in marine biology, physical oceanography, and marine invertebrate zoology. Since interdepartmental programs require courses from several disciplines, their courses are not tabulated.

**Research Facilities**
The descriptions of research facilities were generated from information contributed by a contact person at the institution.

**Contact**
Contact persons were identified by their institutions. Nearly all program contacts either teach or do research in a marine science field. Please note that the information printed in this Directory changes rapidly. You are strongly advised to call the contact person listed before applying to an institution.
**Program Directory**

**Two-Year**

**COLLEGE OF MARIN**

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>MARINE SCIENCE TECHNOLOGY</th>
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<tbody>
<tr>
<td>Degrees Offered</td>
<td>Certificate, A.A., A.S.</td>
</tr>
<tr>
<td>Description</td>
<td>College of Marin offers a broad marine science technology program for three kinds of students: those interested in marine education experience for self enrichment; those majoring in a science discipline, e.g., biology, geology, etc., with the eventual goal of obtaining a B.A. degree; and those interested in a two-year career curriculum with the goal of being certified and working as a marine science aide or technician. The college offers several general marine interest courses, including courses in oceanography, general biology, marine biology, marine organisms, diving, field ecology, general ecology, nature study, and marine field studies. The student interested in eventually majoring in marine biology at a four-year institution is advised to take courses in general biology, botany, mathematics (through calculus), general chemistry and physics, reading and composition, and three marine science courses, namely, marine biology, marine organisms, and marine field studies. Students interested in a two-year career curriculum in the marine sciences pick an area of specialty, usually biology, electronics, data processing, or geology. The program is assembled by design - students must construct their own program with faculty supervision. At the end of two years, the student may receive an A.A. degree plus a certificate of training, depending on the individual program. In addition to the courses available at the campus, courses are taught at the College of Marin’s Bolinas Marine Station.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Marine Science Courses</th>
<th>Not applicable-interdepartmental program</th>
</tr>
</thead>
</table>

| Research Facilities             | Much of the classroom and laboratory study is conducted at the College of Marin’s Bolinas Marine Station. The station is situated in the oceanside community of Bolinas, 22 miles north of San Francisco. The marine station includes a marine laboratory equipped with 20 student stations. The station has a circulating seawater system which supplies laboratory aquaria for instructional research purposes. The station also has Boston whalers for local studies. Marine investigations are conducted year-round by class groups and by individuals working on research projects. |

| Contact                         | Al Molina, Director Bolinas Marine Station Bolinas, California 94924 (415) 868-1771 or (415) 485-9542 Jim Locke Instructor of Oceanography College of Marin Kentfield, California 94904 (415) 485-9526 Gordon L. Chan Director of Marine Technology Programs College of Marin Kentfield, California 94904 (415) 485-9537 |

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<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>OCEANOGRAPHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree Offered</td>
<td>None</td>
</tr>
<tr>
<td>Description</td>
<td>Students can earn a general education A.A.; no emphasis or degree is offered in marine science. Like many other two-year schools, Diablo Valley College has an articulation agreement with Humboldt State University for students who want to transfer for fisheries and oceanography majors. The transfer programs include general education classes and classes in biological science, chemistry, math, geology, and physics. However, the school also has an oceanography curriculum worthy of note. Oceanography classes include Fundamentals of Oceanography, Fundamentals of Oceanography Lab, Field Studies in Oceanography, and Advanced Problems in Oceanography. Fundamentals of Oceanography introduces students to the geological, chemical, physical, and biological aspects of the oceans; resources from the sea; ocean resource management and preservation; instruments and methods of sampling and analysis; and ecological problems of the local bay, estuary, and delta. There is a seven-hour training cruise aboard a research vessel to introduce students to oceanographic operations and navigation. In the laboratory class, students collect marine organisms and water samples, identify and process marine life, test water samples, learn navigation skills, and take a three-hour cruise to prepare to assist instructors during the seven-hour training cruise. Students in the field studies class participate in tutoring, lab assistance, working on the research vessel, community marine science activities, field trips, conferences, developing teaching aids, research projects, the advanced scuba diving program, or as a volunteer in a marine science-related organization. Finally, selected students may take Advanced Problems and pursue independent study under the guidance of an instructor.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>4 oceanography, 1 marine biology</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>Research vessel</td>
</tr>
</tbody>
</table>
| Contact | Gay Ostarello, Chair  
Biology Department  
Diablo Valley College  
321 Golf Club Road  
Pleasant Hill, California  
94523  
(415) 685-1230 |
Program Directory

FULLERTON COLLEGE

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>OCEANOGRAPHIC TECHNOLOGY</th>
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**Degree Offered**  A.A.

**Description**  Fullerton offers an Associate of Arts degree program in oceanographic technology. The two-year curriculum leads to future studies in oceanography, or immediate employment with industries, institutions, and government agencies. During the first year, students are required to take courses in oceanography, math, chemistry, English, and biology. During the second year, students take courses in ocean sampling, marine biology, physics, social science, the humanities, navigation and seamanship, physical geology, aquaculture, and ocean engineering.

Recommended electives to round out the student’s program include courses in data processing, microbiology, photography, electronics, surveying, welding, and diving.

**Number of Marine Science Courses**  7

**Research Facilities**  The college has a small vessel and oceanographic sampling equipment. A cooperative program allows students to participate in shipboard research activities aboard vessels belonging to the University of Southern California.

**Contact**  Larry Leyman
Instructor of Oceanography
Division of Natural Sciences
Fullerton College
321 East Chapman Avenue
Fullerton, California
92634 (714) 992-7108

GLENDALE COMMUNITY COLLEGE

<table>
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<tr>
<th>PROGRAM</th>
<th>BAJA FIELD STUDIES PROGRAM</th>
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**Degrees Offered**  A.A./A.S.

**Description**  Glendale Community College offers a variety of undergraduate marine science courses, the majority of which include extensive laboratory and field components. Course offerings include classes in introductory marine biology, marine mammals, marine zoology, introduction to marine sciences, physical oceanography, directed studies in marine ecology, and tropical and subtropical field studies in marine biology. Courses are offered each summer which allow students to travel abroad to study local marine habitats. Past venues have included Tahiti, Australia, Hawaii, Mexico, Fiji, and Jamaica.

The college maintains a teaching facility located in the small fishing village of Bahia de Los Angeles on the Sea of Cortez. This facility serves as a base for a variety of short- and long-term natural courses including marine biology offerings.
**Program Directory**

**Number of Marine Science Courses**
7 courses, including 3 which are lecture courses, and 4 which are partially or entirely field courses

**Research Facilities**
Baja Field Studies Facility (Estacion del Mar), Baja California, Republic of Mexico

**Contact**
Greg Forbes, Biological Sciences
Glendale Community College
1500 North Verdugo Road
Glendale, California
91208 (818) 240-1000

**PROGRAM**
**BIOLOGY (WITH MARINE EMPHASIS)**

**Degrees Offered**
A.A./A.S.

**Description**
Glendale Community College offers a variety of undergraduate marine science courses, the majority of which include extensive laboratory and field components. Course offerings include classes in introductory marine biology, marine mammals, marine zoology, introduction to marine sciences, physical oceanography, directed studies in marine ecology, and tropical and subtropical field studies in marine biology. Courses are offered each summer which allow students to travel abroad to study marine habitats. Past venues have included Tahiti, Australia, Hawaii, Mexico, Fiji, and Jamaica.

The college maintains a teaching facility located in the small fishing village of Bahia de Los Angeles on the Sea of Cortez. This facility serves as a base for a variety of short- and long-term natural courses including marine biology offerings.

**Number of Marine Science Courses**
7 courses, including 3 which are lecture courses, and 4 which are partially or entirely field courses

**Research Facilities**
Baja Field Studies Facility (Estacion del Mar), Baja California.

**Contact**
Greg Forbes, Biological Sciences
Glendale Community College
1500 North Verdugo Road
Glendale, California
91208 (818) 240-1000

Marine science students at Glendale Community College receive much of their instruction in the field.
PROGRAM  ENVIRONMENTAL SCIENCES

Degree Offered  A.A.

Description  Los Angeles Pierce offers a two-year training program leading to an Associate of Arts degree in environmental sciences. The program includes courses in soil analysis, chemistry, physical science, biology, urban planning, and architecture, in addition to a full year of courses in physical oceanography, and marine biology.

L.A. Pierce, in cooperation with the Claremont Colleges, uses the Vantuna an 85-foot oceanographic vessel, for deep-water studies. Students enrolled in the oceanography lab course take five trips on the Vantuna, and use the vessel’s equipment to conduct lab experiments for the course.

L.A. Pierce offers five courses in oceanography. Enrollment in these courses averages about 500 students in the introductory course, and then about 60 students per semester in the supplementary courses.

Number of Marine Science Courses  5

Research Facilities  L.A. Pierce has access to the Vantuna, a large, deep-sea research vessel operated by the Claremont Colleges. Students do field work in the intertidal zone at Leo Carrillo State Beach or Malibu Lagoon.

Contact  Raymond Wells
Professor of Oceanography
Los Angeles Pierce College
6201 Winnetka Avenue
Woodland Hills, California
91364  (818) 347-0551

PROGRAM  OCEANOGRAPHY PREPARATORY

Degree Offered  None

Description  Mt. San Antonio does not have a degree program in any of the marine sciences. However, it does have a preparatory program designed for students interested in majoring in oceanography at other colleges or universities to which they intend to transfer. Although institutions offer baccalaureate programs in oceanography, Mt. San Antonio suggests that students who wish to have a career in oceanography may be better prepared by undertaking a baccalaureate program in a basic science and doing graduate work toward an oceanographic application of the chosen science.

Preparation for the oceanography degree includes two courses in oceanography (one general, one lab), two courses in marine biology (one general, one lab), and courses in statistics, calculus, analytic geometry, engineering, physics, physical geology, historical geology, chemistry, zoology, and botany.
<table>
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<tr>
<th>Number of Marine Science Courses</th>
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</thead>
<tbody>
<tr>
<td>Research Facilities</td>
<td>None</td>
</tr>
</tbody>
</table>
| Contact                          | Harold Thurman  
Instructor of Oceanography  
Mt. San Antonio College  
1100 N. Grand Avenue  
Walnut, California  
91789 (714) 594-5611 |

**ORANGE COAST COLLEGE**

**PROGRAM**  
MARINE SCIENCE PREPARATORY

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>A.A.</th>
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</table>
| Description    | Orange Coast offers a curriculum that prepares the student who wants to major in marine science to transfer to a four-year institution.  
To prepare the transfer student, Orange Coast suggests a two-year program including courses in mathematics, chemistry, biology, and physics. The marine science faculty and the counselors at the college assist the students in selecting a four-year institution and establishing a faculty contact there.  
The college recommends that students interested in becoming biological oceanographers get a bachelor’s degree in some aspect of general biology. Students interested in chemical oceanography should get an undergraduate degree in chemistry. Those interested in geological oceanography should get a degree in geology. A physical oceanographer needs an undergraduate degree in physics, mathematics, or meteorology, or some combination of these. Sometimes a degree in engineering is acceptable. A marine resource management major should have a degree in either natural science, social-political science, or engineering. |

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<thead>
<tr>
<th>Number of Marine Science Courses</th>
<th>8</th>
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<tbody>
<tr>
<td>Research Facilities</td>
<td>The Marine Science Department at Orange Coast College has training equipment that includes spectrophotometers; pH meters; oxygen tension analyzers; salinometers; water-immersion Nikon microscopes; dissection microscopes; a 3,200 gallon closed system circulating marine aquarium for display and specimen storage; a wet marine laboratory with cold-room capability; a Questar optical system for long-range study, telemicroscopy, and navigation; a Gilson differential respirometer, absorption spectrometer, and gas chromatograph; a 55-foot registered research vessel, R/V Marda; a Seabird TDC and associated computer; and instruments for measuring salinity, pH, conductivity, and other physical parameters in the field.</td>
</tr>
</tbody>
</table>
| Contact                          | Tom Garrison  
Marine Science Department  
Orange Coast College  
2701 Fairview Road  
Costa Mesa, California  
92628-5005 (714) 432-5647 |
PROGRAM  MARINE SCIENCE TECHNOLOGY

Degree Offered  Certificate, A.S.

Description  Saddleback College offers both general Certificate and Associate of Science degree programs in marine science technology. Students in the program are trained in several areas: vessel and equipment maintenance and operation; diving techniques; environmental impact study procedures; mariculture operations; and marine geological, chemical, physical, and biological research.

Students take a variety of marine science courses, including geological, physical, biological, and chemical oceanography; sailing, seamanship, and safety afloat; coastal navigation; oceanographic instrumentation; technical mathematics; diving and underwater techniques; marine science research techniques; underwater scientific photography; and technical writing.

Number of Marine Science Courses  20

Research Facilities  Training includes classroom and laboratory work at the campus, which is complete with modern training equipment. When at sea, work is done aboard the college’s oceanographic research vessels, both sail and power. Field study experience is done throughout southern California where innumerable government and private operations are viewed firsthand.

Contact  Peter Borella
Marine Science Programs
Saddleback College
2800 Marguerite Parkway
Mission Viejo, California
92692  (714) 582-4549
or  (714) 582-4820
## PROGRAM
### MARINE SCIENCE TECHNOLOGY (WITH MARINE BIOLOGY EMPHASIS)

**Degree Offered**  
Certificate, A.S.

**Description**  
Saddleback College offers both Certificate and Associate of Science degree programs in marine science technology with emphasis in marine biology. The marine science technology program trains students in vessel and equipment maintenance and operation; diving techniques; environmental impact study procedures; mariculture operations; and marine geological, chemical, physical, and biological research.

Students wanting a marine biology emphasis take courses such as Geological and Physical Oceanography; Sailing; Seamanship, and Safety Afloat; General Chemistry; Biology of Non-Vascular Plants; Oceanographic Instrumentation; Invertebrate Zoology; Biological and Chemical Oceanography; Diving and Underwater Techniques; Coastal Navigation; and Organic Chemistry.

**Number of Marine Science Courses**  
20

**Research Facilities**  
See previous description

**Contact**  
Robin Newbold-Sturm  
Marine Science Programs  
Saddleback College  
2800 Marguerite Parkway  
Mission Viejo, California  
92692  (714) 582-4803  
or  (714) 582-4820

## PROGRAM
### MARINE SCIENCE TECHNOLOGY (WITH MARINE GEOLOGY EMPHASIS)

**Degree Offered**  
Certificate, A.S.

**Description**  
Saddleback College offers both Certificate and Associate of Science degree programs in marine science technology with emphasis in marine geology. Students are trained in several areas, including vessel and equipment maintenance and operation; diving techniques; environmental impact study procedures; mariculture operations; and marine geological, chemical, physical, and biological research. Students emphasizing marine geology take courses such as Geological and Physical Oceanography; Sailing, Seamanship, and Safety Afloat; Coastal Navigation; General Chemistry; Oceanographic Instrumentation; Technical Mathematics; Introduction to Physical Geology; Biological and Chemical Oceanography; Diving and Underwater Techniques; Marine Science Research Techniques; Underwater Scientific Photography; Historical Geology, and Technical Writing.

**Number of Marine Science Courses**  
20

**Research Facilities**  
See previous description

**Contact**  
Peter Borella  
Marine Science Programs  
Saddleback College  
2800 Marguerite Parkway  
Mission Viejo, California  
92692  (714) 582-4549  
or  (714) 582-4820
Program Directory

Program: Marine Science Technology (with Physical Oceanography Emphasis)

Degree Offered: Certificate, A.S.

Description: Saddleback College offers both Certificate and Associate of Science degree programs in marine science technology with emphasis in physical oceanography. Students are trained in several areas, such as vessel and equipment maintenance and operation; diving techniques; environmental impact study procedures; mariculture operations; and marine geological, chemical, physical, and biological research. Students emphasizing physical oceanography take courses such as Geological and Physical Oceanography; Sailing, Seamanship and Safety Afloat; Coastal Navigation; General Chemistry; Oceanographic Instrumentation; Technical Mathematics; Introduction to Physical Geology; Biological and Chemical Oceanography; Diving and Underwater Techniques; Marine Science Research Techniques; Underwater Scientific Photography; Historical Geology; and Technical Writing.

Number of Marine Science Courses: 20

Research Facilities: See previous description

Contact: Peter Borella
or
Jim Bollingmo
Marine Science Programs
Saddleback College
2800 Marguerite Parkway
Mission Viejo, California
92692 (714) 582-4549
or (714) 582-4741
(714) 582-4820

Program: Marine Science Technology (with Seamanship Emphasis)

Degree Offered: Certificate, A.S.

Description: Saddleback College offers both Certificate and Associate of Science degree programs in marine science technology with emphasis in seamanship. Students are trained in several areas, such as vessel and equipment maintenance and operation; diving techniques; environmental impact study procedures; mariculture operations; and marine geological, biological, and physical research. Students emphasizing seamanship take courses such as Geological and Physical Oceanography; Sailing, Seamanship, and Safety Afloat; Diesel Engine Preventive Maintenance and Tune-up; Oceanographic Instrumentation; Technical Mathematics; A.C. and D.C. Fundamentals; Biological and Chemical Oceanography; Coastal Navigation; Diving and Underwater Techniques; Marine Science Research Techniques; Underwater Scientific Photography; Celestial Navigation; Industrial Electronics; and Technical Writing.

Number of Marine Science Courses: 20

Research Facilities: See previous description
PROGRAM

MARINE DIVING TECHNOLOGY

Degree Offered
A.S. Certificate in Marine Diving Technology

Description
Santa Barbara City College offers an Associate of Science degree program in marine diving technology in response to the growing needs of offshore industry engaged in underwater construction and the worldwide development of marine resources. The program prepares the student to become a marine diving technician.

Students in the program must take three different types of courses. The first is designed to develop the skills and knowledge required of a diving technician. Such courses include Seamanship and Rigging, Petroleum Technology, Basic Diving (Scuba and Hookah), Drawing and Blueprint Reading, Marine Welding, Advanced Diving, Fundamentals of Marine Engines and Compressors, Combination Welding, Underwater Construction, Fundamentals of Electronics, Machine Shop Operations, Underwater Operations, and Diving Systems.

The second series of courses is designed to give students an understanding of the environment in which they will be working. Sample courses include Physical Oceanography for Marine Diving Technology, Marine Biology, Biological Oceanography, and Technical Physics. The third series consists of general education courses such as Technical Report Writing, Speech, and American Institutions that increase the student’s knowledge and communicative ability.

The Marine Diving Technology Program is a cooperative effort among Santa Barbara City College and various industries, institutions, and government agencies. The program was developed and is continually reviewed and revised by members of an advisory committee, in order to effectively serve the current needs of the offshore industry. Advisors to the program include representatives from Brooks Institute of Photography; ManPro; Naval Civil Engineering Laboratory; Solus Ocean Systems, Inc.; Oceaneering International; Santa Barbara Medical Foundation; Scripps Institution of Oceanography; Sub-Sea International, Inc.; Taylor Diving and Salvage Company, Inc.; the University of California, Santa Barbara; Chevron USA, Inc; and Exxon.

Number of Marine Science Courses
16

Research Facilities
The Marine Diving Technology facility houses the diving equipment and training tanks, and includes a 7 l/2 ton bridge crane for handling heavy equipment, such as diving bell, decompression chambers, and compressors.
Santa Barbara City College receives much of its equipment through donations by industry. It has a bell saturation diving system, which includes an Ocean Systems ADS IV bell and deck chamber, a control van, and the required life-support and environmental control components, all acquired through donations.

**Contact**

Mike Von Alvensleben, Department Head  
Marine Technology Department  
Santa Barbara City College  
721 Cliff Drive  
Santa Barbara, California  
93109-2394  (805) 965-0581 ext. 2426/2427

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**PROGRAM**  
**RECREATIONAL DIVING SPECIALIST**

**Degree Offered**  
A.S. Recreational Diving Specialist Certificate

**Description**  
The current demand for well-trained, highly capable Recreational Diving Specialists has never been greater. At present, the dive industry is unable to produce the number of qualified employees to fill the demand. As a Recreational Diving Specialist, the student must become a skilled diver, as well as a technician capable of working above and below the water. The student must be able to work with all types of equipment, while performing a broad variety of tasks under varying conditions. The student must understand the physical and biological elements of the marine environment. The Recreational Diving Specialist must be aware of the importance of *teamwork*, and must be capable of working as an integral part of a team.
The Recreational Diving Program at Santa Barbara City College has two goals. The first is to develop the skills necessary to teach people with no diving experience and bring these people up through the diving ranks to leadership levels. The second goal is to learn how to inspect and repair diving equipment plus gain management and merchandising skills necessary for supervising and coordinating recreational diving activities at resorts, dive shops, and on cruise ships. There is also a series of courses designed to give the students an understanding of the environment in which they will be working. The Recreational Diving Program is the only one in the California College system and one of only a handful in the U.S.

### Number of Marine Science Courses

9

### Research Facilities

The Marine Diving Technology facility houses the diving equipment and training tanks for cold water dive training, regulator repair, chamber operations, and surface supply diving.

### Contact

Mike Von Alvensleben, Department Head
Marine Technology Department
Santa Barbara City College
721 Cliff Drive
Santa Barbara, California
93109-2394  (805) 965-0581 ext. 2426/2427

### PROGRAM

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<tr>
<th>MARINE BIOLOGY PREPARATORY</th>
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<tr>
<td><strong>Degree Offered</strong></td>
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<tr>
<td><strong>Description</strong></td>
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<tr>
<td><strong>Number of Marine Science Courses</strong></td>
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</table>
| **Contact** | Don Biederman
Dean, Science Math and Technology Division
Skyline College
San Bruno, California
94066  (415) 738-4222 |
# PROGRAM

## BIOLOGY (WITH MARINE EMPHASIS)

**Degree Offered**

B.S.

**Description**

There is no official “biology with marine emphasis” degree program at Caltech. However, students can make arrangements to take courses in marine biology offered at the Santa Catalina Marine Biological Laboratory or at other institutions. Using such courses, students can complete the requirements for the biology major and graduate with a Bachelor of Science degree that reflects a strong marine biology emphasis and prepares students for graduate study in marine science.

**Number of Marine Science Courses**

Not applicable

**Research Facilities**

In addition to the facilities offered by the Marine Biological Laboratory on Santa Catalina Island and by Scripps Institution of Oceanography, Caltech has its own facility, namely the William G. Kerckhoff Marine Laboratory at Corona del Mar. The facility houses several laboratories for research in marine physiology and developmental biology. It is equipped with its own shop, has boats and tackle for collecting marine animals, and running seawater aquaria for keeping them.

**Contact**

Charles J. Brokaw
Professor of Biology
William G. Kerckhoff Marine Laboratory
101 Dahlia Street
Corona del Mar, California
92625  (714) 673-9894

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# PROGRAM

## CIVIL ENGINEERING (WITH COASTAL EMPHASIS)

**Degrees Offered**

B.S., M.S., Ph.D.

**Description**

Civil engineering at California Institute of Technology includes the research, development, planning, design, and construction associated with urban development, water supply, energy generation and transmission, water treatment and disposal, and transportation. It deals with the function and safety of such public facilities as buildings, bridges, pipelines, dams, rivers, power plants, and harbors; it is concerned with the protection of the public against natural hazards of earthquakes, winds, floods, landslides, water waves, and fires.

Advances of recent years in technology and the escalation of urban problems have broadened the applications of civil engineering and increased the scope of research in that field. New problems have presented special challenges to the civil engineer well trained in the fundamentals of his or her profession. For this reason, in the advanced study of civil engineering at the Institute, emphasis is placed on the application of basic scientific principles and mathematics to the solution of engineering problems.

Graduate work leading to advanced degrees is chiefly in the following fields: structural engineering and applied mechanics; earthquake engineering; soil mechanics and foundation engineering; hydraulics, which includes hydrodynamics, hydraulic engineering, hydrology and coastal engineering; and environmental engineering (see also Environmental Engineering Science). In recent years, graduate students and members of the staff have pursued a variety of research programs, including
analysis of structures subjected to earthquakes and other dynamic loadings; the use of finite element methods for structural analysis; soil deformation under stress; lunar soil studies; permafrost; investigation of sediment transport; turbulent mixing in density stratified flows; wave-induced harbor oscillations; tsunamis; dynamics and kinematics of breaking and nonbreaking waves; wave-structure interactions; design criteria for various hydraulic structures; aerosol filtration; radioactive waste disposal; water reclamation; and ocean outfalls for thermal discharges or sewage effluents.

Students whose interests are in environmental problems may enroll for graduate degrees in either civil engineering or environmental engineering science.

Number of Marine Science Courses

One in coastal engineering; other courses in free surface hydrodynamics and wave dynamics not specifically of an engineering nature.

Research Facilities

Civil engineering activities are housed in two buildings: the Franklin Thomas Laboratory, which contains the soil mechanics laboratory, the earthquake engineering laboratory, and the dynamics laboratory; and the W. M. Keck Engineering Laboratories, which contain the laboratory of hydraulics and water resources and the environmental engineering laboratory. Excellent digital computing facilities are housed in the Booth Computing Center.

Contact

Fredric Raichlen
California Institute of Technology
1201 E. California Boulevard
Pasadena, California
91125 (818) 356-4403

PROGRAM ENVIRONMENTAL ENGINEERING

Degrees Offered

M.S., Ph.D.

Description

An exchange program has been established with the Scripps Institution of Oceanography (SIO), University of California, San Diego, permitting Caltech graduate students in the Division of Engineering and Applied Science to enroll in and receive credit for graduate courses offered by SIO. Thesis research in the marine sciences can be done at SIO.

Number of Marine Science Courses

Not applicable

Research Facilities

See Caltech Biology program

Contact

Norman H. Brooks
Professor and Executive Officer for Environmental Engineering
Caltech 138-78
Pasadena, California
91125 (818) 356-4404
PROGRAM  
GEOLOGY, GEOCHEMISTRY, GEOPHYSICS, GEOBIOLOGY, PLANETARY SCIENCE

Degrees Offered  
B.S., M.S., Ph.D.

Description  
In the Division of Geological and Planetary Sciences at the California Institute of Technology, study of the earth and planets is pursued with the aim of understanding their origin, constitution, and development, and the impact of the resulting physical and chemical environments on the history of life and on man. The approach to these problems is made with strong reliance on the basic sciences; close contact and interaction with the other divisions of the Institute are cultivated.

The geographical position and geologic setting of the Institute are favorable for year-round field access to a wide variety of earth problems and materials. Current advances in understanding the dynamic motions of the earth’s crust and the structure of the interior have opened up new opportunities for research into the processes responsible for the earth’s development and activity. Seismic activity in the Southern California area presents stimulus and research material for the study of earthquakes, which are of great practical concern and are intimately related to the earth’s development on a global scale. Human records of seismic activity are put into long-term perspective by studies of surface and bedrock geology, which reveal the history of motion of fault systems. Major events in the chemical and physical evolution of the earth can be identified by studying the structure and chemistry of rocks formed or modified in these events, and their absolute chronology can be established by measurements of radioactive isotopes. Stable isotopes can indicate the temperature conditions both of deep-seated events and of the habit of ancient life, whose chemical and structural evolution responded to the changing environment provided by the developing earth. The earliest history of the earth can be approached via the history of the moon, which is being revealed by studies of lunar samples obtained in the Apollo missions. Further breadth in our understanding of the earth and its place in the cosmos is being gained by comparative study of other planets their atmospheres, surfaces, and internal structures.

Number of Marine Science Courses  
6

Research Facilities  
The Seeley G. Mudd Building of Geophysics and Planetary Science provides research and teaching facilities for seismology, experimental geophysics, and planetary science. The Seismological Laboratory of the Institute, with excellent facilities including computers and extensive shops, is also located in this building. These laboratories together with many outlying, auxiliary stations in Southern California, which were built and are maintained with the aid of cooperative companies and organizations constitute an outstanding center for education and research in seismology. State-of-the-art wideband, high dynamic range instruments constitute TERRAscope, an array used to understand both regional and global seismic activity and earth structure. In addition, special facilities are available at the Seismological Laboratory for the study of the behavior of rocks and minerals in the pressure and temperature environments of planetary interiors. Ultra-high-pressure equations of state and shock effects in minerals are being studied in a shock-wave laboratory.

In the neighboring Arms and Mudd laboratories, work in geology and geochemistry makes use of extensive mass spectrometry capabilities and analytical facilities. Petrology research includes understanding the origin of oceanic crust and hot spot volcanism. Geochemical research includes work on climate change, sea level change and chemical oceanography. Geobiological research includes analysis of the role of magnetite in living organisms (including marine biota).

Contact  
David J. Stevenson  
Geological and Planetary Sciences  
California Institute of Technology  
1201 E. California Boulevard  
Pasadena, California  
91125 (818) 356-6108
CLAREMONT McKENNA COLLEGE

PROGRAM BIOLOGY (WITH MARINE EMPHASIS)

Degree Offered B.A.

Description Claremont McKenna College does not offer an official “biology with marine emphasis” degree program. However, students can design such a major with faculty supervision. Claremont McKenna offers all of the basic undergraduate programs in science through the Joint Science Department, which services the science needs of Scripps and Pitzer Colleges as well. Students can also take advantage of and receive credit for marine biology courses offered at Pomona College. Currently there are several students doing their senior theses in marine science fields at Claremont McKenna College.

Number of Marine Science Courses 2 undergraduate; 0 graduate

Research Facilities Claremont McKenna College has three constant-temperature rooms, seawater systems, two boats (one outboard skiff and an inboard/outboard cruiser), scuba gear, and underwater photography equipment.

Contact Robert Feldmeth
Joint Science Department
Claremont McKenna College
Claremont, California
91711 (714) 621-8190
FAX (714) 621-8458

DOMINICAN COLLEGE OF SAN RAFAEL

PROGRAM BIOLOGY (WITH ECOLOGY/ENVIRONMENTAL EMPHASIS)

Degrees Offered B.A., B.S.

Description Dominican College offers no official “biology with marine emphasis” degree program. However, it offers a research program for biology students interested in graduate programs and careers in marine biology.

Number of Marine Science Courses 2 undergraduate; 0 graduate

Research Facilities Research on water chemistry, phytoplankton, zooplankton, and benthic populations with relation to sewage effluent are conducted in San Francisco Bay, and nearby coastal waters.

Contact Jean Durham, Assistant Professor
Department of Biology
Dominican College of San Rafael
San Rafael, California
94901 (415) 457-5533 (ext. 343)
### PROGRAM

**BIOLOGY (WITH MARINE OPTION)**

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>B.S., Minor in Marine Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Loyola Marymount offers a degree program in biology with a marine biology option. In addition to the biology major requirements, the student majoring in marine biology should take as many marine science courses as possible. The biology department recommends seven biology courses from which to choose, as well as one course from chemistry and one from earth science (both upper-division courses). The department also recommends language and psychology courses for the student interested in marine biology. Loyola Marymount also offers a special minor in marine biology for students majoring in other disciplines. The biology department requires a total of 21 semester hours with at least 10 semester hours in upper-division courses. The courses must be selected under the direction of the chairman of the biology department.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>8 undergraduate; 0 graduate</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>Loyola Marymount operates the Loyola Marymount University Baja California Biological Station, which is located at Coloradito, Baja California Norte, Mexico.</td>
</tr>
</tbody>
</table>

**Contact**

Roy Houston, Director  
LMU Baja California Biological Station  
Department of Biology  
Loyola Marymount University  
Loyola Boulevard at West 80th Street  
Los Angeles, California  
90045  
(310)338-7343

John Waggoner III, Assistant Director  
LMU Baja California Biological Station  
Chair, Department of Biology  
Loyola Marymount University  
Loyola Boulevard at West 80th Street  
Los Angeles, California  
90045  
(310) 338-7338
**OCCIDENTAL COLLEGE**

**PROGRAM** BIOLOGY (WITH MARINE EMPHASIS)

**Degree Offered** B.A., M.A.

**Description** Occidental offers programs in biology and marine biology. Students emphasizing marine biology must take at least nine biology courses, four chemistry courses, two mathematics courses, two physics courses, and one geology course. Students are encouraged to take the scuba class offered by the physical education department. All students in the program are involved as student instructors on the Vantuna and must register for at least one term of Biology Research as participants in either the deep-water research programs aboard the Vantuna or intertidal/scuba studies of inshore waters.

**Number of Marine Science Courses** 5 undergraduate; 3 graduate

**Research Facilities** Occidental uses the Vantuna, an 85-foot oceanographic vessel for deep-water studies, and 3 small boats for inshore marine studies using scuba equipment. A seaside research facility is operated jointly with Southern California Edison Company, which is partially devoted to researching possible ecological problems associated with electrical power operation.

**Contact** John S. Stephens, Jr.
Professor of Marine Biology
Biology Department
Occidental College
1600 Campus Road
Los Angeles, California
90041 (213) 259-2675

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**PACIFIC UNION COLLEGE**

**PROGRAM** BIOLOGY (WITH MARINE EMPHASIS)

**Degrees Offered** B.A., B.S.

**Description** Pacific Union offers no official “biology with marine emphasis” degree program. However, the college operates the Mendocino Biological Field Station at Albion, which offers numerous opportunities for study in marine biology. Courses offered at the field station are applicable toward the biology degree. Students interested in future work in marine biology are encouraged to take as many courses at the field station as possible.

**Number of Marine Science Courses** 1 undergraduate; 7 summer session courses offered at the field station

**Research Facilities** Pacific Union operates the Mendocino Biological Field Station at Albion, 100 miles from the college campus. The station is located where the Albion River empties into the Pacific Ocean, and it offers a unique opportunity for studying marine biology.
Facilities include a botany and a marine laboratory with a saltwater aquarium facility. A 16-foot Boston whaler is available for studies along the coast. Equipment and space are primarily geared to basic studies in marine biology, botany, and ecology.

Contact

Gilbert S. Muth
Professor of Biology

or

Ken Millard, Chair
Department of Biology

or

Earl M. J. Aagaard
Professor of Biology
Department of Biology
Pacific Union College
Angwin, California
94508 (707) 965-6227

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SUCCESSOR

BIOLOGY (WITH MARINE EMPHASIS)

Degree Offered: B.A.

Description: Pitzer College does not offer an official “biology with marine emphasis” degree program. However, students can design such a major with faculty supervision. Through the Joint Science Department, composed of faculty from three of the Claremont Colleges, namely Pitzer, Scripps, and Claremont McKenna, Pitzer students can undertake any of the basic undergraduate programs in science. Students can also take advantage of and receive credit for marine biology courses offered at Pomona College. Currently there are several students doing their senior theses in marine science fields.

Number of Marine Science Courses: 2 undergraduate; 0 graduate

Research Facilities: The Joint Science Department offers three constant-temperature rooms, seawater systems, two boats (one outboard skiff and an inboard outboard cruiser), scuba gear, and underwater photography equipment.

Contact: Robert Feldmeth
Joint Science Department
Claremont McKenna College
Claremont, California
91711 (714) 621-8190
PROGRAM BIOLOGY (WITH MARINE EMPHASIS)

Degree Offered B.A.

Description Pomona does not offer an official “biology with marine emphasis” degree program. However, students can choose biology electives that will reflect a strong background in marine biology, marine geology, or oceanography. Students at Pomona can also take courses at Harvey Mudd College through the Joint Science Department composed of faculty from three of the Claremont Colleges, namely Pitzer, Scripps, and Claremont McKenna Colleges. Pomona is well equipped for class study and independent research in field marine biology.

Students interested in the marine sciences can attend a summer session at a coastal or inland biological station. In particular, students at Pomona have spent the summer at Woods Hole, Massachusetts, the Oregon Institute of Marine Biology, and other marine laboratories, attending classes and doing research in marine biology while in residence.

Pomona students take trips on the Vantuna, an 85-foot tuna clipper modified for instruction and research in oceanography and marine biology. Trips are taken to coastal and offshore areas to sample benthic and pelagic organisms to a depth of 4,000 meters, and to study physical and chemical characteristics of the marine environment.

Number of Marine Science Courses 8 undergraduate (plus one at Harvey Mudd College and two through joint science department); 0 graduate

Research Facilities Pomona is a member of an interuniversity consortium which operates the Vantuna, an oceanographic vessel used for deep-water studies. The Vantuna is equipped with modern oceanographic instruments and sampling devices.

Contact Larry Oglesby
Biology Department
Pomona College
609 North College Avenue
Claremont, California
91711 (714) 621-8000 (ext. 8603 or 2950)
**SCRIPPS COLLEGE**

**PROGRAM** BIOLOGY (WITH MARINE EMPHASIS)

**Degree Offered** B.A.

**Description** Scripps College does not offer an official “biology with marine emphasis” degree program. However, students can design such a major with faculty supervision. Through the Joint Science Department, composed of faculty from three of the Claremont Colleges, namely Pitzer, Scripps, and Claremont McKenna, Scripps students can undertake any of the basic undergraduate programs in science. Students can also take advantage of and receive credit for marine biology courses offered at Pomona College. Currently there are several students doing their senior theses in marine science fields.

**Number of Marine Science Courses** 2 undergraduate; 0 graduate

**Research Facilities** The Joint Science Department offers three constant-temperature rooms, seawater systems, two boats (one outboard skiff and an inboard outboard cruiser), scuba gear, and underwater photography equipment.

**Contact**

Robert Feldmeth  
Joint Science Department  
Claremont Men’s College  
Claremont, California  
91711  (714) 621-8190

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**STANFORD UNIVERSITY**

**PROGRAM** BIOLOGY (WITH MARINE EMPHASIS)

**Degrees Offered** B.S., M.S., Ph.D. (in cooperation with Hopkins Marine Station)

**Description** Stanford has no official “biology with marine emphasis” degree program. However, it offers many classes at the Hopkins Marine Station in Pacific Grove. Students who wish to develop a biology program with marine biology emphasis need to take several classes at the Marine Station.

**Number of Marine Science Courses** 0 undergraduate; 0 graduate (15 undergraduate and graduate courses offered at Hopkins)

**Research Facilities** Stanford operates the Hopkins Marine Station in Pacific Grove, situated about 90 miles from the main university campus in Palo Alto. The station has several laboratories, a large library, and a sheltered landing place and storage for small boats. The station operates year-round and maintains a permanent staff, increased periodically by visiting faculty.

The station offers course work in the marine sciences year-round. Stanford students at both the undergraduate and graduate levels participate in the extensive marine curricula offered by the station.
PROGRAM
SCHOOL OF EARTH SCIENCES: DEPARTMENT OF GEOLOGICAL AND ENVIRONMENTAL SCIENCES AND THE PROGRAM IN EARTH SYSTEMS

Degrees Offered
B.S., M.S., and Ph.D.

Description
Stanford offers courses dealing with the marine environment and the development of the oceans and ocean basins as part of the required curricula and as electives for the B.S. degree in the Department of Geological and Environmental Sciences. The flexibility of the B.S. curriculum allows a student to specialize in marine aspects of the earth sciences. Students can also choose to minor in a related subject such as marine biology. Introductory survey courses open to non-majors include general oceanography, earth history, and physical geology. Graduate programs in the department leading to the M.S. and Ph.D. also include studies in paleoceanography, marine geochemistry, marine sedimentology, and marine geology with a number of faculty pursuing fundamental research in these topics. Graduate programs commonly involve courses and faculty with marine interests in other departments, including Geophysics, Chemistry, Materials Science, Biology, and Civil Engineering.

The undergraduate program in Earth Sciences offers a multidisciplinary curriculum coupling the biological, earth, and social sciences as a means to understand global earth processes, environmental changes through time, and their human impacts. The Earth Systems core curriculum and more focused courses in the Geosphere track include study of the ocean, atmosphere, climate change, and related subjects.

The Hopkins Marine Station offers classes in the marine sciences. These courses are open to biology majors and to those geology majors studying the marine sciences.

Number of Marine Science Courses
9 undergraduate; 9 graduate

Research Facilities
The School of Earth Sciences houses an array of modem laboratories and computer facilities for studying earth materials including specialized laboratories for sedimentology, organic geochemistry, and marine micropaleontology. The Branner Earth Sciences library contains over 100,000 books and journals dealing with the earth sciences including oceanography. In addition, the library contains over 200,000 maps covering every aspect of the earth’s surface. Students also have access by arrangement to research facilities at Stanford’s Hopkins Marine Station and the nearby Monterey Bay Aquarium Research Institute. Graduate students and faculty are active participants in the International Deep Sea Drilling Program and other research programs investigating the ancient and modem oceans of the world.

Contact
Dennis Powers, Director
Hopkins Marine Station of Stanford University
Pacific Grove, California
93950 (408) 373-0464

James C. Ingle
Department of Geological and Environmental Sciences
Stanford University
Stanford, California
94305 (415) 723-2537

Dennis Powers, Director
Hopkins Marine Station of Stanford University
Pacific Grove, California
93950 (408) 373-0464
PROGRAM: GEOPHYSICS

Degrees Offered: B.S., M.S., Ph.D.

Description: Geophysics is the branch of earth science concerned with exploration of the earth and its history by physical measurements. The undergraduate and graduate programs offered by Stanford University are designed to provide (1) a background of fundamentals in science and (2) courses in geophysics. The program leading to the Bachelor of Science in Geophysics permits many electives and a high degree of flexibility. Graduate programs give specialized training for professional work in exploration, research, and education.

Current research activities in the department include studies of geothermal areas, application of seismology to study of present-day tectonics, near field seismology, free oscillation and surface wave studies, reflection seismology, geophysical monitoring of the San Andreas fault, paleomagnetic investigations, studies of circum-Pacific tectonic evolution, marine geophysics, and major research programs in data analysis techniques and experimental and theoretical rock physics.

Number of Marine Science Courses: 5

Research Facilities: The Department of Geophysics is housed in the Ruth Wattis Mitchell Earth Sciences Building. The department has a number of research facilities, among which are a rock-magnetism laboratory, computers, a high pressure and temperature rock deformation laboratory, and various instruments for field measurements.

Contact: Mark D. Zoback
Department of Geophysics
Stanford University
Stanford, California 94305 (415) 725-9295

PROGRAM: MARINE STUDIES

Degrees Offered: B.A. (Marine Sciences, Ocean Studies); M.S. (Marine Science)

Description: The University of San Diego offers a variety of programs in Marine Studies at the undergraduate and graduate levels. These programs are offered with the support of the nearby Hubbs-Sea World Research Institute. At the undergraduate level, two interdisciplinary degrees are offered: Marine Sciences and Ocean Studies. The Marine Sciences degree is part of the Natural Sciences and has at its core a series of oceanographic courses (biological, geological, and physical/chemical oceanography, as well as law of the sea). A student chooses one of three pathways in this major: Biology, Chemistry, or Physics. Students take the largest part of their science curriculum, mainly at the upper division level, in their pathway. The Ocean Studies degree is largely a Social Science curriculum, but one where the student becomes conversant with marine science. Several science courses are required at the lower and upper division levels, including general oceanography, marine geology and geography, and marine environment. However, students also take a number of courses in Political Science, Anthropology, History, and Economics; many of these courses emphasize the Pacific Rim. Furthermore, students develop a course concentration in one of those social sciences. At the graduate level, the University offers a Master’s of Marine Science degree for students with an undergraduate background in the sciences. All students do research leading to a thesis. Many of the faculty and research scientists at the University and at Hubbs-Sea World Research Institute are available as thesis advisors.
Number of Marine Science Courses: 16

Research Facilities: USD has several laboratories dedicated to marine-related research; most of them are directed toward biological or geological research. The Environmental Studies Laboratory on campus also contributes lab space and holding facilities. One of three teaching laboratories has marine holding facilities; there is also an aquarium room in the Biology Department. Computer facilities are readily available. Especially at the graduate level, the program also utilizes the laboratory facilities and research vessels of Hubbs.

Contact: Hugh I. Ellis, Director  
Marine and Environmental Studies Program  
University of San Diego  
Alcala Park  
San Diego, California  
92110 (619) 260-4600
## PROGRAM

### BIOLOGY (WITH MARINE EMPHASIS)

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>M.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The University of San Francisco offers a Master of Science degree in biology with work encompassing the fields of botany, ecology, genetics, invertebrate biology, marine biology with an emphasis on invertebrates and ecology, microbiology, photobiology, physiology, environmental management, and vertebrate zoology. The immunology degree can be achieved either by examination or through a research program, which requires a written thesis. Marine biology is one area a student can choose.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>3 undergraduate; 3 graduate</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>The department has a field vehicle, two small boats with outboard motors, six refrigerated marine aquaria, a cold room, common sampling and field equipment, a physiology laboratory, and an electron microscope facility.</td>
</tr>
</tbody>
</table>
| Contact | Paul K. Chien  
Associate Professor of Marine Biology  
University of San Francisco  
Biology Department  
Ignatian Heights  
San Francisco, California  
94117  (415) 666-6531 |

### PROGRAM

#### DEPARTMENT OF BIOLOGICAL SCIENCES: MARINE BIOLOGY AND BIOLOGICAL OCEANOGRAPHY

<table>
<thead>
<tr>
<th>Degrees Offered</th>
<th>B.S., M.S., Ph.D (with marine specialization)</th>
</tr>
</thead>
</table>
| Description     | USC offers no official undergraduate “biology with marine emphasis” degree program. However, undergraduates with sufficient desire to concentrate in the field of marine biology can participate in the undergraduate Marine Biology Semester. During the spring semester of their junior or senior year, students take four upper-division elective courses while in residence at the Wrigley Marine Science Center on Santa Catalina Island. Additional courses in marine biology are taught at the main campus.  
Graduate students may choose from among three programs of study within the Graduate Program in Biological Sciences: two of these feature a strong emphasis in either marine biology or neurobiology, and the other leads to a graduate degree in molecular biology. Graduate courses in marine biology are offered on the main campus. |
| Number of Marine Science Courses | 10* undergraduate; 12* graduate and several seminars (*some courses are offered on an irregular basis). |
Research Facilities

Well equipped laboratories include facilities for stable isotope (\(^{15}\)N) and radioisotope studies, phytoplankton and bacterial culture, pigment analysis, optical studies, primary nutrient analysis, high performance liquid chromatography (HPLC), scanning and transmission electron microscopy. Adequate equipment is also available for field studies. In addition to the excellent computer facilities of the University Computing Center and numerous SUN workstations, the Marine Biology Program has in-house computers, including a PDP 11/45 with a full set of oceanographic software for data acquisition at sea and analysis of data in the laboratory. A PDP 11/23, a DEC 6220 and a variety of personal computers also are available for at-sea and laboratory needs.

Library facilities include the outstanding Allan Hancock Library of Oceanography and Marine Biology. Large collections of marine invertebrates and algae are housed in the Allan Hancock Foundation Building, providing exceptional resources for systematic, ecological, and biogeographic studies. Within reach are also the extensive collections of marine organisms of the Los Angeles County Museum of Natural History. The curators of these collections hold adjunct faculty positions in the Department of Biological Sciences and participate in the training of graduate students.

The University maintains a fleet of vessels for marine research. For details, see entry under “Ocean Sciences.”

Contact
Marine Biology Research Program
Department of Biological Sciences
University of Southern California
Los Angeles, California
90089-0371  (213) 740-5804

PROGRAM
GEOLOGICAL SCIENCES (WITH MARINE EMPHASIS)

Degrees Offered
M.S., Ph.D.

Description
The University of Southern California does not offer an oceanography degree program at the undergraduate level, since the department believes that specialized work in the field should be based on a sound preparation in a traditional field such as mathematics, science, or engineering. USC offers a general science service course in oceanography for non-science undergraduates, as well as an upper-division course in introductory oceanography for science and engineering majors with interests in the ocean and the global environment. At the graduate level, USC’s Department of Geological Sciences offers a graduate program in geological sciences with strong areas of specialization in marine geology, geochemistry, geophysics, and chemical and physical oceanography. All degrees are in geological sciences, but course programs, theses, and dissertation research are in marine science areas. Approximately half of the Ph.D.’s awarded in geological sciences in the last 43 years have been in marine geological subjects. Major areas include dynamics of marine sediment transport, marine sedimentary environmental studies, coastal dynamics, water and sediment chemistry, isotopic studies, shelf and basin water circulation, heat flow, crustal structure and seismic stratigraphic studies of marine basins, and paleoecologic and microfaunal studies of shelf and deep-sea environments.

Number of Marine Science Courses
2 undergraduate; 11 graduate
### Program: Ocean Sciences

#### Degrees Offered
- M.S., Ph.D

#### Description
The Hancock Institute for Marine Studies (HIMS) offers an opportunity for graduate study with an emphasis in interdisciplinary aspects of oceanography. Areas of current research included upper ocean ecology and dynamics, coastal upwelling, marine microbial physiology, dynamics of marine food chains, larval biology, sediment diagenesis, marine chemistry, and dynamics of fluid motion.

#### Number of Marine Science Courses
3 graduate, plus others under Biology, or Geology, or Engineering.

#### Research Facilities
The research programs in HIMS include the study of marine organisms and their environment and are conducted both in laboratory facilities on the USC main campus and in the field. The University maintains a fleet of vessels for marine research including the 65-foot R/V *Seawatch*, the 43-foot R/V *Golden West*, and a number of smaller craft. The fleet is berthed in the Port of Los Angeles at the Fish Harbor Laboratory, a building that houses 5,400 sq. ft. of research and office space. Equipment for collecting water and sediment samples is maintained at the Marine Facility. The University also operates the Wrigley Marine Science Center (WMSC), located on Santa Catalina Island, 23 miles from the mainland. The WMSC includes a 30,000 sq. ft. laboratory building with equipment for a wide range of teaching and research, a running seawater system, a diving support complex, and housing and dining facilities. Campus facilities include a wide spectrum of analytical instrumentation that is described under the Geology and Biology listings.

#### Contact
Hancock Institute for Marine Studies  
University of Southern California  
Los Angeles, California  
90089-0373  (213) 740-7530  
FAX  (213) 740-8143
**Program Directory**

**California Maritime Academy**

<table>
<thead>
<tr>
<th>Program</th>
<th>Engineering (With Ocean Technology Option)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Degree Offered</strong></td>
<td>B.S.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Marine Engineering Technology Major (MET): The Marine Engineering Technology curriculum provides college level preparation for a professional career in the technological spectrum between the more theoretically oriented mechanical engineer and the applied technician. The emphasis is on applied practice rather than analytical methods. Lower division course work includes science, mathematics, computer science, drafting, and manufacturing processes as well as general education courses. Building on this foundation, upper division courses develop an understanding of properties of engineering materials, selection of machine components, mechanical, electrical, and fluid energy and power technology, and systems control. Graduates of MET have the practical and theoretical background to successfully operate, maintain, and manage shipboard and shoreside power plants, manufacturing systems, utilities, heating, ventilation and air conditioning systems, and machinery maintenance systems. This program is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology. The three intensive sea training cruises instill the competence and confidence necessary to operate and maintain a power plant at sea and ashore. During the cruises, students stand watches of increasing responsibility and carry out all of the functions necessary to keep the plant operating reliably and efficiently. This experience qualifies the graduate of this program to earn a U.S. Coast Guard license as Third Assistant Engineer, Steam and Diesel, Unlimited Horsepower. In addition, senior students qualify to take optional examinations to earn registration as Engineers-in-Training in California and certification as Third Class Power Engineers from the National Association of Power Engineers.</td>
</tr>
<tr>
<td>Mechanical Engineering Major: The Mechanical Engineering curriculum prepares the student for a wide range of professional activity in the engineering field, particularly with energy systems and their application to the generation of power and propulsion, and to the motion of mechanical systems and fluids. The program includes a strong foundation in mathematics, the basic sciences, and the engineering sciences to enable competent engineering analysis, synthesis, and design. These more theoretical studies are accompanied by equally solid experience with engineering systems-hands-on experience. The result is a graduate with the knowledge, skills, and experience to move immediately into responsible engineering positions, or to go on to graduate study and research. The Mechanical Engineering curriculum at CMA includes in-depth coverage of the wide spectrum of mechanical and energy systems associated with shipboard and related land-based applications. Three sea training cruises aboard CMA’s training ship Golden Bear provide extensive practical experience in the operation of such systems, and result in a graduate who is both competent and confident. In addition to the Bachelor of Science degree in Mechanical Engineering, the graduate of this program will also earn a U.S. Coast Guard license as Third Assistant Engineer, Steam and Diesel.</td>
<td></td>
</tr>
<tr>
<td><strong>Number of Marine Science Courses</strong></td>
<td>16 undergraduate (units); 0 graduate</td>
</tr>
<tr>
<td><strong>Research Facilities</strong></td>
<td>The academy is adjacent to the Carquinez Strait, where a deep-water pier provides berthing space for the training ship Golden Bear. The Golden Bear is a 7,987 gross-ton vessel which can cruise at 16 knots, and serves as a “floating laboratory” during annual training cruises and during the campus trimesters.</td>
</tr>
<tr>
<td>Program Directory</td>
<td>Four-Year Public</td>
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</tbody>
</table>
| **Contact**       | Commander Ralph Davis  
|                   | Head of Engineering Department  
|                   | California Maritime Academy  
|                   | Maritime Academy Drive  
|                   | Vallejo, California  
|                   | 94590 (707) 648-4200 |
| **PROGRAM**       | MARITIME MANAGEMENT |
| **Degree Offered**| B.S.              |
| **Description**   | *Marine Transportation Major:* The student choosing a career as a licensed deck officer (mate) or a shoreside maritime manager majors in Marine Transportation. This major provides the broadest maritime industry training exposure possible consistent with officer licensing requirements.  
Marine Transportation graduates have a broad employment field open to them. A wide variety of shoreside management positions await the graduate in numerous maritime sectors, including vessel operations, ship’s agency, marine insurance, stevedoring, charter brokering, and federal employment. Shipboard employment opportunities are also open to the Marine Transportation graduate. This major is designed to prepare the student to take the U.S. Coast Guard Third Mate’s examination and meet his or her responsibilities as a licensed deck.  
Composition, number, and organization of departments and groups on board ship vary from nation to nation, company to company, and ship to ship. However, on all ships the Master, Captain, or Commanding Officer is the ranking officer aboard to whom the heads and chiefs of the various departments and groups are responsible. Directly under the Master in the chain-of-command are the Chief Officer, the junior deck officers, and the balance of the Deck Department. The Deck Department is charged with the navigation and management of the vessel.  
Deck licenses issued by the U.S. Coast Guard in increasing rank are as follows: Third Mate, Second Mate, Chief Mate, and Master. Further increase in grade is dependent upon the graduates’ ability to accumulate sea time and to pass examinations of increasing complexity and difficulty. The U.S. Coast Guard issues higher licenses to deck officers after satisfactory completion of a written examination and actual sea-going experience, usually one year.  
*Business Administration:* The student choosing a career as a manager for a transportation company should consider the Business Administration degree program. This program consists of a set of basic core courses and an area of concentration. The primary objective of the Business Administration degree program is to provide students with the basic concepts and practices of business, with a specific concentration of expertise in a business specialty, in order to prepare the student to think creatively and exercise analytical judgment in the making of business decisions.  
California Maritime Academy has a Memorandum of Agreement with the School of Business at San Francisco State University, which has agreed to accept courses, conditions, and entrance requirements for CMA graduates of the Business Administration program into SFSU’s Master of Business Administration or Master of Science in Business Administration program. San Francisco State will schedule the program to serve the unique needs of Cal Maritime graduates.  
The area of concentration is Transportation, with options in Management, and Intermodal Transportation. |
| **Number of Marine Science Courses** | 18 undergraduate (units); 0 graduate |
Research Facilities
See the description of research facilities under California Maritime Academy’s Engineering program.

Contact
California Maritime Academy
Maritime Academy Drive
Vallejo, California
94590  (707) 648-4200

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**CALIFORNIA POLYTECHNIC STATE UNIVERSITY, SAN LUIS OBISPO**

**PROGRAM**
ECOLOGY AND SYSTEMATIC BIOLOGY (WITH MARINE BIOLOGY AND FISHERIES CONCENTRATION)

**Degrees Offered**
B.S., M.S. ( Biological Sciences)

**Description**
The Bachelor of Science degree with concentration in marine biology and fisheries prepares students for advanced training or professional employment in public or private agencies concerned with marine sciences, freshwater ecology, fisheries, biology, fisheries management, or related fields. By judicious selection of electives, the student will be academically prepared to apply for professional certification as a Fisheries Biologist by the American Fisheries Society. The Master of Science degree, offered in biological sciences, provides preprofessional preparation for the biomedical fields.

**Number of Marine Science Courses**
7 undergraduate; 1 graduate

**Research Facilities**
A marine biology laboratory with recirculating seawater is maintained in the Science North building on campus and water tables are available for graduate students. An algal collection is part of the herbarium. Basic collecting and dredging gear, several small boats, and a 17-foot dory are provided for field work. A radioactive chromatograph scanner, an X-ray diffraction machine, and liquid scintillation apparatus may be used by marine sciences students for radioactive tracer studies. Other pertinent equipment includes a Leitz micro-manipulator, a transmission electron microscope and a scanning electron microscope, a Leitz orthomat for automatic photomicrography, recording spectrophotometer (UV through visible), gas chromatography apparatus, fraction collectors, ultra-centrifuge, densitometers, fluorometer, and high-voltage electrophoresis and atomic absorption equipment. Several controlled growth chambers and a dew chamber are also available. The department shares the use of an IBM 360 computer with 128K core storage units.

**Contact**
Thomas L. Richards
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California
93407  (805) 756-2943
Degree Offered
Part of baccalaureate

Description
Ocean engineering is a cross-disciplinary field dealing with all aspects of the marine environment. Subjects include marine structures, marine vehicles, marine chemistry, marine ecology, and coastal and marine engineering. The Ocean Engineering minor has access to the research facilities of the CSU Ocean Studies Institute (OSI) and the 76-foot Research Vessel Yellowfin. Cal Poly Pomona facilities include a circular tow tank, wave tank, three trailable boats, a remotely-operated vehicle, and a fluids laboratory.

The minor in Ocean Engineering is available to any engineering student. Aerospace, Civil, Electrical, and Mechanical engineering majors may be able to acquire this minor within the framework of their normal degree requirements through careful substitution of certain requirements. Other engineering majors will find it necessary to take additional units beyond those required for the bachelor’s degree.

The attainment of a minor in Ocean Engineering is accomplished by appropriate selection, timely scheduling, and satisfactory completion of certain required and elective type courses totaling a minimum of 24 units as outlined below.

Completion of the following courses is required:
- Introduction to Ocean Engineering EGR 230 (2 units)
- Ocean Electronics ECE 434 (4 units)
- Ocean Engineering EGR 430 (4 units)
- Oceanography GSC 335 (4 units)

The remainder of the 24 units required may be taken from:
- Introduction to Marine Biology BIO 220 (4 units)
- Marine Ecology BIO 442 (5 units)
- Coastal Engineering CE 455 (4 units)
- Underwater Sound EGR 437 (4 units)
- Special Topics EGR 499 (1 to 4 units)
- Corrosion Chemistry CHM 446 (4 units)
- Coastal Processes GSC 338 (4 units)
- Welding Fabrication and Design MTE 337 (3 units)
- Skin and Scuba Diving PE 231 (3 units)

Research Facilities
There is a variety of student projects going on at any time. Testing of project equipment can be carried out at sea by use of our trailable boats or of R/V Yellowfin, as needed. Communications between Cal Poly boats and on-campus stations are available.

Contact
George F. Engelke
Chair, Ocean Engineering & Mechanical Engineering
J. Patton Rimer
Ocean Engineering Coordinator
Mechanical Engineering Department
College of Engineering
California State Polytechnic University, Pomona
3801 West Temple Avenue
Pomona, California
91768-4062  (909) 869-2575
or  (909) 869-2587
CALIFORNIA STATE UNIVERSITY, FRESNO

PROGRAM
BIOLOGY (WITH OPTIONS IN ECOLOGY, ORGANISMIC AND GENERAL BIOLOGY, PHYSIOLOGY, AND MOLECULAR AND CELLULAR BIOLOGY)

Degree Offered B.A.

Description
CSU, Fresno offers a degree program in biology with two options appropriate to studies in marine science. The biology degree provides the required specialization for entering graduate schools, professional schools, or vocations requiring a biological background. Two options-ecology and organismic and general biology-have the flexibility and breadth needed to permit development of marine science within the biology degree program. Both options provide the foundation necessary for graduate study; organismic and general biology is associated with preparation for teaching, while ecology is more suitable for careers in marine science field work and research, environmental law and consulting, as well as fish and game research and management.

The marine science emphasis is made possible through course work taken at Moss Landing Marine Laboratories. Students at CSU, Fresno receive resident (home campus) credit for courses taken at Moss Landing.

Number of Marine Science Courses
6 undergraduate (21 at MLML); 0 graduate (22 at MLML)

Research Facilities
CSU, Fresno is one of the six California State Universities operating the Moss Landing Marine Laboratories. This facility offers full-time course work in marine biology, oceanography, and other marine sciences. The curriculum offered at Moss Landing is designed to support majors in biological and physical sciences through course offerings that may be incorporated into those of the biology, chemistry, and geology degree requirements. See description of Moss Landing Marine Laboratories under San Jose State University.

Contact
Bert A. Tribbey
Professor of Biology
California State University
Fresno, California
93740  (209) 278-2068
or  (209) 278-2001

CALIFORNIA STATE UNIVERSITY, FULLERTON

PROGRAM
BIOLOGY (WITH MARINE EMPHASIS)

Degrees Offered B.A., M.A.

Description
CSU, Fullerton offers Bachelor of Arts and Master of Arts degree programs in biology with emphasis in marine biology. The programs are designed for students preparing to enter graduate or professional schools, for those preparing to teach, and for those preparing for careers in industry or government service.

The marine science programs emphasize the nearshore environment and include active field and laboratory instruction in the biology and ecology of coastal marine plankton, benthic macroalgae and invertebrates, and fishes. Students seeking the Bachelor of Arts degree should construct a program of course work consistent with career objectives in consultation with an advisor. For the
Master of Arts degree, advisor-approved graduate course work, a research thesis, and a final oral examination are required.

**Number of Marine Science Courses**
10 undergraduate/graduate

**Research Facilities**
The marine biology teaching and research program occupies modern laboratory facilities which are serviced by a temperature-controlled, recirculating seawater system. Laboratories are well equipped for ecological, physiological, systematic and biochemical studies, and are serviced by a dedicated aquarium room. Additional departmental support facilities include scanning and transmission electron microscopes, and greenhouse complex. Reference collections of algae and invertebrates are also available.

CSU, Fullerton is a founding member of the Ocean Studies Institute (OSI), which provides research and instructional support facilities aboard the R/V *Yellowfin*, a converted 76-foot fisheries research vessel berthed in Alamitos Bay, Long Beach. (See the description of research facilities under CSU, Long Beach’s marine program).

**Contact**
Michael H. Horn (Ichthyology)

or

Steven N. Murray (Phycology)

or

Roger R. Seapy (Invertebrate Zoology)

Department of Biological Science
California State University
Fullerton, California
92634   (714) 773-3614

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**CALIFORNIA STATE UNIVERSITY, HAYWARD**

**PROGRAM**  
BIOLOGICAL SCIENCES

**Degree Offered**  
M.S.

**Description**
CSU, Hayward offers the Master of Science degree in biological science with study areas in general ecology, population biology, marine ecology, limnology, insect ecology, plant ecology, cell and molecular biology, genetics, immunology, plant and animal physiology, or microbial physiology.

Students working toward an M.S. degree utilizing marine organisms may take courses both on the home campus and at the Moss Landing Marine Laboratories. Both facilities offer a variety of courses in marine biology and oceanography. Qualified graduate students may enroll in courses at both Hayward and Moss Landing and earn CSUH resident credit for such course work.

**Number of Marine Science Courses**
8 undergraduate; 6 graduate (20 at MLML)

**Research Facilities**
The CSU, Hayward Department of Biological Sciences has modern facilities and equipment for both field and laboratory work in marine biology. The close proximity to the shores of San Francisco Bay provides ample opportunity for field studies in estuarine environments such as salt marshes, intertidal mud flats, seagrass beds and open water habitats.
CSU, Hayward is one of the six cooperating state universities that offer courses and research at the Moss Landing Marine Laboratories, owned and operated by the California State Universities consortium. The facility functions as a seaside extension of the six campuses and is equipped for field studies in marine biology, oceanography, and other marine sciences.

Contact
Edward B. Lyke
Department of Biological Sciences
California State University
Hayward, California
94542 (415) 881-3471

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>GEOLOGY (WITH OPTION IN ENVIRONMENTAL GEOLOGY)</th>
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<tbody>
<tr>
<td>Degree Offered</td>
<td>M.S.</td>
</tr>
<tr>
<td>Description</td>
<td>CSU, Hayward offers a Master of Science degree program in geology with an option in environmental geology. The program is designed to prepare students for, among other things, doctoral research in various aspects of geology, geochemistry, geophysics, geomorphology, and oceanography, depending upon undergraduate backgrounds. Students working toward an M.S. in geology may take courses offered at the Moss Landing Marine Laboratories (MLML). The facility offers full-time course work in marine geology, oceanography, and other marine-related earth sciences. Qualified graduate students may enroll for a term of instruction at Moss Landing and earn resident credit for such course work.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>3 undergraduate (5 at MLML); 2 graduate (11 at MLML)</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>See the description of Moss Landing Marine Laboratories under CSU, Hayward’s Marine Sciences program.</td>
</tr>
<tr>
<td>Contact</td>
<td>Detlef A. Warnke</td>
</tr>
<tr>
<td></td>
<td>Department of Geological Sciences</td>
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<tr>
<td></td>
<td>California State University</td>
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<td></td>
<td>Hayward, California</td>
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<td></td>
<td>94542 (510) 881-3486</td>
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</table>

CALIFORNIA STATE UNIVERSITY, LONG BEACH

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<thead>
<tr>
<th>PROGRAM</th>
<th>BIOLOGY (WITH MARINE EMPHASIS)</th>
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<tbody>
<tr>
<td>Degree Offered</td>
<td>M.S.</td>
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<tr>
<td>Description</td>
<td>CSU, Long Beach offers a Master of Science degree program in biology with an emphasis in marine biology. Courses for the degree program and the thesis research program are selected in consultation with a thesis advisor selected by mutual consent. Departmental faculty have active research programs in marine pollution, physiology, ichthyology, parasitology, ornithology, invertebrate ecology and physiology, phycology, bioluminescence, and shark behavior.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>10 undergraduate; 7 graduate</td>
</tr>
</tbody>
</table>
Research Facilities
The biology department occupies facilities in three science buildings, which house an electron microscope, a seawater system and marine laboratory, greenhouses, and research and teaching collections of algae, fungi, vascular plants, invertebrates, and vertebrates. The department, through its Institute for Molecular Ecology, conducts research in environmental toxicology and other areas of relevance to the marine environment.

CSU, Long Beach is a member of the Ocean Studies Institute (OSI), which offers special courses in ocean studies. The OSI operates the 75-foot research vessel Yellowfin, which provides onboard research laboratories and classroom facilities.

Contact
Graduate Secretary
Department of Biology
California State University
1250 Bellflower Boulevard
Long Beach, California
90840-3702 (310) 985-4806

PROGRAM GEOLOGY (WITH MARINE EMPHASIS)

Degrees Offered
B.S., M.S. (with marine emphasis)

Description
CSU, Long Beach offers a Bachelor of Science degree program in geology with marine emphasis. Students considering this program must obtain a departmental advisor to help plan a four-year program that reflects a strong marine geology basis. The Master of Science program is unofficial and must be planned with the faculty. The geological sciences department participates in the interdisciplinary Center for Ocean Science Studies, which offers a variety of courses suitable for the student interested in marine geology.

Number of Marine Science Courses
5 undergraduate; 2 graduate

Research Facilities
The geological sciences department is a member of the Ocean Science Institute, described in the program description for the CSU, Long Beach - Biology.

Contact
Stanley C. Finney, Chairman
Department of Geological Sciences
1250 Bellflower Boulevard
California State University
Long Beach, California
90840-3702 (310) 985-4809

PROGRAM MARINE BIOLOGY

Degree Offered
B.S.

Description
CSU, Long Beach offers a Bachelor of Science degree program in marine biology. Courses for the degree program are selected in consultation with a faculty advisor. The student majoring in marine biology can select elective courses that provide additional emphasis in marine biology, or another field of biology, such as biosystematics, ecology, genetics, morphology, or plant or animal physiology. Courses are offered in several areas of experimental biology. Because the campus is near the ocean, the department is able to offer a number of field and laboratory courses in marine biology.

Number of Marine Science Courses
10 undergraduate; 7 graduate
Research Facilities

The biology department occupies facilities in three science buildings, which house two electron microscopes, a seawater system and marine laboratory, greenhouses, and research and teaching collections of algae, fungi, vascular plants, invertebrates, and vertebrates.

CSU, Long Beach is a member of the Ocean Studies Institute (OSI), which offers special courses in ocean studies. The OSI operates the 75-foot research vessel *Yellowfin*, which provides onboard research laboratories and classroom facilities.

Contact

Marine Biology Advisor
Department of Biology
California State University
1250 Bellflower Boulevard
Long Beach, California
90840-3702  (310) 985-4806

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CALIFORNIA STATE UNIVERSITY, LOS ANGELES

PROGRAM

ISSUES IN ENVIRONMENTAL BIOLOGY

Degree Offered

Part of baccalaureate

Description

CSU, Los Angeles is in the process of developing a number of courses with environmental emphasis. Students seeking certification will be able to qualify by choosing from a selection of marine-related courses such as oceanography, ichthyology, invertebrate zoology, botany, and ecology.

Number of Marine Science Courses

7 undergraduate; 2 graduate courses

Research Facilities

CSU, Los Angeles is a member of the Ocean Studies Institute (OSI). CSU has a 1200 gallon recirculating seawater wet lab and complete dry lab facilities used for instruction and research. Other facilities are provided by cooperative agreement with OSI and the University of Southern California. See description under CSU, Long Beach-Marine Biology program for a description of available research vessel and onboard laboratory facilities.

Contact

Carlos Robles
Professor of Biology
California State University
5151 State University Drive
Los Angeles, California
90032  (213) 343-2067
PROGRAM  BIOLOGY (WITH MARINE EMPHASIS)

Degrees Offered  B.A., B.S.

Description  The Department of Biology offers both a B.A. and B.S. in biology within the Environmental Option. Within this option students may emphasize marine biology. A formal Marine Biology Option is planned in the near future. Courses are offered within the department and in conjunction with the Ocean Studies Institute, a consortium of CSU campuses in Southern California.

Number of Marine Science Courses  8 undergraduate; 5 graduate

Research Facilities  The Marine Biology Program maintains a wet-laboratory facility which includes a temperature controlled running seawater system allowing maintenance of marine organisms over extended periods. Additionally, facilities include an electron microscope facility with both transmission and scanning EM capabilities, and access to a new Center for Molecular and Population Studies laboratory for students interested in population biology or systematics of marine organisms. CSU, Northridge is also a member of the Ocean Studies Institute and has access to the 75-foot teaching and research vessel R/V Yellowfin and two 16-foot Boston Whalers for coastal and nearshore research. The facilities of the Wrigley Marine Science Center on Santa Catalina Island are also available to support research.

Contact  Department of Biology
California State University
Northridge, CA
91330  (818) 885-3356

PROGRAM  BIOLOGY (WITH MARINE EMPHASIS)

Degree Offered  M.S.

Description  The Department of Biology offers an M.S. degree in biology. For students interested in marine biology, a graduate program can be designed to provide advanced courses and research training in their area of interest. The graduate program is particularly strong in preparing students for further graduate training and advanced academic careers. Interested students are encouraged to contact a faculty member within their area of academic interest.

Number of Marine Science Courses  8 undergraduate; 5 graduate

Research Facilities  The Marine Biology Program maintains a wet-laboratory facility, which includes a temperature-controlled running seawater system allowing maintenance of marine organisms over extended periods. Additionally, facilities include an electron microscope facility with both transmission and scanning EM capabilities, and access to a new Center for Molecular and Population Studies laboratory for students interested in population biology or systematics of marine organisms. CSU, Northridge is also a member of the Ocean Studies Institute and has access to the 75-foot teaching and research vessel R/V Yellowfin and two 16-foot Boston Whalers for coastal and nearshore research. The facilities of the Wrigley Marine Science Center on Santa Catalina Island are also available to support research.
| Contact | Larry Allen  
or  
Robert Carpenter  
or  
Pete Edmunds  
or  
Ross Pohlo  
Department of Biology  
California State University  
Northridge, California  
91330  (818) 885-3356 |

### PROGRAM

**PROGRAM**  BIOLOGICAL SCIENCES (BIOLOGICAL CONSERVATION WITH MARINE EMPHASIS)

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>M.S.</th>
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</table>
| Description | CSU, Sacramento does not offer an official “biology with marine emphasis” degree program. However, one option of the biology program focuses on biological conservation, and requires a bachelor’s degree in biology with specialty in zoology, ecology, fishery biology, or wildlife biology for admission.  
Each student designs a specific curriculum with an advisor, and students interested in marine biology can take courses offered at Moss Landing Marine Laboratories for credit toward the major. |
| Number of Marine Science Courses | 3 undergraduate (21 at MLML); 0 graduate (24 at MLML) |
| Research Facilities | See description of Moss Landing Marine Laboratories under San Jose State University. |
| Contact | P. Thomas Kantz  
Professor of Biology  
Department of Biological Sciences  
California State University  
6000 J Street  
Sacramento, California  
95819  (916) 454-6244  
or  
(916) 454-6535 |
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<tr>
<th>PROGRAM</th>
<th>BIOLOGICAL SCIENCES (WITH MARINE EMPHASIS)</th>
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<tr>
<td><strong>Degree Offered</strong></td>
<td>M.A.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>CSU, Sacramento does not offer an official “biology with marine emphasis” degree program. However, it is possible to design a specific curriculum with an advisor, and students interested in marine biology can take courses offered at Moss Landing Marine Laboratories for credit toward the major.</td>
</tr>
<tr>
<td><strong>Number of Marine Science Courses</strong></td>
<td>3 undergraduate (21 at MLML); 0 graduate (24 at MLML)</td>
</tr>
<tr>
<td><strong>Research Facilities</strong></td>
<td>See description of Moss Landing Marine Laboratories under San Jose State University.</td>
</tr>
</tbody>
</table>
| **Contact** | P. Thomas Kantz  
Professor of Biology  
Department of Biological Sciences  
California State University  
6000 J Street  
Sacramento, California  
95819 (916) 454-6244  
or (916) 454-6535 |

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<tr>
<th>PROGRAM</th>
<th>BIOLOGICAL SCIENCES (WITH AQUATIC BIOLOGY EMPHASIS)</th>
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<tr>
<td><strong>Degree Offered</strong></td>
<td>B.A.</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>CSU, Sacramento does not offer an official Bachelor of Arts degree program in biological science with emphasis in marine biology or limnology (aquatic biology). However, by selecting appropriate electives a student may obtain such an emphasis. Students take a biology preparatory program that includes core subjects such as basic biological concepts, animal biology, plant biology, physiology, microbiology, ecology, and genetics; supporting subjects in chemistry, physics, and statistics; and a minimum of 9 units selected from courses including invertebrate zoology, nonvascular plants, limnology, ichthyology, marine ecology, vertebrate zoology, and general oceanography (offered by the Geological Sciences Department).</td>
</tr>
<tr>
<td><strong>Number of Marine Science Courses</strong></td>
<td>3 undergraduate (21 at MLML); 0 graduate (24 at MLML)</td>
</tr>
<tr>
<td><strong>Research Facilities</strong></td>
<td>CSU, Sacramento is one of the six participating state universities and colleges offering full-time course work at the Moss Landing Marine Laboratories (MLML). Students can take courses in marine biology, oceanography, marine geology, and other marine sciences offered at the facility. See description of MLML under San Jose State University.</td>
</tr>
</tbody>
</table>
| **Contact** | P. Thomas Kantz  
Professor of Biology  
Department of Biological Sciences  
California State University  
6000 J Street  
Sacramento, California  
95819 (916) 454-6244  
or (916) 454-6535 |
PROGRAM GEOLOGY (WITH OCEANOGRAPHY EMPHASIS)

Degree Offered B.S.

Description CSU, Sacramento offers no official “geology with marine emphasis” degree program. However, students interested in oceanography can design a program using courses offered at Moss Landing Marine Laboratories. Students interested in this individual program must seek a faculty advisor to help formulate a program that shows a strong oceanography basis.

Number of Marine Science Courses 2 undergraduate (9 at MLML); 0 graduate (7 at MLML)

Research Facilities See the description of Moss Landing Marine Laboratories under San Jose State University.

Contact Susan Slaymaker
Professor of Geology
Department of Geology
California State University
Sacramento, California
95819 (916) 454-6337

PROGRAM BIOLOGY (WITH MARINE CONCENTRATION)

Degrees Offered B.A., B.S., M.S. in Marine Science (in conjunction with Moss Landing Marine Laboratories)

Description CSU, Stanislaus offers both a Bachelor of Arts and a Bachelor of Science undergraduate degree program in the biological sciences with concentration in marine biology. The Bachelor of Arts degree is designed to provide breadth and background in the natural sciences and to allow sufficient flexibility to accommodate the diverse needs of the general student. Individuals preparing for careers in agriculture, industry, and elementary or secondary teaching will find that this degree is adaptable to their career objectives. The Bachelor of Science is designed to provide the comprehensive background in the sciences required for students planning to attend graduate or professional schools.

The marine biology option is one of several options offered by the biological sciences department. Completing a concentration is optional. Students interested in marine biology and oceanography may elect course work at the Moss Landing Marine Laboratories for partial fulfillment of their in-resident major and degree requirements.

At the graduate level, an M.S. in Marine Science is offered in conjunction with Moss Landing Marine Laboratories.

Number of Marine Science Courses 5 undergraduate (19 at MLML); 0 graduate (23 at MLML)

Research Facilities CSU, Stanislaus is a member of the California State Universities consortium that operates the Moss Landing Marine Laboratories at Moss Landing, California. This facility functions as a seaside extension of the cooperating campuses (Stanislaus, Fresno, Hayward, Sacramento, San Francisco, and San Jose), and offers course work in marine biology, geology, oceanography, and other marine sciences. The curriculum is designed to fulfill major requirements for qualified upper-division and
graduate students. Such students can plan their academic schedules to provide for one or more
terms at the Moss Landing Marine Laboratories and will be considered an in-residence student at
CSU, Stanislaus.

Contact
Pamela Roe
Professor of Biology
Department of Biological Science
California State University, Stanislaus
Turlock, California
95380 (209) 667-3484
or (209) 667-3476

HUMBOLDT STATE UNIVERSITY

PROGRAM ENVIRONMENTAL RESOURCE ENGINEERING (WATER QUALITY, WATER RESOURCE,
AND GEOTECHNICAL EMPHASIS)

Degree Offered B.S.

Description Humboldt offers ocean and coastal engineering courses within the water and geotechnical emphasis
areas in the environmental resource engineering degree program. The engineering department
requires students to design a natural resources- or environment-oriented engineering program, in
consultation with their advisors.

Number of Marine Science Courses 8 undergraduate; 0 graduate

Research Facilities Students enrolled in the engineering programs with water and geotechnical emphasis can get
instrumentation experience aboard the vessels available through Humboldt’s marine laboratory in
Trinidad. A complete water quality laboratory is available in the engineering department. Field
monitoring equipment is also available. See also description of Humboldt State’s Biology with
Marine Specialization program.

Contact Alden Burrows, Chairman
Department of Engineering
Humboldt State University
Environmental Resources Engineering Department
Arcata, California
95521 (707) 826-3618

Ron Chaney
Professor of Engineering
Humboldt State University
Environmental Resources Engineering Department
Arcata, California
95521 (707) 826-4992

Bob Gearheart
Professor of Engineering
Humboldt State University
Environmental Resources Engineering Department
Arcata, California
95521 (707) 826-3135
**PROGRAM**  
FISHERIES

**Degrees Offered**  
B.S., M.S.

**Description**  
Humboldt offers lower and upper division degree courses with fisheries emphasis. Undergraduate courses are available in commercial fisheries, mariculture, techniques in fishery biology, ecology of marine fishes, fish population dynamics, and principles of fishery management. At the graduate level, students may choose from early life history of fishes, and advanced fish population dynamics.

**Number of Marine Science Courses**  
6 undergraduate; 2 graduate

**Research Facilities**  
See description in Humboldt State’s Biology with Marine Specialization program.

Specialized facilities are available for fisheries instruction and research. These include a freshwater fish hatchery and associated rearing ponds, raceways, spawning pens, and an artificial stream. Saltwater aquaria, with capacities of up to 500 gallons, are located at the marine laboratory in Trinidad.

Facilities also include a fish pathology laboratory and a toxicity bioassay area. An anadromous salmonid fish-culture facility, utilizing domestic wastewater and seawater, is located at the City of Arcata sewage treatment plant on Humboldt Bay.

**Contact**  
Ted Kerstetter  
Department of Fisheries  
Humboldt State University  
Arcata, California  
95521 (707) 826-3953  
or  
Timothy J. Mulligan  
(707) 677-3671

**PROGRAM**  
INTERDISCIPLINARY STUDIES IN NATURAL RESOURCES (WITH AN OCEANOGRAPHY OPTION)

**Degree Offered**  
M.S.

**Description**  
Humboldt offers a graduate program in interdisciplinary studies in natural resources with an oceanography option. To complete the program, students must have an undergraduate degree in either the natural resources, a life science, or a physical science. Students choose from numerous marine science courses offered by the biology, oceanography, and fisheries departments.

**Number of Marine Science Courses**  
43 undergraduate; 16 graduate

**Research Facilities**  
See the description of research facilities under HSU’s Marine Biology program.

**Contact**  
Jeffry C. Borgeld, Chair  
Department of Oceanography  
Humboldt State University  
Arcata, California  
95521-8299 (707) 826-4147
**PROGRAM** BIOLOGY (WITH MARINE BIOLOGY OPTION)

**Degrees Offered** B.S., M.A.

**Description** A Bachelor of Science degree is offered in Biology with a Marine Biology Option. All biology students take the same core of lower division courses. Students of the Marine Biology Option take the following upper division courses: Principles of Ecology, Genetics, Evolution, General Bacteriology, Intertidal Ecology, Marine Phycology, Invertebrate Zoology, Organic Chemistry, and General Oceanography. Furthermore, one course is selected from each of the following sets of courses: Plant Physiology, Vertebrate Physiology and Comparative Physiology, Comparative Vertebrate Anatomy, Natural History of the Vertebrates, Mammalogy, and Embryology. Lastly, two units of Field Problems, Senior Seminar, or Directed Study are selected during the senior year.

A Master of Arts degree is also offered in Biology. The M.A. degree does not offer options, but a student informally establishes an “option” with the construction of his graduate program.

**Number of Marine Science Courses** 6 (including 2 units of Field Problems)

**Research Facilities** Humboldt has facilities for research both on the main campus and at the Telonicher Marine Sciences Laboratory in Trinidad, on the coast 15 miles north of the campus. The university has an ocean-going 80-foot vessel with wet and dry laboratory facilities for class and individual research. Other boats available for student research include a 26-foot pontoon for protected waters, a 23-foot offshore dory for open ocean waters, and smaller boats for bays and lakes. Equipment and instrumentation necessary for research are available both on campus and at the marine laboratory, and include trawls, plankton nets, NIO bottles, bottom grabs and corers, centrifuges, spectrophotometers, conductivity meters, and isotope counting instruments.

**Contact**
John Pequegnat, Director
Fred Telonicher Marine Laboratory
P.O. Box 624
Trinidad, California
95570  (707) 677-3671

Richard Meyer, Chairman
Department of Biology
Humboldt State University
Arcata, California
95521  (707) 826-3245

**PROGRAM** OCEANOGRAPHY

**Degree Offered** B.S. (minor in oceanography)

**Description** Humboldt offers both a Bachelor of Science and a minor degree program in oceanography. The oceanography program is designed to allow the student to accomplish any of the following educational objectives:

1. Preparation as an ocean specialist to work on oceanographic cruises and in other field work undertaken by federal, state, educational, and private agencies.
2. Preparation for graduate study in oceanography or in other closely related sciences.
3. Provision of a broadly based science background and fundamental knowledge of the oceans for those students who have an academic interest in oceanography but do not intend to pursue it as a career.
In order to meet these objectives, course work and experience required to attain a B.S. degree in oceanography are kept flexible; there are a variety of pathways which the student may follow. All students, regardless of the pathway chosen, acquire a science background of considerable breadth, an understanding of fundamental concepts unique to oceanography, and an appreciation for how concepts from various closely allied science fields are interrelated and applied to the solution of oceanographic problems. To achieve this, students are required to take a block (at least 24 units) of approved upper-division science electives, including courses in biology, geology, physics, mathematics, and chemistry.

Humboldt also offers a degree minor in oceanography. To obtain the minor, a student must complete a general oceanography course and at least 13 units of approved courses.

Number of Marine Science Courses

- 23 undergraduate; 3 graduate

Research Facilities

Students enrolled in the oceanography degree program can gain useful experience in marine studies aboard one of the many research vessels available through Humboldt’s marine laboratory in Trinidad, California. See the description under HSU’s Marine Biology program.

Contact

Jeffry C. Borgeld, Chair
Department of Oceanography
Humboldt State University
Arcata, California
95521-8299 (707) 826-4147

Program

ZOOLOGY (WITH MARINE EMPHASIS)

Degree Offered

B.A.

Description

Humboldt does not offer an official “zoology with emphasis in marine zoology” degree program. However, students in the zoology program can choose several courses in the marine sciences that are applicable to the major. Such courses include Invertebrate Zoology and Zooplankton Ecology.

Number of Marine Science Courses

Not applicable-interdisciplinary program

Research Facilities

See description of Humboldt State’s Biology with Marine Specialization program.

Contact

Richard Meyer, Chairman
Department of Biological Sciences
Humboldt State University
Arcata, California
95521 (707) 826-3245
PROGRAM

AIR OCEAN SCIENCE

Degree Offered: M.S.

Description: The Air Ocean Science Curriculum is an interdisciplinary program that encompasses those areas of meteorology and oceanography that are directly related to environmental support of military operations. The program consists of preparatory subjects, basic courses in dynamic and physical meteorology and oceanography, and a sequence in environmental analysis and forecasting.

Classroom instruction is supplemented by laboratory exercises ashore and afloat. The research vessel Acania is used for class laboratory experience and individual research. Guest lectures, seminars, and field trips round out the curriculum. The Fleet Numerical Oceanography Center is a focal point for Air Ocean Science operations and applied research. Each student is required to complete a thesis. Upon completion of the program, the student is qualified to independently serve as a meteorological and oceanographic forecaster in support of military operations.

Matriculation may occur any quarter with preferred entry in the fall and spring. A typical program for students with a baccalaureate degree in either meteorology or oceanography is eight quarters. However, this period may be shortened by validation of courses previously taken, transfer of credits, and by completing, prior to enrollment, courses offered by the NPS Office of Continuing Education. Students successfully completing the program are awarded the M.S. degree in Meteorology and Oceanography.

A baccalaureate degree in meteorology, oceanography, or the equivalent is required for admission. While this program is open to officers of the other U.S. military services, allied officers, and civilian employees of the U.S. federal government, it is available only to U.S. Navy Officers in the Restricted Line (Special Duty Geophysics). Also, Navy officer students in the Air Ocean Tactical Environmental Support Curriculum may, upon change of designator, transfer into the Air Ocean Science Curriculum. U.S. Naval officers who successfully complete this curriculum will be awarded the XX47P subspecialty billet code.

Number of Marine Science Courses: 4 undergraduate; 25 upper division or graduate; 21 graduate

Research Facilities: See the description under the Oceanography program.

Contact: Curtis Collins
Chair, Department of Oceanography
Naval Postgraduate School
Monterey, California
93943 (408) 656-2673

PROGRAM

AIR OCEAN TACTICAL ENVIRONMENTAL SUPPORT

Degree Offered: M.S.

Description: The interdisciplinary Air Ocean Tactical Environmental Support Curriculum at the Naval Postgraduate School provides a firm foundation in meteorology and oceanography with an emphasis on the tactical environmental support of military operations. The program consists of preparatory
numerical and statistical analysis, basic courses in dynamical and physical meteorology and oceanography, a sequence in air/ocean analysis and forecasting, and tactical environmental support.

Classroom instruction is supplemented by laboratory exercises ashore and afloat. The research vessel *Acania* is used for class laboratory experience and individual research. Guest lectures, seminars, and field trips round out the curriculum. The Fleet Numerical Oceanography Center is a focal point for Air Ocean Science operations and applied research. Each student is required to complete a thesis.

Matriculation may occur any quarter with preferred entry in the fall and spring. Although the program is designed for eight quarters, qualified students may have this period shortened by validation of courses previously taken, transfer of credits, and by completing, prior to enrollment, courses offered by the NPS Office of Continuing Education. Students successfully completing the program are awarded the M.S. degree in Meteorology and Oceanography.

A baccalaureate degree or equivalent with above average grades in mathematics and the physical sciences is required for admission to this program. Completion of mathematics through differential and integral calculus, one year of college physics, and one year of college chemistry is required.

The curriculum is open to all Navy officer communities (surface, subsurface, and aviation), officers of other U.S. services, allied officers, and civilian employees of the U.S. federal government. U.S. Naval officers who successfully complete this curriculum will be awarded the XX49P subspecialty billet code.

**Number of Marine Science Courses**

4 undergraduate; 29 upper division or graduate; 21 graduate

**Research Facilities**

See the description under the Oceanography program.

**Contact**

Curtis Collins
Chair, Department of Oceanography
Naval Postgraduate School
Monterey, California
93943 (408) 646-2673

**PROGRAM**

HYDROGRAPHY (MAPPING, CHARTING, AND GEODESY)

**Degree Offered**

M.S.

**Description**

The program consists of preparatory subjects, basic courses in numerical and statistical analysis, a dynamics sequence, and a core of MC&G subjects. The curriculum recognizes the importance of precise positioning systems, error budget analysis, accuracy requirements, data collection methods, and data reduction techniques as applied to the planning, conduct, and evaluation of hydrographic, magnetic, and gravity surveys. Graduates will be prepared to make optimum use of the ocean environment in the course of their duties and to conduct and evaluate research in oceanography and hydrography, both basic and applied.

Naval Postgraduate School classroom instruction is supplemented by laboratory exercises ashore and afloat. The research vessel *Acania*, is used for class laboratory experience and individual research. Additionally, the National Oceanic and Atmospheric Administration provides laboratory time aboard working hydrographic survey ships. Guest lectures, seminars, and field trips round out the curriculum. Each student is required to complete a thesis.
The Master of Science in Hydrographic Sciences is granted upon successful completion of the program. Matriculation may occur any quarter of the year. A typical program consists of seven to eight quarters. However, highly qualified students may have this period shortened by validation of courses previously taken, transfer of credits, and by completing, prior to enrollment, courses offered by the NPS Office of Continuing Education.

A baccalaureate degree or equivalent with above average grades in mathematics and the physical sciences is required for admission to the program. Differential and integral calculus, one year of college physics, and one year of college chemistry are required.

The program is open to officers of the National Oceanic and Atmospheric Administration, Coast Guard, Corps of Engineers, allied officers, and civilian employees of the U.S. federal government. The curriculum is not open to U.S. Naval officers.

Number of Marine Science Courses
4 undergraduate; 29 upper division or graduate; 21 graduate

Research Facilities
The Naval Postgraduate School’s Acania may be used to collect hydrographic and bathymetric data. A 40-foot motor launch is available for shallow water surveys. Cooperative programs with NOAA’s Pacific Marine Center in Seattle, Washington, provide additional opportunities for the collection and analysis of hydrographic data. The Fleet Numerical Oceanographic Center (FNOC) and the Naval Environmental Prediction Research Facility (NEPRF), located in the Monterey area, allow analysis of environmental satellite imagery and access to advanced computer processing facilities.

See also the description under the Oceanography program.

Contact
Curtis Collins
Chair, Department of Oceanography
Naval Postgraduate School
Monterey, California
93943 (408) 646-2673

PROGRAM OCEANOGRAPHY

Degree Offered M.S., Ph.D.

Description
The Oceanography Curriculum at the Naval Postgraduate School is directly related to oceanographic support of military operations. Classroom instruction is supplemented by laboratory exercises ashore and afloat. The research vessel Acania is available for class laboratory experience and individual research. Guest lectures and seminars round out the curriculum. Each student is required to complete a satisfactory thesis. In so doing the officer is introduced to the concept of applying theoretical knowledge toward a practical application. Students successfully completing this program are awarded the degree of Master of Science in Oceanography.

Matriculation may occur any quarter with preferred entry in the fall. Although the program is designed for eight quarters, qualified students may shorten this period by validation of courses previously taken, transfer of credits, and by completing, prior to enrollment, courses offered by the NPS Office of Continuing Education.

A baccalaureate degree or equivalent with above average grades in mathematics and the physical sciences is required for admission to the master’s program. Completion of mathematics through differential and integral calculus, one year of college chemistry, and one year of college physics are required.
Admission requirements for the degree of Doctor of Philosophy are a master’s degree (or the equivalent) in science or engineering, a bachelor’s degree with a high QPR, or a highly successful first graduate year on a master’s program with clear evidence of research ability.

The program is open to officers of other U.S. military services, allied officers, and qualified civilian employees of the U.S. federal government. This curriculum is not open to U.S. Naval officers.

**Number of Marine Science Courses**

4 undergraduate; 29 upper division or graduate; 21 graduate

**Research Facilities**

The Department of Oceanography has two beachfront laboratories, a small biological oceanography laboratory with saltwater aquaria and a filtered saltwater circulating system, and a 4,000-square-foot laboratory with lecture room and student study areas. Equipment includes a wave tank, drying oven, and high-pressure test chamber. Facilities include a small ocean engineering laboratory and a chemical oceanography laboratory.

The Naval Postgraduate School operates the research vessel *Acania*, a 126-foot vessel used for oceanographic instruction and research. The research vessel and the curriculum are sponsored by the Oceanographer of the Navy.

In addition to the NPS Computer Facility, there are large computational resources at the nearby Fleet Numerical Oceanographic Center and Naval Environmental Prediction Facility. These organizations also have large data bases and satellite image-processing facilities. Research is supported through contracts with various government agencies including the Office of Naval Research.

**Contact**

Curtis Collins
Chair, Department of Oceanography
Naval Postgraduate School
Monterey, California
93943 (408) 646-2673

The primary functions of the Coastal and Marine Institute at San Diego State University are to coordinate the multidisciplinary Marine Studies Program offered by the departments involved, to aid in the development of instructional, research, and public service aspects of the program, and to provide special services to associated faculty and students. Services provided by the center include advising students concerning marine studies and employment opportunities; job placement for students; assisting faculty and students in obtaining funding, conducting research, and publishing their results; the diving safety program; a boat operations program; and operation of the university’s marine laboratories. Responsibility for instruction remains within the traditional departments. There are 28 faculty members in these departments who are directly involved in the marine studies program. Marine-related courses and research are conducted primarily at the campus, located 12 miles from the coast, and at a marine laboratory operated by the CMI.

**Research Facilities**

Participating science departments have well-equipped laboratory and shop facilities, including standard physical and biological oceanographic equipment, laboratories for the analysis of seawater and sediment characteristics, radioisotope and computer facilities, constant-temperature rooms, and experimental aquarium facilities. Marine studies are well represented in library holdings.
Small craft for use in marine studies are maintained by the CMI at Perez Cove on Mission Bay, adjacent to the SDSU Marine Laboratory. Training and certification by the university as a boat operator is required of all those who operate university boats. The small craft available include:

Four 17-ft Boston Whaler skiffs with 70- and 90-hp engines. (One of these is equipped with a small hydrographic winch and a davit-towing frame for inshore sampling.)
One 13-ft Boston Whaler skiff with 25-hp engine.
One Zodiac inflatable boat with 15-hp engine.

Fathometers and portable VHF marine radios are available for use with these boats. A base-station radio is maintained at the SDSU Marine Laboratory.

The MRV *Pelican* is a 32-ft Radon fiberglass vessel specifically designed and equipped for coastal marine studies. The vessel is operated by the Hubbs Sea World Research Institute and is maintained at Perez Cove adjacent to the SDSU Marine Laboratory.

A marine laboratory is operated in the San Diego area to support research and instruction in marine studies. The San Diego State University Marine Laboratory is located adjacent to Sea World on Mission Bay. Four experimental aquarium rooms provide controlled light and temperature conditions for experimental work in fiberglass water tables, tanks, and pools. These are supplied with filtered and unfiltered water from the open-cycle seawater system operated by Sea World.

The work areas are designed so that they can be rearranged easily to meet the needs of individual investigators. Partially covered, outside areas contain a series of fiberglass pools and rectangular holding tanks for use in larger-scale work. Three fiberglass pools with viewing windows are available for behavioral studies of larger animals and for other research. Large raceways, larval-culture tanks and other systems are used for studies of fishes and for work in aquaculture. A horizontal temperature-gradient system is maintained for research on temperature preference behavior of fishes and invertebrates.

Instrument laboratories, dry work areas, and a large classroom laboratory are located in the building. In addition to all standard equipment, special equipment available in these laboratories includes a spectrophotometer, a fluorometer with photo-multiplier tube for chlorophyll analysis, high-accuracy polarographic-electrode units for measuring dissolved oxygen, a high-accuracy electronic balance, a refrigerated centrifuge, ultra-low-temperature cabinets, a sterilizer, and a fume hood. A laboratory for research on bioacoustics is operated on a cooperative basis by the Hubbs-Sea World Research Institute (HSWRI) and SDSU.

Many specialized displays and associated research facilities of Sea World and the HSWRI are available for studies. By special arrangement with HSWRI, research projects may be conducted utilizing marine animals maintained at Sea World, San Diego. These animals include a wide variety of sharks and other large fishes, marine mammals, penguins, and other marine birds.

Many field and laboratory studies coordinated by HSWRI or conducted cooperatively with SDSU afford students the opportunity to gain practical experience. These include field studies in Alaska, Antarctica, Hawaii, and the Channel Islands. Laboratory studies include work with dolphins, whales, seals, penguins, and sharks.

The use of larger oceanographic vessels and other specialized facilities are arranged in cooperation with Scripps Institution of Oceanography.

**Contact**

Susan Williams, Director  
Coastal and Marine Institute  
San Diego State University  
San Diego, California  
92182-0413  (619) 594-7435
### Program Directory

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>BIOLOGY (WITH MARINE EMPHASIS)</th>
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</table>

#### Degrees Offered
A.B., B.S., M.A., M.S., Ph.D. (in Ecology) offered jointly with UC Davis

#### Description
San Diego State University (SDSU) offers an emphasis in marine biology within the traditional undergraduate degree program. Students can emphasize marine studies through advanced, marine-related course work and research. A minor in oceanography also is available to undergraduate majors in biology. The Department of Biology offers marine-related courses in biological oceanography, fisheries biology, marine invertebrate zoology, marine botany, ichthyology, and aquaculture. Students who wish to take more marine science courses can choose from a wide assortment of marine-related courses offered by other science disciplines, including courses in oceanography and marine microbiology.

#### Number of Marine Science Courses
9 undergraduate and 3 graduate courses in Biology department, 3 undergraduate courses in Geology department, and 2 undergraduate courses in Oceanography.

#### Research Facilities
See the description of the Coastal and Marine Institute under SDSU.

#### Contact
Susan Williams, Director
Coastal and Marine Institute
San Diego State University
San Diego, California
92182-0413 (619) 594-7435

San Diego State University students can study the dynamics of coastal wetlands.
<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>CHEMISTRY (WITH MARINE EMPHASIS)</th>
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<tbody>
<tr>
<td>Degrees Offered</td>
<td>A.B., B.S., M.A., M.S.</td>
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<tr>
<td>Description</td>
<td>San Diego State does not offer an official “chemistry with marine emphasis” degree program. Instead, students can emphasize marine studies within the traditional chemistry department degree program. A minor in oceanography also is available to undergraduate majors in chemistry. The Department of Chemistry offers an undergraduate course in chemical oceanography and research experience in marine chemistry including work at sea. A wide assortment of marine-related courses offered by other science disciplines are available, including biological oceanography, geochemistry, physical oceanography, marine microbiology, and meteorology. Specific options in “Marine Geology” and “Geochemistry” are available in the SDSU Geology Department.</td>
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<tr>
<th>Number of Marine Science Courses</th>
<th>1 undergraduate or graduate in Chemistry; 3 undergraduate or graduate in Geology</th>
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<tbody>
<tr>
<td>Research Facilities</td>
<td>See the description of the Coastal and Marine Institute under SDSU. Close collaboration with the marine chemistry laboratories at the Naval Ocean Systems Center is also maintained.</td>
</tr>
</tbody>
</table>
| Contact | Chairman  
Department of Chemistry  
San Diego State University  
San Diego, California  
92182-0067 (619) 594-595 |

<table>
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<tr>
<th>PROGRAM</th>
<th>ECOLOGY</th>
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<tr>
<td>Degree Offered</td>
<td>Ph.D. (Joint with UC Davis)</td>
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<tr>
<td>Description</td>
<td>A doctoral program leading to a Ph.D. in ecology is being offered jointly by the Ecology Program Area at SDSU and the Graduate Group in Ecology at UC Davis. Students admitted to the program will spend at least one year in full-time residence at each campus and may elect to carry out their thesis research at either campus. When the major professor (dissertation adviser) is at SDSU, the student will do the majority of his work at SDSU; students who elect to work under a UCD faculty member will spend most of their time at UCD. Regardless of which campus is chosen for longer residence, the Ph.D. is awarded jointly by the two institutions. The principal objective of the joint doctoral program is to provide excellent training in biological ecology for a modest number of doctoral students. This jointly offered program offers several distinct opportunities. It makes available to students a broader range of faculty members with whom to interact, a greater diversity of courses, and a greater variety of possible research experiences. It provides easier access to a wide range of field areas for ecological research, since representatives of nearly all the major biomes of California are close to at least one of the campuses. Students are eligible for financial assistance and have the opportunity to obtain teaching experience while in the program.</td>
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<tr>
<th>Number of Marine Science Courses</th>
<th>Not applicable-individual program</th>
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<tbody>
<tr>
<td>Research Facilities</td>
<td>See description of the Coastal and Marine Institute under SDSU.</td>
</tr>
</tbody>
</table>
| Contact | Boyd D. Collier  
Department of Biology  
San Diego State University  
San Diego, California  
92128 (619) 594-6448 |
### ECONOMICS (WITH MARINE EMPHASIS)

<table>
<thead>
<tr>
<th>Degrees Offered</th>
<th>A.B., M.A.</th>
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<tr>
<td>Description</td>
<td>San Diego State does not offer an official “economics with marine emphasis” degree program. Instead, students can emphasize marine studies within the traditional economics department degree program. The Department of Economics offers two undergraduate marine-related courses: economics and ecology, and economics of the ocean. Students who wish to take more marine science courses can choose from marine-related courses offered by other disciplines, such as courses in biology, oceanography, politics, engineering, chemistry, geography, geology, botany, business, microbiology, or botany.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>2 undergraduate; 0 graduate</td>
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<tr>
<td>Research Facilities</td>
<td>See the description of the Coastal and Marine Institute under SDSU.</td>
</tr>
</tbody>
</table>
| Contact | Renatte Adler  
Department of Economics  
San Diego State University  
San Diego, California  
92182-0379 (619) 594-1662 |

### ENGINEERING (WITH MARINE EMPHASIS)

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<tr>
<th>Degrees Offered</th>
<th>B.S., M.S.</th>
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<tr>
<td>Description</td>
<td>San Diego State does not offer an official “engineering with marine emphasis” degree program. Instead, students can emphasize marine studies within the traditional engineering interdepartmental degree program. The College of Engineering offers several undergraduate engineering courses in marine-related fields, including courses in fluid mechanics, water resources engineering, soil mechanics, hydrodynamics, and water and wastewater engineering, in addition to graduate courses in water quality processes, foundation engineering, and water quality engineering.</td>
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<tr>
<td>Number of Marine Science Courses</td>
<td>9 (marine-related, plus 4 oceanography department courses) undergraduate; 6 (marine-related) graduate</td>
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<tr>
<td>Research Facilities</td>
<td>See the description of the Coastal and Marine Institute under SDSU.</td>
</tr>
</tbody>
</table>
| Contact | Iraj Noorany  
Department of Civil Engineering  
San Diego State University  
San Diego, California  
92182 (619) 594-5932 |

### GEOLOGICAL SCIENCES (WITH MARINE EMPHASIS)

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<th>Degrees Offered</th>
<th>B.S., M.S.</th>
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<tr>
<td>Description</td>
<td>San Diego State does not offer an official “geological sciences with marine emphasis” degree program. Instead, students can emphasize marine studies within the traditional geological sciences department degree program. The Department of Geological Sciences offers several marine-related</td>
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<td>Number of Marine Science Courses</td>
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<tr>
<td>Research Facilities</td>
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undergraduate courses, including geochemistry, marine geology, descriptive physical oceanography, and coastal and estuarine physical oceanography. The department offers several graduate courses in marine-related fields, including courses in petrology of carbonates, biostratigraphy, paleoecology, sedimentary geochemistry, marine geology, and marine minerals.

**Number of Marine Science Courses**
- 4 undergraduate (plus 4 oceanography department courses)
- 5 (marine-related) graduate

**Research Facilities**
See the description of the Coastal and Marine Institute under SDSU.

**Contact**
Michael J. Walawender, Chairman
Department of Geological Sciences
San Diego State University
San Diego, California
92182   (619) 594-5586

**PROGRAM**
**GEOLOGY (DEGREE IN APPLIED ARTS AND SCIENCES, MARINE GEOLOGY OPTION)**

**Degree Offered**
B.S.

**Description**
San Diego State offers a Bachelor of Science degree in applied arts and sciences with major in geology and option in marine geology. Students in this program take the basic requirements for the geology major, plus the requirements of the marine geology option. The option requires several additional courses from the geology, mathematics, physics, and chemistry departments.

**Number of Marine Science Courses**
- 6 undergraduate; 4 graduate

**Research Facilities**
See the description of the Coastal and Marine Institute under SDSU.

**Contact**
Chairman
Department of Geological Sciences
San Diego State University
San Diego, California
92182   (619) 594-5586

**PROGRAM**
**OCEANOGRAPHY MINOR**

**Degree Offered**
Part of baccalaureate

**Description**
San Diego State offers a program for a minor in oceanography. The minor is offered by the geology department; and interdisciplinary instructional and research activities are coordinated by the Center for Marine Studies. Students opting for the oceanography minor program can choose from such courses as biological oceanography, chemical oceanography, marine geology, descriptive physical oceanography, theoretical physical oceanography, coastal and estuarine physical oceanography, marine microbiology, marine invertebrate zoology, the oceans, oceanography laboratory, and practical oceanography.

The oceanography minor is intended for students with extensive background in the sciences. The oceanography minor is not open to geology majors. Geology students interested in the marine sciences should major in geology with the marine geology option.
### Program Directory

**Number of Marine Science Courses**

- 10 undergraduate; 6 graduate

**Research Facilities**

See the description of the Coastal and Marine Institute under SDSU.

**Contact**

Chairman  
Department of Geological Sciences  
San Diego State University  
San Diego, California  
92182 (619) 594-5586

---

**PROGRAM**  
**POLITICAL SCIENCE (WITH MARINE EMPHASIS)**

**Degrees Offered**

- A.B., M.A.

**Description**

San Diego State does not offer an official “political science with marine emphasis” degree program. Instead, students can emphasize marine studies within the traditional political science department degree program. Students who wish to take marine science-related courses can choose from those offered in other disciplines, including courses in biology, oceanography, engineering, chemistry, geography, economics, geology, botany, business, microbiology, and botany.

**Number of Marine Science Courses**

Not applicable - interdepartmental program

**Research Facilities**

See the description of the Coastal and Marine Institute under SDSU.

**Contact**

C. Richard Hofstetter  
Department of Political Science  
San Diego State University  
San Diego, California  
92182 (619) 594-6244

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**PROGRAM**  
**BIOLOGY (WITH MARINE CONCENTRATION)**

**Degrees Offered**

- B.S., M.A.

**Description**

San Francisco State offers both a Bachelor of Science and a Master of Arts degree program in biology with concentration in marine biology and limnology. The undergraduate major provides students with a fundamental understanding of general biology and concentration in their chosen fields of emphasis. It also provides a foundation for graduate study in any of the liberal arts graduate concentrations of the biology department.

Students may elect a general emphasis in marine invertebrate zoology, marine vertebrate zoology, marine botany, or estuarine ecology. Graduate work also may be general or may follow similar specific strengths such as ecology, systematics, functional morphology, physiology and ethology.

The marine curriculum and facilities of San Francisco State are strongly supported by the Tiburon Center for Environmental Studies and Moss Landing Marine Laboratories.
Students interested in San Francisco State’s marine biology program have quite a selection of courses from which to choose. Sample courses include those in marine invertebrate zoology, marine phyology, natural history of marine invertebrates, biology of fishes, biological oceanography, fisheries biology, general oceanography, marine ecology, and an introduction to marine plankton.

**Number of Marine Science Courses**

12 undergraduate (22 at MLML); 7 graduate (23 at MLML)

**Research Facilities**

The Paul F. Romberg Tiburon Center for Environmental Studies field campus of San Francisco State University is located on San Francisco Bay approximately thirty miles north of the campus. Research on the ecology of San Francisco Bay and the central California coast is conducted by senior research scientists and graduate students. Facilities include a 30,000-square-foot research building, offices, laboratories, environmental growth chambers, boats, computing facilities, and a library. Coursework is offered in conjunction with degree programs on campus.

The Moss Landing Marine Laboratories, approximately one hundred miles south of San Francisco, are operated year-round by a consortium of six California state universities and colleges. San Francisco State is one of those cooperating universities, and students can attend classes and do research at the Moss Landing facility.

The laboratories offer full-time course work in oceanography including marine biology, marine geology, and other marine sciences for majors in either the biological or physical sciences whose objectives include further graduate study, teaching the sciences, or research in the marine sciences. See also the description of Moss Landing Marine Laboratories under San Jose State University.

**Contact**

(undergraduate)
Ralph Larson
Department of Biology
San Francisco State University
1600 Holloway Avenue
San Francisco, California
94132  (415) 338-1027

(Tiburon Center)
Director
Tiburon Center for Environmental Studies
P.O. Box 055
Tiburon, California
94920  (415) 435-1717

or

(graduate)
Thomas Niesen
Department of Biology
San Francisco State University
1600 Holloway Avenue
San Francisco, California
94132  (415) 338-1549
BIOLOGICAL SCIENCE (WITH MARINE BIOLOGY CONCENTRATION)

Degrees Offered
B.A., M.A.

Description
San Jose State offers both a Bachelor of Arts and a Master of Arts degree program in biological sciences with concentration in marine biology. The curriculum for the program satisfies the requirements for a major in biological science (and, at the student’s option, a minor in chemistry), and will lead to graduate work in the field of marine biology. The concentration emphasizes a program which involves the student in courses available at Moss Landing Marine Laboratories (MLML).

Students in this program can choose courses from several disciplines, including physics, geology, mathematics, physical education, chemistry, zoology, biology, botany, microbiology, and marine science.

Number of Marine Science Courses
2 undergraduate (25 at MLML) ; 0 graduate (21 at MLML)

Research Facilities
San Jose State is one of the six California state colleges and universities operating the Moss Landing Marine Laboratories and serves as the administering institution. MLML is centrally located on Monterey Bay in Moss Landing, approximately halfway between Santa Cruz and the Monterey Peninsula. The laboratories are owned and operated by a consortium of six of the California state universities: CSU, Fresno; CSU, Hayward; CSLJ, Sacramento; San Francisco State University; San Jose State University; and CSU, Stanislaus. The laboratories’ function is similar to that of a department for each of the home campuses, with students from all six institutions attending classes at Moss Landing. The curriculum is designed to support majors in the biological and physical sciences.

As a result of the 1989 Loma Prieta earthquake, MLML has moved temporarily to Salinas, 10 miles inland. However, a shore lab facility is maintained in Moss Landing. Specialized facilities include a photographic dark room, a filtered-air clean laboratory for trace element analyses, a benthic sorting shed, and a museum with collections of local fish, invertebrates, birds, mammals, and algae. Permanent equipment includes various microscopes, balances, and spectrophotometers, as well as a C-H-N analyzer, a freeze-drymachine, several programmable desk-top computers, a Coulter counter, scanning electron microscope, closed circuit TV, Warberg respirometer, an X-ray system, a liquid scintillation counter, and numerous other items. A well-equipped shop permits construction of special equipment. A filtered seawater system supplies seawater to several classrooms, laboratories, and holding tanks.

The laboratories operate the 135-foot research vessel Point Sur, on lease from National Science Foundation. The Point Sur is well-equipped for instructional uses and coastal research with a trawling winch, a hydrowinch, A-frame and U-frame; a wet lab for hydrographic sampling, water chemistry, and preliminary sorting of specimens; a walk-in freezer; and a dry lab for oceanographic profiling instrumentation and other work. The lab includes a flow-through system for horizontal profiling of chlorophyll, turbidity, temperature, and salinity. A beam transmissometer and sophisticated CTD system are available for vertical profiling. There is a large working area on the fantail for trawling and geological work. Faculty and students from MLML also utilize University National Oceanographic Laboratory System (UNOLS) vessels when they have open ocean research requirements.
In addition to the research vessel *Point Sur*, MLML owns and operates the 35-foot research vessel *Ricketts*. *Ricketts* is equipped with standard navigation, radio, and scientific equipment. Deck equipment consists of two winches and an A-frame, and AC power is available to operate instruments. *Ricketts* is available for day cruises in and around Monterey Bay.

Moss Landing Marine Laboratories has 8 faculty to teach the 22 undergraduate and 23 graduate courses offered every year.

**Contact**

Director  
Moss Landing Marine Laboratories  
P.O. Box 450  
Moss Landing, California  
95039  
(408) 633-3304  
or  
(408) 755-8650

Lee Dorosz, Chairman  
Department of Biological Sciences  
Duncan Hall 254  
San Jose State University  
San Jose, California  
95192  
(408) 277-2355

**PROGRAM**  
GEOLOGY (WITH OCEANOGRAPHY CONCENTRATION)

<table>
<thead>
<tr>
<th>Degrees Offered</th>
<th>B.A., B.S., M.A., M.S.</th>
</tr>
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<tbody>
<tr>
<td><strong>Description</strong></td>
<td>San Jose State offers a Bachelor of Arts and a Bachelor of Science degree program in geology with concentration in oceanography. In addition to the general education requirements, students interested in obtaining the special marine emphasis geology degree take courses from several disciplines, including courses in geological sciences, marine sciences, mathematics, chemistry, physics, and civil engineering. Students interested in studying marine geology can take courses at either the Moss Landing Marine Laboratories or San Jose State. SJSU offers a graduate degree in Geology, including topics in marine geology, tectonics and geophysics. Research projects focus on Pacific Rim studies. MLML offers a Master of Science degree in Marine Science in cooperation with the consortium campuses. This degree will give students the opportunity to acquire a practical and theoretical education in the marine sciences to prepare them for careers as marine specialists, scientists, and teachers. The program at MLML provides extensive field and laboratory work for advanced study in the marine sciences, which cannot be duplicated on individual California State University consortium campuses.</td>
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<table>
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<tr>
<th>Number of Marine Science Courses</th>
<th>2 undergraduate (10 at MLML); 0 graduate (8 at MLML)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research Facilities</strong></td>
<td>See the description of Moss Landing Marine Laboratories under San Jose State University (Biological Science).</td>
</tr>
</tbody>
</table>
| **Contact** | John W. Williams, Chairman  
Department of Geology  
San Jose State University  
One Washington Square  
San Jose, California  
95192-0102  
(408) 924-5050 |
**PROGRAM**  
**BIOLOGY (WITH AQUATIC EMPHASIS)**

**Degree Offered**  
B.S.

**Description**  
Sonoma State does not offer an official Bachelor of Sciences degree program in “biology with aquatic emphasis.” However, it offers an aquatic biology plan for students interested in the marine sciences. Students following the advisory plan and completing the B.S. degree program in biology will be qualified to enter a graduate program in aquatic biology or to apply for employment in that field.

Students in the advisory program take courses from several disciplines, including biology, chemistry, mathematics, physics, and geology.

**Number of Marine Science Courses**  
4 undergraduate; 0 graduate

**Research Facilities**  
Sonoma State has a boat, as well as access to an Osborne preserve and numerous lakes, streams, and estuaries. It has most of the equipment necessary for research in aquatic biology.

**Contact**  
Colin Hermans  
Professor of Biology  
Sonoma State University  
1801 E. Cotati Avenue  
Rohnert Park, California  
94928  
(707) 664-2316  
or  
(707) 664-2189
INTEGRATIVE BIOLOGY (WITH MARINE SPECIALIZATION)

**Degree Offered**
B.A.

**Description**
UC Berkeley offers a Bachelor of Arts degree program in Integrative Biology with specialization in marine biology. The program serves the needs of undergraduate students who want a broader training in the marine biological sciences than is possible in a departmental major.

Students enrolled in the program take courses from several fields, including biology, zoology, paleontology, botany, genetics, oceanography, chemistry, physics, and statistics. Students may complete a course at a marine laboratory. They can meet this requirement by taking summer courses in biology of marine invertebrates, ichthyology, ecology, and marine algology, offered at the Bodega Marine Laboratory or another marine station or by a full-time (15 quarter-unit) spring course, Tropical Island Biology, taught at the UC Berkeley Gump Biological Research Station on Moorea, French Polynesia.

**Number of Marine Science Courses**
Over a dozen undergraduate courses and several graduate courses or seminars in the department are available to students in the specialization and related fields.

**Research Facilities**
Research in marine biology is conducted at the Berkeley campus, the Richmond Field Station, Bodega Marine Laboratory, and the Gump Station in French Polynesia.

**Contact**
Jere H. Lipps, Chair
Department of Integrative Biology
University of California
Berkeley, California
94720
(510) 642-6227

or

Diane Nakamura
Undergraduate Advisor
(510) 643-7204

GEOPHYSICS

**Degrees Offered**
B.S., M.S., Ph.D.

**Description**
The major in geophysics at UC Berkeley is designed for students with facility in mathematics and an interest in geology; it provides a general background in the physical sciences, with emphasis on the physics of the Earth. Both master’s degree and Ph.D. are offered. A master’s degree is not prerequisite for a Ph.D.

**Number of Marine Science Courses**
0
Research Facilities

The University operates 16 seismographic stations in northern California to study the seismicity here and in adjacent parts of Nevada and Oregon and to conduct other research in seismology. Research includes the study of earthquake wave propagation, the nature of the waves, their relation to earth structure, the nature of earthquake sources, eigenvibrations of the earth, and the theory of the seismograph. Offices are in the Earth Sciences Building; seismographs and laboratories are in Haviland Hall and in an underground vault in Strawberry Canyon.

Contact

Donald J. DePaolo, Chair
Geology and Geophysics
301 Earth Sciences Building
University of California
Berkeley, California
94720  (510) 643-7686

PROGRAM

NAVAL ARCHITECTURE AND OFFSHORE ENGINEERING

Degrees Offered

B.S., M.S., D.Eng., Ph.D

Description

The Department of Naval Architecture and Offshore Engineering at UC Berkeley offers courses in the fundamentals of marine-vehicle design, offshore-system design, and the theories of marine structures and marine hydrodynamics.

An accredited undergraduate program in Naval Architecture is offered as a full four-year curriculum. The coursework contains fundamental background in mechanical and civil engineering, together with specialized courses in ship statics and dynamics, ship design, marine engineering, and ocean systems.

Graduate study is offered in Naval Architecture in the areas of ship structures and ship hydrodynamics, leading to master’s and doctor’s degrees. Graduate study is also offered in Offshore Engineering in the areas of offshore platform design. With sufficient undergraduate preparation, a student may earn a master’s degree in two semesters of study. Further details on graduate programs (including the program in ocean engineering) are available from the department upon request.

Number of Marine Science Courses

17

Research Facilities

University of California, Berkeley has outstanding research facilities. The Ship Model Towing Tank and Ship Structural Laboratory are located at the Richmond Field Station. These laboratories have modern instrumentation and computer data acquisition systems. On campus, a Computational Marine Mechanics Laboratory is available for advanced digital simulation of marine-related phenomena.

Contact

Ronald W. Yeung
300A Naval Architecture Building
University of California
Berkeley, California
94720  (415) 642-5464
PROGRAM: OCEAN ENGINEERING

Degrees Offered: M.S., M.E., Doctor of Engineering, Doctor of Philosophy in Engineering

Description: UC Berkeley offers several graduate-level degree programs in ocean engineering. The ocean engineering program is interdisciplinary; it incorporates a wide range of engineering disciplines, including civil engineering, materials science, mineral engineering, mechanical engineering, and naval architecture and offshore engineering.

Graduate students in the ocean engineering program study a multitude of marine-related engineering programs, such as air/sea interactions, coastal engineering, corrosion, fatigue, marine and offshore construction, reassessment and rehabilitation of marine structures, harbor design, marine geophysics, wetlands, engineering properties of marine sediments, marine sediment transport, offshore platforms and pipelines, marine and estuarine pollution, remote operated vehicles management, properties of engineering materials in seawater, and reliability of marine structures.

Research is conducted chiefly in the various laboratories on the Berkeley campus and at the Richmond Field Station, and the Scripps Institution of Oceanography.

Number of Marine Science Courses: Not applicable-interdisciplinary program

Research Facilities: Research in the ocean engineering field is conducted at the Richmond Field Station and the Bodega Marine Laboratory. Oceanographic research vessels and ship time are available locally through working arrangements with the California Maritime Academy and other sources, and in San Diego for worldwide operations through the university’s marine facilities at the Scripps Institution of Oceanography.

Contact: Robert Bea
Professor of Civil Engineering and Ocean Science and Engineering
212 McLaughlin Hall
University of California
Berkeley, California
94720 (510) 642-0967

PROGRAM: GEOPHYSICS

Degrees Offered: B.S., M.S., Ph.D.

Description: The major in geophysics at UC Berkeley is designed for students with facility in mathematics and an interest in geology; it provides a general background in the physical sciences, with emphasis on the physics of the Earth. Both master’s degree and Ph.D. are offered. A master’s degree is not prerequisite for a Ph.D.

Number of Marine Science Courses: 0

Research Facilities: The University operates 16 seismographic stations in northern California to study the seismicity here and in adjacent parts of Nevada and Oregon and to conduct other research in seismology. Research includes the study of earthquake wave propagation, the nature of the waves, their relation to earth structure, the nature of earthquake sources, eigenvibrations of the earth, and the theory of the seismograph. Offices are in the Earth Sciences Building; seismographs and laboratories are in Haviland Hall and in an underground vault in Strawberry Canyon.
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<th>Contact</th>
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<td>Degrees Offered</td>
<td>M.S., M.E., Doctor of Engineering</td>
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<tr>
<td>Description</td>
<td>U.C. Berkeley offers several graduate-level degree programs in ocean engineering. The ocean engineering program is interdisciplinary: it incorporates a wide range of engineering disciplines, including civil engineering, materials science, mineral engineering, mechanical engineering, and naval architecture and offshore engineering. Graduate students in the ocean engineering program study a multitude of marine-related engineering programs, such as air-sea interactions, coastal engineering corrosion, fatigue, marine and offshore construction, reassessment and rehabilitation of marine structures, wetlands, engineering properties of marine sediments, marine sediment transport, remote operated vehicles management, offshore platforms and pipelines, marine and estuarine pollution management, properties of engineering materials in seawater, and reliability of marine structures. Research is conducted chiefly in the various laboratories on the Berkeley campus and at the Richmond Field Station, and the Scripps Institution of Oceanography.</td>
</tr>
<tr>
<td>Number of Marine Science Courses</td>
<td>Not applicable - interdisciplinary program</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>Research in ocean engineering field is conducted at the Richmond Field Station and the Bodega Marine Laboratory. Oceanographic research vessels and ship time are available locally through working arrangements with the California Maritime Academy and other sources, and in San Diego for worldwide operations through the university’s marine facilities at the Scripps Institution of Oceanography.</td>
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<tr>
<td>Contact</td>
<td>Robert Bea</td>
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<td></td>
<td>Professor of Civil Engineering and Ocean Science &amp; Engineering</td>
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<td>212 McLaughlin Hall</td>
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<td>University of California</td>
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<td>Berkeley, California</td>
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<td>94720 (510) 642-0967</td>
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</table>
PROGRAM: AGRICULTURAL ECONOMICS

Degrees Offered: B.S., M.S., Ph.D.

Description:
Agricultural and Managerial Economics focuses on the student’s understanding of the total economic and social environment through study of the agricultural, biological, physical, and social sciences. The major offers an option of two areas of specialization: (a) Agricultural Economics and (b) Managerial Economics.

The Agricultural Economics option is preprofessional, essentially preparation for continued study at the graduate level. The emphasis is on the theoretical aspects that lie behind decisions concerning production, marketing, use of resources, prices, and policy. Supplemental courses are offered in statistics, effects of governmental policy, rural appraisal, and related topics.

The Managerial Economics option, while considering the theoretical, deals more with practical managerial problems. Emphasis is on the decision-making function of management, use of scientific management controls and organization, personnel policies, and procurement and marketing methods.

Both options prepare graduates for professional management positions in financial and research institutions not necessarily limited to agriculture.

The Department offers courses in natural resource economics. In graduate research it is possible to emphasize marine aspects of economics such as fisheries, seafood, and aquaculture within agricultural economics.

Number of Marine Science Courses: Not applicable — individual program

Research Facilities: No departmental facilities specific to marine programs.

Contact: Hoy F. Carman  
Department of Agricultural Economics  
University of California  
Davis, California  
95616-8512 (916) 752-1517
ANIMAL SCIENCE (WITH OPTION IN AQUACULTURE)

Degrees Offered
B.S., M.S., Ph.D. (in related field)

Description
Animal Science is the study of domestic animal resource use through the integration of natural and social sciences such as genetics, biochemistry, physiology, nutrition, and economics. Emphasis may be placed on animal biology, production, husbandry, and management aspects of aquaculture, as well as on environmental problems affecting wild and domestic aquatic animals.

The Department of Animal Science at UC Davis also offers the graduate degrees of Master of Science, and Master of Agriculture and Management, both of which can be focused on aquaculture. Graduate study in other disciplines is directed by faculty divided into “graduate groups” according to their research interests. Graduate students interested in aquaculture have chosen a variety of disciplines to pursue their degrees, such as ecology, nutrition, genetics, physiology, zoology, water science, animal science, international agricultural development, and engineering. Students complete the requirements for their particular graduate groups, but their projects concern aquaculture.

Number of Marine Science Courses
The Department of Animal Science offers 6 undergraduate courses. These courses are supplemented by other courses in the Department, as well as courses in physiology, genetics, and nutrition required for the B.S. degree. Other departments offer courses in marine biology, aquaculture engineering, fish and invertebrate biology, and veterinary medicine.

Research Facilities
Research in aquaculture is carried out by departments and coordinated by the Aquaculture and Fisheries Program, housed in the College of Agricultural and Environmental Sciences. On the Davis campus, research facilities include: well-equipped departmental laboratories; the Aquatic Center, which has over 750 square meters of laboratories and over 150,000 liters of both indoor and outdoor freshwater tanks, including a specially equipped room to provide large numbers of embryo and larval fish for toxicologic studies; and the Fish Hatchery, a 200-square meter building with both indoor and outdoor facilities and the capacity to hatch 100 groups of fish simultaneously.

At Bodega Marine Laboratory, on the coast north of San Francisco, scientists and students work in a 1,860-square-meter facility designed and built specifically for aquacultural research. This complex contains large animal-holding facilities and laboratories designed for studies in genetics, pathology, nutrition, and physiology of marine crustaceans and mollusks.

Contact
Animal Science Advising Center
Aquaculture Program
Department of Animal Science
University of California
Davis, California
95616 (916) 752-6118

The culture of marine and freshwater species is an area of focus at UC Davis.
PROGRAM: BIOLOGICAL SCIENCES (WITH MARINE EMPHASIS)

**Degrees Offered**

B.S., M.S., Ph.D.

**Description**

UC Davis does not offer an official degree program in "biological sciences with marine specialization." However, students in the biology baccalaureate degree program may enroll in a three-month, full-time field study at the Bodega Marine Laboratory.

**Number of Marine Science Courses**

7 undergraduate; 2 graduate

**Research Facilities**

Research is conducted at the Bodega Marine Laboratory, a UC facility north of San Francisco. See description of Bodega Marine Laboratory under the UC Davis Animal Science Program.

**Contact**

Richard K. Grosberg  
Associate Professor of Zoology  
4328 Storer Hall  
University of California  
Davis, California  
95616  
(916) 752-1114  
or  
(916) 752-2937

or

James F. Quinn  
Division of Environmental Studies  
Wickson Hall  
University of California  
Davis, California  
95616  
(916) 752-8027  
(916) 752-1114  
or  
(916) 752-2937

or

Donald Strong  
Professor of Zoology  
Bodega Marine Laboratory  
P.O. Box 247  
Bodega Bay, California  
94923  
(707) 875-2022

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PROGRAM: ECOLOGY

**Degrees Offered**

M.S., Ph.D.

**Description**

The Graduate Group in Ecology at UC Davis includes more than 110 faculty from 36 departments in six schools and colleges. The broad options available for student specialization are agricultural ecology, conservation ecology, environmental policy analysis, functional ecology, human ecology, systems and landscape ecology, restoration ecology, and basic and theoretical ecology. One of the major objectives of the program is to encourage cross-disciplinary training, with principles of ecology being central to the application of other disciplinary skills.

Appropriate preparation is undergraduate work in any of the biological, social, behavioral sciences, or the physical sciences, mathematics, or engineering. But note that all applicants to the biological
and physical chemical areas will normally be expected to have completed a two-course sequence in basic biology, in elementary chemistry, and in elementary physics; and a course in statistics, one in calculus, and a course in ecology.

<table>
<thead>
<tr>
<th>Number of Marine Science Courses</th>
<th>Not applicable-individual major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Facilities</td>
<td>See the description of Bodega Marine Laboratory under the UC Davis Animal Science program.</td>
</tr>
</tbody>
</table>
| Contact                          | Ted Foin  
Graduate Group in Ecology  
University of California  
Davis, California  
95616 (916) 752-6751 |
| PROGRAM                          | ECOLOGICAL ANALYSIS (WITH SUBSPECIALIZATION IN AQUATIC ECOLOGY) |
| Degree Offered                   | B.S. |
| Description                      | The Division of Environmental Studies at UC Davis does not offer a degree program. However, it recommends that “highly motivated undergraduates who find existing majors unsuited to their educational objectives [should] contact the division regarding individual majors.” The department offers elective programs for students from a variety of majors. One such elective program entitled, “Ecological Analysis with Subspecialization in Aquatic Ecology,” is designed to supplement the natural sciences curriculum. The ecological analysis emphasis includes courses in general and population ecology, community dynamics analysis, ecological system evolution, field and laboratory methods in ecology, limnology laboratory, and experimental animal ecology. The subspecialization in aquatic ecology includes courses in limnology, physical and chemical oceanography, geology of the oceans, biological oceanography, and ecology of polluted waters. The Division of Environmental Studies is an intercollege teaching unit, and its programs, such as the one listed here, are examples of what students may pursue at UC Davis. |
| Number of Marine Science Courses | 6 undergraduate; 0 graduate |
| Research Facilities              | Laboratories for research in fish physiology and ecology are located in Briggs Hall and the Institute of Ecology. |
| Contact                          | John Loomis  
Associate Professor  
Division of Environmental Studies  
2132 Wickson Hall  
University of California  
Davis, California  
95616 (916) 752-3026 |
PROGRAM

**INDIVIDUAL MAJOR: MARINE BIOLOGY**

**Degree Offered**
B.S.

**Description**
UC Davis does not offer an official “marine biology” degree program. However, interested students can design an individual major in marine biology by submitting an appropriate program proposal to the Individual Majors Committees of the College of Letters and Science or the College of Agricultural and Environmental Sciences. Sample programs that have recently been approved include courses from biochemistry, botany, biological sciences, geology, genetics, and zoology.

**Number of Marine Science Courses**
Not applicable-individual program

**Research Facilities**
Research is conducted at the Bodega Marine Laboratory, a UC facility north of San Francisco. See description of Bodega Marine Laboratory under the UC Davis Animal Science (with Aquaculture Specialization) Program.

**Contact**
Richard K. Grosberg
Associate Professor of Zoology
4348 Storer Hall
University of California
Davis, California
95616 (916) 752-1114
or (916) 752-2937

**WILDLIFE AND FISHERIES BIOLOGY (WITH FISHERIES SPECIALIZATION)**

**Degree Offered**
B.S.

**Description**
UC Davis offers a Bachelor of Science degree program in wildlife and fisheries biology with a specialization in fisheries biology. Although the program is not clearly defined as a marine science-oriented program, students may take courses in marine invertebrates and oceanography to complete the major, in place of freshwater-oriented courses. The three required fisheries courses place equal emphasis on marine and freshwater fishes.

The summer field course in fish biology is sometimes offered at a coastal location, allowing study of marine and estuarine fishes.

The major deals with the interface between the needs of people and wildlife in terms of ecological stability, recreation, and food supply. Emphasis is placed on biological and physical sciences, with special emphasis in fisheries and aquatic biology. The program provides training in biology appropriate to careers in fisheries biology, aquatic biology, or, after additional academic preparation, for careers in teaching, research, and administration in the fisheries field.

Students in the fisheries biology specialization program take courses from several disciplines, including aquatic entomology or invertebrate zoology, environmental studies, mathematics, wildlife and fisheries biology, biology, botany, chemistry, computer sciences, physics, zoology, genetics, and physiology. A marine orientation is also possible in the wildlife major.

**Number of Marine Science Courses**
7 undergraduate; 2 graduate
Laboratories for research in fish physiology and ecology are located in Briggs Hall and the Institute of Ecology.

**Contact**  
Nadine K. Jacobsen, Master Advisor  
Department of Wildlife and Fisheries Biology  
1088 Academic Surge Bldg.  
University of California  
Davis, California  
95616  (916) 752-6979  
(916) 752-6586

While there is no formal program for degrees with marine specialization at UC Irvine, two faculty members do offer courses in marine ornithology and ocean atmospheric turbulence.

**Research Area**  
Graduate study in marine ornithology is available in the Department of Ecology and Evolutionary Biology. An upper division undergraduate course in ocean ecology is taught, as are undergraduate and graduate courses in a wide variety of ecological disciplines of relevance to the study of the foraging and reproductive ecology of marine birds.

**Contact**  
George L Hunt, Jr.  
Professor of Ecology & Evolutionary Biology  
University of California  
Irvine, California  
92171  (714) 856-6322

**Research Area**  
The general research area is the study of the atmospheric boundary layer over the ocean from coastal areas to the open ocean. Special emphasis is given to the measurement and parameterization of air-sea fluxes of heat, water vapor, and wind momentum from low-flying aircraft and special research platforms such as Scripps Institution of Oceanography’s R/P FLIP.

**Contact**  
Carl A. Friehe  
Professor of Mechanical Engineering  
University of California  
Irvine, California  
92171-3945  (714) 856-6159  
FAX  (714) 856-8585
UCLA’s Department of Biology offers a degree with an emphasis in marine biology. Undergraduate study in marine biology includes broad exposure to the various biological disciplines as well as courses specifically concerning marine organisms. The program’s highlight is the Catalina Marine Biology Quarter (CMBQ) which involves ten or eleven weeks’ full-time study of marine biology courses at the University of Southern California’s Wrigley Marine Science Center on Catalina Island. This quarter is usually taken in the senior year. After the CMBQ, the student is encouraged to participate in one or more advanced courses and in courses offered at various marine laboratories around the country during the summer.

The CMBQ is offered in the fall quarter of each year. The combination of courses varies from year to year but always includes four courses that together provide an integrated study of the biology of the marine life of Catalina Island and of general biological oceanography. Scuba diving is strongly recommended. Prerequisites include preparation for the biology major and approval of instructors.

Although UC Riverside does not offer a formal program in marine biology, the Department of Biology teaches several undergraduate courses that involve the use of marine organisms. These include:

- Biology 151-a course in invertebrate biology, and
- Biology 167-a course in developmental biology.

Several of the faculty members in the department use marine organisms in their research projects. These individuals include Leah T. Haimo, Edward J. Carroll, and Prue Talbot.

Facilities for maintaining and working with marine organisms are located in the Department of Biology.
Contact
Prue Talbot
Professor of Biology
Department of Biology
University of California
Riverside, California
92521  (909) 787-3768
FAX  (909) 787-4286

UNIVERSITY OF CALIFORNIA, SAN DIEGO—SCRIPPS INSTITUTION OF OCEANOGRAPHY

Research Facilities
UCSD’s Scripps Institution of Oceanography (SIO) is one of the oldest, largest, and most important centers for research, graduate training, and public service in the marine sciences. The institution occupies 65 buildings on 230 acres. The staff numbers approximately 1,200, including approximately 200 graduate students.

The scientific scope of research conducted at Scripps embraces physical, chemical, geological, geophysical, and biological studies of the oceans. Continuing investigations are conducted on the topography and composition of the ocean bottom, on waves and currents, on the flow and interchange of matter between seawater and the ocean bottom and between seawater and the atmosphere, and on life in the sea.

The education program at Scripps is at the graduate level only, and studies are marked by a high degree of interdisciplinary and international collaboration. Academic work is conducted through an academic department of UCSD, the SIO Graduate Department and its seven curricular groups: Biological Oceanography, Physical Oceanography, Marine Biology, Geological Sciences, Marine Chemistry, Geophysics, and Applied Ocean Sciences. Approximately eighty professors are complemented by an academic staff of more than a hundred research scientists, some of whom also teach.

Scripps maintains several major research ships. The fleet sails both on limited-objective trips and far-flung expeditions. The fleet includes the Melville, Scripps’s largest ship, and the research vessels Robert Gordon Sproul, and the New Horizon. Several research platforms are also used extensively.

Research funds from sources outside the university are primarily federal, and cover a wide variety of marine research. The general research effort is conducted by four divisions, designated the Marine Biology Research Division, the Geological Research Division, the Physical Oceanography Research Division, and the Marine Research Division. The diversity of their work is extended by three special-purpose laboratories: the Marine Physical Laboratory, the Physiological Research Laboratory, and the Center for Coastal Studies; and by other specialized groups such as the Marine Life Research Group, sponsored by the State of California, and components of two University-wide institutes, the Institute of Marine Resources and the Institute of Geophysics and Planetary Physics. A Ship Operations and Marine Technical Support unit provides essential services and facilities to all research units of the institution: this unit also administers the scientific collections.

Closely affiliated with Scripps is the University of California’s statewide Institute of Marine Resources, administrative home of the California Sea Grant College. Sea Grant is a statewide, multiuniversity program of marine research, extension services, and education. It offers an undergraduate scholarship in marine science each year, the John D. Isaacs Memorial Scholarship, as well as graduate fellowships in marine policy at the federal and state capital.
Also located on the UC San Diego campus is the Southwest Fisheries Science Center, one of thirty major laboratories and centers operated by the National Marine Fisheries Service, a component of the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce.

Contact
Richard H. Rosenblatt, Chairman
Graduate Department of SIO, 0208
Scripps Institution of Oceanography
University of California, San Diego
La Jolla, California
92093-0208 (619) 534-3208

PROGRAM: APPLIED OCEAN SCIENCES

Degrees Offered
M.S., Ph.D. in Oceanography, Earth Sciences, or Marine Biology

Description
The Graduate Department of the Scripps Institution of Oceanography does not offer a specific degree in applied ocean science. Instead, it offers applied ocean science as a concentration area for students working toward a graduate degree in oceanography, marine biology, or earth sciences. The program is designed to produce oceanographers who are knowledgeable about modern engineering and instrumentation as well as marine-oriented engineering scientists who are familiar with the oceans. Research activities include studies of deep circulation and deep fish populations; deep-sea autonomous vehicles, instruments, basic control devices, and special collecting gear; seismic surveys of the mantle; ocean bottom microseismic and crustal displacements associated with earthquakes; design and construction of special-purpose ocean vehicles (ships, submarines, platforms such as FLIP); underwater acoustic propagation, active and passive sonar systems and related signal processing; underwater photography and television; remote sensing of sea surface temperatures, roughness, and marine resources from aircraft and orbital spacecraft; turbulent flows, formation of barrier beaches; and mechanisms of currents, sand transport, and sediment transport in the surf zone, the shelf, and in submarine canyons.

Number of Marine Science Courses
Not applicable-interdepartmental program involving the Departments of Applied Mechanics and Engineering Sciences and Electrical Engineering and Computer Sciences.

Research Facilities
See the description of research facilities under UCSD Scripps Institution of Oceanography.

Contact
Chairman
SIO Graduate Department, 0208
University of California, San Diego
La Jolla, California
92093-0208 (619) 534-1694
PROGRAM BIOLOGICAL OCEANOGRAPHY

Degrees Offered
M.S., Ph.D. in Oceanography

Description
The Graduate Department of the Scripps Institution of Oceanography offers a graduate degree program in oceanography with emphasis in biological oceanography. The program concerns the interactions of populations of marine organisms with one another and with their physical and chemical environment. Studies include those in physical oceanography, marine chemistry, marine geology, and biology. Research activities include studying the factors influencing primary and secondary productivity and nutrient regeneration, food-chain dynamics, community ecology of benthic and pelagic forms, population dynamics, habitat changes and disruption, fishery biology, systematics, evolution, biogeography, behavior as it affects distribution, and sampling problems.

Number of Marine Science Courses
0 undergraduate; 14 graduate

Research Facilities
See the description of research facilities under UCSD-Scripps Institution of Oceanography.

Contact
Chairman
SIO Graduate Department, 0208
University of California, San Diego
La Jolla, California
92093-0208  (619) 534-1694

PROGRAM GEOLOGICAL SCIENCES

Degree Offered
Ph.D. in Earth Sciences or Oceanography

Description
The Geological Sciences Curricular Group of the Scripps Institution of Oceanography offers programs leading to a graduate degree in earth sciences or oceanography. Principal subprograms within the group are marine geology and geophysics, petrology, and geochemistry. The marine geology and geophysics subprogram focuses on the study of the origin, properties, and history of ocean basins and the geological and geophysical processes that affect them. Research areas include tectonics and volcanism; geomorphology, structure, and deformation of the oceanic crust and continental margins, utilizing both geophysical and geological techniques; deep sea and continental margin sedimentation, stratigraphy, and paleontology; and beach and nearshore processes.

Petrology is the study of the origin and history of the rock complexes of the Earth’s crust and upper mantle, with emphasis on the igneous, metamorphic, and sedimentary rocks of the ocean basins and their margins, the characteristics and interrelations of the oceanic and continental crust, and studies of lunar and meteoritic materials.

The geochemistry program is designed for students with undergraduate degrees in either geology or chemistry. Areas of advanced study and research include the geochemistry of the ocean, the atmosphere, and the solid earth; nuclear geochemistry; circulation and mixing of oceanic water masses based on carbon, oxygen, carbon-14, radium, radon, stable isotopes, and rare gases; volcanic and geothermal phenomena; the interaction of sediments with seawater and interstitial waters; marine pollution; geochemical cycles; and the history and composition of the ocean and sedimentary rocks.
### PROGRAM

**GEOPHYSICS**

**Degrees Offered**

M.S., Ph.D. in Earth Sciences or Oceanography

**Description**

The Scripps Institution of Oceanography offers a graduate degree program in earth sciences and in oceanography, through which students may specialize in geophysics. There is no single course of study appropriate to the geophysics curriculum; instead, the student's individual interests will dictate course work in seismology, geomagnetism, etc. Every student will be required to have knowledge in one or more of the ocean sciences.

Geophysics emphasizes the application of general principles of mathematics and experimental physics to fundamental problems of the oceans, the oceanic crust, and the deep interior of the Earth. Research interests of the group include: observational and theoretical studies of electric and magnetic fields in the ocean and on land; theoretical seismology with special emphasis on the free oscillations of the Earth; long-period observational seismology; ocean-bottom seismology; earthquake source mechanisms and strong motions of the ground caused by earthquakes; measurements of slow crustal deformation; geophysical inverse theory; geophysical time-series analysis; magneto-hydrodynamics of the core of the Earth; geophysical instrumentation, particularly in the marine environment; and acoustic propagation in the ocean.

**Number of Marine Science Courses**

0 undergraduate; 15 graduate

**Research Facilities**

See the description of research facilities under UCSD-Scripps Institution of Oceanography.

**Contact**

Chairman
SIO Graduate Department, 0208
University of California, San Diego
La Jolla, California
92093-0208 (619) 534-1694
PROGRAM  MARINE BIOLOGY

Degrees Offered  M.S., Ph.D. in Marine Biology or Oceanography

Description  The Graduate Department of the Scripps Institution of Oceanography offers a graduate degree program in marine biology. The program concerns physiological and biochemical processes in marine organisms, their genetic relationships, and the relationship between them and their environment, both biotic and physical. Research activities include microbiology, ultrastructure, photobiology, barobiology, cardiovascular physiology, comparative biochemistry, comparative and cellular physiology, neurophysiology and behavior, symbioses in marine organisms, systematics, distribution, ecology, developmental biology, and evolution of marine animals and plants.

Number of Marine Science Courses  0 undergraduate; 22 graduate

Research Facilities  See the description of research facilities under UCSD-Scripps Institution of Oceanography.

Contact  Chairman
SIO Graduate Department, 0208
University of California, San Diego
La Jolla, California
92093-0208  (619) 534-1694

A Scripps graduate student sets up a bacterial conjugation experiment in order to transfer recombinant DNA molecules into deep-sea bacteria
PROGRAM GEOCHEMISTRY/MARINE CHEMISTRY

Degrees Offered
M.S., Ph.D. in Oceanography and Earth Sciences

Description
Geochemistry and Marine Chemistry concern chemical and geochemical processes operating in a broad range of study areas; the oceans, the solid earth, the atmosphere, marine organisms, polar ice sheets, lakes, meteorites, and the solar system. Areas of advanced study and research include: the physical and inorganic chemistry of seawater; ocean circulation and mixing based on chemical and isotopic tracers; marine organic and natural products chemistry; geochemical interactions of sediments with seawater and interstitial waters; geochemistries of volcanic and geothermal phenomena; chemical exchanges between the ocean and the atmosphere; geochemical cycles of carbon, sulfur, nitrogen and other elements; isotopic geochemistry of the solid earth and meteorites; atmospheric trace gas chemistry; paleoatmospheric composition recorded in polar ice cores and in sediments; and chemistry of lakes and other freshwater systems.

Number of Marine Science Courses
0 undergraduate; 9 graduate

Research Facilities
See the description of research facilities under UCSD Scripps Institution of Oceanography.

Contact
Chairman
SIO Graduate Department, 0208
University of California, San Diego
La Jolla, California
92093-0208 (619) 534-1694

PROGRAM PHYSICAL OCEANOGRAPHY

Degrees Offered
M.S., Ph.D. in Oceanography

Description
The Graduate Department of the Scripps Institution of Oceanography offers a graduate degree program in oceanography with emphasis in physical oceanography. The program deals with the mechanisms of energy transfer through the sea and across its boundaries, and with the physical interactions of the sea with its surroundings. Research activities include study of the general circulation of the oceans, including the relations of ocean currents to driving forces and constraints of the ocean basins; fluctuations of currents and the transport of properties; the mechanisms of energy, momentum, and physical substance transport; properties of wind waves, internal waves, tsunami, and planetary waves; optical and acoustic properties of the sea; and surf influence on nearshore current and sediment transport.

Number of Marine Science Courses
0 undergraduate; 15 graduate

Research Facilities
See the description of research facilities under UCSD-Scripps Institution of Oceanography.

Contact
Chairman
SIO Graduate Department, 0208
University of California, San Diego
La Jolla, California
92093-0208 (619) 534-3208
ECOLOGY, EVOLUTION, AND MARINE BIOLOGY (UNDERGRADUATE)

Degree Offered
B.A. in Aquatic Biology, Biological Sciences, or Ecology and Evolution

Description
UC Santa Barbara offers a Bachelor of Arts degree in ecology, evolution, and marine biology. The program provides opportunities for students to specialize in a number of subjects including marine pharmacology, marine biology, biological oceanography, limnology, marine and freshwater ecology, mariculture, and population biology of aquatic organisms. Opportunities for concentration in certain of these subjects are provided by a broad range of courses offered at the upper-division level.

In preparation for their major, students must take lower-division courses in biology, general chemistry, organic chemistry, physics, and mathematics. Upper-division credit must include courses taken from several categories, including aquatic animals, aquatic plants, physiology, genetics, development, and ecology.

Number of Marine Science Courses
29 undergraduate; 16 graduate

Research Facilities
Marine laboratories in several buildings are provided with flow-through seawater service and are suitably equipped for needs in a broad range of biological and other disciplines. Field-oriented work is supported by boats suitable for work in coastal waters (including those around the Santa Barbara Channel Islands), and by diving and other field equipment. The university operates a field station on Santa Cruz Island, the largest of the northern Channel Islands.

Other research facilities used by UCSB include vessels operated by the Scripps Institution of Oceanography and the UNOLS national fleet.

Also housed at UCSB is the Marine Science Institute (MSI), an organized research unit which assists and encourages faculty, professional researchers, and students in marine research. The MSI administers research projects involving faculty and graduate students from eight disciplines. A core of research activity is focused on the resources of the California coast and on their wise management. The MSI specifically encourages and promotes basic and applied research leading to a better understanding of the world’s ocean.

Contact
Undergraduate Adviser
Department of Biological Sciences
University of California
Santa Barbara, California
93106 (805) 893-3052

or
James P. Kennett, Director
Marine Science Institute
University of California
Santa Barbara, California
93106 (805) 893-3764
<table>
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<tr>
<th>PROGRAM</th>
<th>ECOLOGY, EVOLUTION, AND MARINE BIOLOGY (GRADUATE)</th>
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<tr>
<td><strong>Degrees Offered</strong></td>
<td>M.A., Ph.D. in Biological Sciences</td>
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<tr>
<td><strong>Description</strong></td>
<td>UC Santa Barbara offers a graduate degree program in ecology, evolution, and marine biology. Students can choose between a number of specialized areas in aquatic and population biology, including biology of arthropods, biological oceanography and limnology, ichthyology, parasitology, marine pharmacology, population ecology, mariculture, tropical ecology, field oceanography, marine and freshwater ecology.</td>
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<tr>
<td><strong>Number of Marine Science Courses</strong></td>
<td>29 undergraduate; 16 graduate</td>
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<tr>
<td><strong>Research Facilities</strong></td>
<td>See the description of research facilities under UCSB’s Ecology, Evolution, and Marine Biology undergraduate program.</td>
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<tr>
<td><strong>Contact</strong></td>
<td>Graduate Program Assistant or Director</td>
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<td>Department of Biological Sciences or Marine Science Institute</td>
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<td>(805) 893-3023 or (805) 893-3764</td>
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<tr>
<th>PROGRAM</th>
<th>OCEAN ENGINEERING</th>
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<td><strong>Degrees Offered</strong></td>
<td>M.S., Ph.D.</td>
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<td><strong>Description</strong></td>
<td>The Mechanical and Environmental Engineering Department at UC Santa Barbara offers graduate degrees with an emphasis in the field of Ocean Engineering. The core curriculum includes courses in basic fluid mechanics, waves, nearshore processes, geophysical fluid dynamics, and advanced hydrodynamics. In addition, other courses in environmental engineering and fluid mechanics, such as sediment transport, turbulence, viscous flow, rotating fluids, and computational methods are available, as well as courses in solid mechanics and structures, and thermal science.</td>
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<tr>
<td><strong>Research Facilities</strong></td>
<td>The Ocean Engineering Laboratory at UC Santa Barbara includes a large wave/towing tank, 55 m long, 4 m wide and 2 m deep. Both planar and directional waves can be generated and a wind tunnel capable of producing 20-knot winds is currently being constructed over the tank. A 22 m long, .9 m wide and .9 m deep recirculating, tilting flume is also available. This facility can be used either as a wave tank or as a water channel in which flows to .35 m/s can be produced. In addition, there is a 3.5 m long, 2 m wide, .5 m deep tank in which stratified fluids processes, such as internal waves, can be studied.</td>
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<tr>
<td><strong>Contact</strong></td>
<td>Director</td>
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<td>Ocean Engineering Laboratory</td>
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<td>University of California</td>
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<td>(805) 893-4937</td>
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A UC Santa Barbara graduate student in engineering is shown constructing a model of a semisubmersible platform used in offshore oil and gas exploration.

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<tr>
<th>PROGRAM</th>
<th>BIOLOGY (WITH MARINE EMPHASIS)</th>
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<tr>
<td>Degrees Offered</td>
<td>B.A. (Marine Biology), M.A., Ph.D.</td>
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<tr>
<td>Description</td>
<td>UC Santa Cruz offers a biology degree within which students may design a four-year program that reflects a strong marine emphasis. This program ensures that students are well grounded in biology but also develop an understanding of the marine environment. Marine biology faculty have special strengths in higher marine vertebrates, the reproductive, cellular, and developmental biology of marine invertebrates and algae, marine ecology, and biological oceanography.</td>
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<tr>
<td>Number of Marine Science Courses</td>
<td>14 undergraduate; 4 graduate</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>Marine biology instruction is supported by the Institute of Marine Sciences. On campus the Institute has analytical laboratories for marine chemistry, biology, and geology; an oceanography cruise-staging building; culture rooms for invertebrates and algae, and a computer laboratory. The Long Marine Lab, less than ten minutes from campus, provides running seawater required for instruction and research in marine biology. UC Santa Cruz also has research jurisdiction over Año Nuevo Island, a major pinniped rookery 14 miles north of Santa Cruz. The Institute operates a Boston Whaler for nearshore research and the 40-foot research vessel David Johnston, which is well equipped for bay and nearshore coastal research and instruction. Faculty and students also work in a variety of places around the world aboard larger oceanographic research vessels.</td>
</tr>
</tbody>
</table>
PROGRAM DIRECTORY

Four-Year Public

Contact
Gary B. Griggs, Director
Institute of Marine Sciences
Applied Sciences Building, Room 272
University of California
Santa Cruz, California
95064 (408) 459-2464

PROGRAM

EARTH SCIENCES

Degrees Offered
B.A., B.S., M.S., Ph.D.

Description
Santa Cruz offers programs leading to undergraduate and graduate degrees in earth sciences. Undergraduate students follow either a general geology or a geophysics path. Geology is the study of the origin, properties, and history of continents and ocean basins and the geological processes that affect them. Research areas include tectonics and volcanism; geomorphology, structure, and deformation of the oceanic crust and continental margins, utilizing both geophysical and geological techniques; deep sea and continental margin sedimentation, stratigraphy, and paleontology; and beach and nearshore processes.

Number of Marine Science Courses
5 undergraduate; 8 graduate

Research Facilities
UCSC has well-equipped laboratories for petrography and thin sectioning, mineral separation, and the deformation of rocks and minerals at high temperatures and pressures. Field equipment includes a LaCoste-Romberg gravity meter, a portable proton magnetometer, and a hammer seismic refraction device. The Scammon, a 40-foot vessel, is also available for coastal research.

Analytical laboratory: The XRF spectrometry lab is fully automated and is used routinely to determine 10 major elements with an accuracy of 0.5 to 1.5 percent relative, and up to 15 trace elements (including light REE) with accuracy of 3 to 5 percent relative or 1 to 3 ppm (whichever is higher) and a detection limit of 1 ppm for most elements.

Electron microscope laboratory: Earth scientists have access to a centralized electron microscope laboratory, which is equipped with two scanning electron microscopes and two transmission electron microscopes, along with ancillary sample preparation equipment such as vacuum evaporators.

Paleomagnetic laboratory: The heart of our present facilities consists of a very sensitive digital spinner magnetometer plus thermal and alternating field demagnetization equipment made by Schonstedt Instrument Company. Data acquisition, plotting, and analysis, as well as other computing and word processing tasks, are handled simultaneously within our own multiuser computer system. We also have six portable drills and the necessary orienting and field equipment for paleomagnetic sampling expeditions, a very sensitive magnetic susceptibility bridge, and a low-field torque meter for determining anisotropy of magnetic susceptibility.

Seismological research facilities: The new Charles F. Richter Seismological Laboratory was dedicated in December 1982 and consists of a seismogram analysis laboratory and seismogram archive; a seismological engineering shop; two computer rooms housing a Vax 11/750 computer, terminals, graphics plotter and large digitizing table; and offices for faculty, graduate students, and complete support staff. A site is being selected for the Richter Seismographic Vault, which will house the short-, intermediate-, and long-period seismometers and the Woods-Anderson seismograph for recording at Santa Cruz. Available equipment includes Sprengnether <EQ-800 portable field recorders. Teledyne Geotech and Kinematics drum recorders, Kinematics Ranger...
seismometers, Kinematics SMA-1 strong-motion recorders, and mobile seismographic trailer film recorders.

Opportunities are abundant for cooperative research with other institutions. Santa Cruz researchers use many of the specialized facilities at Stanford and the U.S. Geological Survey, such as the electron probe and seismological equipment and data. Faculty and graduate students have undertaken oceanographic research in cooperation with the U.S. Geological Survey and Scripps Institution of Oceanography.

Contact
Shirley Preiss
Chair, Department of Earth Sciences
Earth Sciences Board of Studies
University of California
Santa Cruz, California
95064 (408) 459-0111

PROGRAM MARINE SCIENCES

Degree Offered M.S.

Description The Marine Sciences Program offers a Master of Science degree in four pathways: biology, chemistry, earth sciences, and physics. The degree combines specified courses to provide breadth in marine sciences with a focused thesis that affords depth and experience in original research. Graduates from the program may take research or management positions in organizations concerned with the marine environment, become educators, or enter doctoral programs in one of the marine sciences.

Number of Marine Science Courses 12 undergraduate; 11 graduate

Research Facilities Most research facilities used by marine sciences are provided by UCSC’s Institute of Marine Sciences, including on-campus analytical laboratories for chemistry and geology; an on-shore marine laboratory with aquariums and holding tanks supplied with running seawater, located two miles from campus; a 43-foot research vessel for off-shore and open ocean research; and Año Nuevo Island, a unique site 19 miles north of Santa Cruz especially suitable for work on pinnipeds and marine birds. Most students work within their faculty sponsor’s laboratory and have access to campus-wide facilities as well, including an electron microscope suite, darkrooms, library, computers, and machine, electronics, glass, and wood shops.

Contact Mary Silver, Chair
Marine Sciences Committee
Applied Sciences Building, Room 273
University of California
Santa Cruz, California
95064 (408) 459-4630
or (408) 459-4026