

# MARINE SCIENCES

College of Natural Sciences and Mathematics

## Program Description

Moss Landing Marine Laboratories (MLML) at Moss Landing, California, is operated year round by the California State University. This marine facility functions as an extension of seven participating State Universities (Fresno, Hayward, Monterey Bay, Sacramento, San Francisco, San Jose, Stanislaus) and offers full-time coursework in marine biology, oceanography, marine geology, and other marine sciences.

Enrollment is open to properly qualified upper division and graduate students from each of the participating colleges. New students may qualify through normal matriculation procedures at one of the home campuses. With approval of academic advisors, students may satisfy a part of their requirements in Biological Sciences through courses offered at the Moss Landing Laboratories. The Master of Science degree in Marine Science is offered as an interdepartmental degree through Biological Sciences in cooperation with Moss Landing Marine Laboratories.

## Special Features

- Most courses are field-oriented, taking advantage of a diversity of nearby coastal and marine habitats, including Monterey Submarine Canyon, subtidal kelp forests, Elkhorn Slough, and rocky and sandy intertidal zones.
- Field activities are facilitated by the MLML fleet, the 135' R/V POINT SUR, the 35' R/V ED RICKETTS, two Boston Whalers, and a number of inflatable rafts.
- Ongoing research by faculty and graduate students further enhances the MLML learning experience.

## Contact Information

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## Graduate Program

### Admission Requirements

The Master of Science degree in Marine Science program is administered through MLML and the Biological Sciences Department. The prospective student must meet the entrance requirements for the program and will be accepted into unclassified or conditionally classified graduate status by normal procedures. The student will become classified upon completion of MLML's requirements.

A conditionally classified student may become fully classified in the Marine Science program as follows:

- obtain an advisor at MLML and one from the department of the student's choice at the home campus. Each new student in the MS

program at MLML will be assigned an advisor who may or may not be the final thesis advisor;

- make up any coursework deficiencies at either the home campus department (see their regulations) and/or MLML. MSCI 104, and three of the following five courses are prerequisites for classified graduate standing:

MSCI 103	Marine Ecology	4
MSCI 141	Geological Oceanography	4
MSCI 142	Physical Oceanography	4
MSCI 143	Chemical Oceanography	4
MSCI 144	Biological Oceanography	4

These courses may be waived by the graduate committee upon certification that equivalent courses have been satisfactorily completed. MSCI 104 is a prerequisite and cannot be counted toward the 30-unit degree requirement;

- students who do not receive a GPA of 3.0 or better in the courses listed above taken at MLML, or who wish to substitute equivalent courses taken elsewhere regardless of the grade(s) received, must pass a written qualifying examination given by the faculty at MLML. Contact MLML for further information.

## Advancement to Candidacy

To be advanced to candidacy, the student must have:

- attained classified standing;
- selected a thesis problem and a thesis advisory committee. The thesis committee will be composed of at least three members, including one faculty member from MLML (who is ordinarily the thesis advisor) and, at the discretion of the home campus, a representative from that campus. The other member or members of the thesis committee may also be from MLML, or from the home campus, or elsewhere, with the approval of the thesis advisor; and
- taken the Writing Placement for Graduate Students (WPG) or taken a Graduate Writing Intensive (GWI) course in their discipline within the first two semesters of coursework at California State University, Sacramento or secured approval for a WPG waiver.

## MS Degree in Marine Science

A student becomes eligible for the MS degree in Marine Science after satisfying the following requirements:

- the student has been advanced to candidacy;
- the student has satisfied MLML's requirements for the degree; and
- the student has completed the following 30-unit curriculum requirements.

### Required Courses (7-10 Units)

MSCI 285	Seminar in Marine Biology	2
MSCI 286	Seminar in Marine Geology	2
MSCI 287	Seminar In Oceanography	2
MSCI 299	Master's Thesis	1 - 4

### Electives (24 Units) <sup>1</sup>

Select 9 units of electives from MSCI 200-level courses	9
Select 15 units of electives from MSCI 100-level or above courses as approved by the thesis committee. The following courses may be used:	15
MSCI 112	Marine Birds and Mammals

MSCI 113	Marine Ichthyology
MSCI 124	Marine Invertebrate Zoology I
MSCI 125	Marine Invertebrate Zoology II
MSCI 131	Marine Botany
MSCI 201	Library Research Methods
MSCI 202	Oceanographic Instrumentation
MSCI 211	Ecology of Marine Birds and Mammals
MSCI 212	Advanced Topics in Marine Vertebrates
MSCI 221	Advanced Topics in Marine Invertebrates
MSCI 231	Biology Of Seaweeds
MSCI 234	Advanced Biological Oceanography
MSCI 242	Plate Tectonics
MSCI 248	Marine Benthic Habitat Techniques
MSCI 251	Marine Geochemistry
MSCI 261	Ocean Circulation and Mixing
MSCI 271	Population Biology
MSCI 272	Subtidal Ecology
MSCI 280	Scientific Writing
MSCI 298	Research in the Marine Sciences
Total Units	31-34

<sup>1</sup> Other electives, including courses from home campus departments, may be included after consultation with the thesis advisory committee. See course descriptions for prerequisites.

#### Notes:

- The student must have submitted a thesis approved by the thesis advisory committee. The thesis must conform to the rules set forth by the home campus.
- The student must successfully give an oral thesis defense in the form of a seminar open to the general public. The thesis advisory committee must be present, may require further oral questioning after the seminar, and will evaluate the success of the presentation.

#### MSCI 103. Marine Ecology. 4 Units

**Prerequisite(s):** Ecology, statistics; or concurrent registration in MSCI 104.

Field-oriented introduction to the interrelationships between marine and estuarine organisms and their environment with emphasis on quantitative data collection and analysis. Lecture two hours; laboratory six hours.

#### MSCI 104. Quantitative Marine Science. 4 Units

**Prerequisite(s):** College mathematics.

Mathematical methods for the analysis of biological, chemical and physical data from the marine environment; experimental design, parametric and nonparametric statistics. Lecture three hours; laboratory three hours.

**Note:** Not for major credit.

#### MSCI 105. Marine Science Diving. 3 Units

**Prerequisite(s):** Upper division science major status, thorough physical examination, ability to pass swimming test.

Skin SCUBA diving course, pool-training culminates in ten ocean dives. Topics covered included diving physics, physiology, diving environments, night diving and research diving. Successful completion gives NAUI and MLML certification. Lecture one hour; laboratory six hours.

**Note:** Not for major credit.

#### MSCI 112. Marine Birds and Mammals. 4 Units

**Prerequisite(s):** Upper division college vertebrate zoology or instructor permission; MSCI 103 recommended.

Systematic, morphology, ecology and biology of marine birds and mammals. Lecture two hours; laboratory six hours.

#### MSCI 113. Marine Ichthyology. 4 Units

**Prerequisite(s):** College zoology or equivalent or instructor permission; MSCI 103 recommended.

Description of the taxonomy, morphology, and ecology of marine fishes. Both field and laboratory work concentrate on the structure, function and habits of marine fishes and the ecological interactions of these fishes with their biotic and abiotic surroundings. Lecture two hours; laboratory six hours.

#### MSCI 124. Marine Invertebrate Zoology I. 4 Units

**Prerequisite(s):** College zoology or instructor permission; MSCI 103 recommended.

Field oriented introduction to the structure, systematics, evolution, and life histories of the major and minor marine phyla. Lecture two hours; laboratory and six hours.

#### MSCI 125. Marine Invertebrate Zoology II. 3 Units

**Prerequisite(s):** College zoology or instructor permission; MSCI 103 and MSCI 124 recommended.

Field oriented introduction to the structure, systematics, evolution and life histories of the minor marine invertebrate phyla. Lecture one hour; laboratory and field six hours.

#### MSCI 131. Marine Botany. 4 Units

**Prerequisite(s):** MSCI 103 recommended.

Introduction to the plants of the sea, marshes, and dunes, with emphasis on the morphology, taxonomy and natural history of seaweeds and vascular plants. Lecture two hours; laboratory six hours.

#### MSCI 135. Physiology of Marine Algae. 4 Units

**Prerequisite(s):** MSCI 103, MSCI 131, and MSCI 144. Lecture two hours; laboratory six hours.

Physiological basis for understanding the adaptation of marine algae to their environment. Topics include respiration, enzyme activity, and biochemical composition. Hands-on experience in basic electronic instrumentation, chemical separations, optical measurements, culturing methods, and radioisotope techniques.

#### MSCI 141. Geological Oceanography. 4 Units

**Prerequisite(s):** MSCI 142, MSCI 143; may be taken concurrently.

Study of the structures, physiography and sediments of the sea bottom and shoreline. Lecture two hours; laboratory and field six hours.

#### MSCI 142. Physical Oceanography. 4 Units

**Prerequisite(s):** College algebra, college physics recommended.

Introduction to the nature and causes of various oceanic motions including currents, waves, tides, and mixing and the Physical properties of seawater. Limited use of calculus. Lecture three hours; laboratory three hours.

- MSCI 143. Chemical Oceanography. 4 Units**  
**Prerequisite(s):** One year of college chemistry.  
 Introduction to the theoretical and practical aspects of the chemistry of the oceans, including major salts, dissolved gases, nutrient ions, carbonate system, transient tracers, and shipboard sampling techniques. Lecture two hours; laboratory six hours.
- MSCI 144. Biological Oceanography. 4 Units**  
**Prerequisite(s):** General biology, general chemistry.  
 Ocean as an ecological system. Emphasis will be on the complexity of organismal-environmental interaction of the plankton, the transfer of organic matter between trophic levels and nutrient cycles. Laboratory sessions will include methods in sampling, shipboard techniques, identification of the plankton, and current analytical techniques. Lecture two hours; laboratory six hours.
- MSCI 175A. Coastal Geol Processes. 1 Unit**
- MSCI 175B. Intro To Marine Science. 1 Unit**
- MSCI 180. Independent Study. 1 - 4 Units**  
**Prerequisite(s):** Instructor permission.  
 Faculty-directed study of selected research problems; open to undergraduate students with adequate preparation. Three hours work per unit.
- MSCI 201. Library Research Methods. 1 Unit**  
**Prerequisite(s):** Graduate standing in the Marine Science M.S. program and instructor permission.  
 Students will gain advanced understanding of the nature of scientific information. Provides the framework for using and evaluating a variety of information sources in marine and ocean sciences. Strong emphasis will be placed on developing critical skills to interweave knowledge of the history of science into the context of bibliographic tools including the digital realm. Lecture: three hours.
- MSCI 202. Oceanographic Instrumentation. 4 Units**  
**Prerequisite(s):** MSCI 141, MSCI 142 and instructor permission.  
 Principles of instruments used in oceanographic research, introduction to electronics, and applications of instrument measurements. Emphasis will vary from CTD profilers, current meters, radiometry and chemical measurement. Lecture two hours; laboratory six hours.
- MSCI 204. Sampling and Experimental Design. 4 Units**  
**Prerequisite(s):** MSCI 103, MSCI 104.  
 Discussion of random sampling, systematic sampling, subsampling, survey techniques, and design of single and multifactorial experiments using randomized and block experimental designs: basic design of experiments and field sampling will be covered. Biases and problems of sampling marine biota will be presented and discussed by critiquing relevant literature. Lecture four hours.
- MSCI 208. Molecular Ecology: Concepts and Methods. 4 Units**  
**Prerequisite(s):** Basic cellular/molecular biology course; consent of instructor.  
 Use of genetic information affecting interactions of organisms with environment. Lectures on molecular markers used to assess diversity in communities, characterize spatial/temporal variation in species composition, assess genetic variability in populations, discriminate/reveal kinship among individuals, and detect/quantify gene expression important in organismal responses to environmental fluctuation. Basic molecular methods (DNA and RNA isolation/amplification/cloning/sequencing) taught. Students projects as budget permits. Enrollment limited. Lecture 2 hours; laboratory 6 hours.
- MSCI 211. Ecology of Marine Birds and Mammals. 4 Units**  
**Prerequisite(s):** MSCI 103, MSCI 104, MSCI 112.  
 Community approach to the ecology of marine birds and mammals using experimental and sampling methodology; examine the distribution, abundance, trophic ecology, and behaviors of birds and mammals in Elkhorn Slough and Monterey Bay. Lecture two hours; laboratory six hours.
- MSCI 212. Advanced Topics in Marine Vertebrates. 4 Units**  
**Prerequisite(s):** MSCI 112 or MSCI 113 and instructor permission.  
 Advanced consideration of the ecology, physiology and phylogeny of fishes, birds, reptiles or mammals, emphasizing current literature and research. Topics and emphasis will vary with term and instructor. Lecture two hours; laboratory six hours.  
**Note:** May be repeated once for credit.
- MSCI 212A. Adv Ichthyology. 4 Units**
- MSCI 212B. Ichthyoplankton. 4 Units**
- MSCI 212C. Marine Bird+Mammal Ecology. 4 Units**
- MSCI 212D. Sampling+Expermntl Design. 4 Units**
- MSCI 221. Advanced Topics in Marine Invertebrates. 4 Units**  
**Prerequisite(s):** MSCI 124 and instructor permission.  
 Advanced considerations of the ecology, physiology and phylogeny of the various invertebrate phyla emphasizing current literature and research. Topics will vary from term to term. Lecture two hours; laboratory six hours.  
**Note:** May be repeated for credit when topics change.
- MSCI 221A. Marine Symbioses. 4 Units**
- MSCI 231. Biology Of Seaweeds. 4 Units**  
**Prerequisite(s):** MSCI 131 or instructor permission.  
 Lecture-discussions in algal development, reproduction, and ecology. Extensive reading of original literature. Ecologically oriented individual research projects involving laboratory culture and field experimentation. Lecture two hours; laboratory six hours.
- MSCI 233A. Adv Marine Ecology. 4 Units**
- MSCI 233B. Sampling+Expermntl Design. 4 Units**
- MSCI 233C. Coastal Ecology-Gulf of California. 3 Units**  
**Prerequisite(s):** MSCI 103, MSCI 104, MLML SCUBA certified, graduate status, instructor permission.  
 Field-oriented examination of the interrelationships between intertidal and shallow subtidal organisms and their environment in the Gulf of California, Mexico. Information from lectures and review of primary literature on the ecology of the region will be used to write a research proposal. 1 hour lecture, 6 hours laboratory.
- MSCI 233D. Immune Respn Marine Orgns. 2 Units**
- MSCI 234. Advanced Biological Oceanography. 4 Units**  
**Prerequisite(s):** MSCI 144.  
 Experimental techniques in biological oceanography with emphasis on problems important to plankton ecology. Includes lectures, labs, and discussions of current research problems. An individual research project involving analytical tools will be required. Lecture two hours; laboratory six hours.
- MSCI 242. Plate Tectonics. 3 Units**  
**Prerequisite(s):** MSCI 141 or instructor permission.  
 Historical background, modern theory, and geo-physical evidence of continental drift sea floor spreading and plate tectonics. Examinations of the impact of the recent revolution in historical geology. Lecture three hours.

<b>MSCI 248. Marine Benthic Habitat Techniques.</b>	<b>4 Units</b>	<b>MSCI 281. Coastal Dynamics.</b>	<b>4 Units</b>
<b>Prerequisite(s):</b> Graduate standing and instructor permission. Collection and interpretation of geophysical data used to characterize marine benthic habitats. Basic geophysical principles will be reviewed. Application of techniques to identify and characterize marine benthic habitats, including echosounders, multibeam bathymetry and backscatter, sidescan sonar, seismic profiling, and GIS. Lecture two hours; laboratory six hours.		<b>Prerequisite(s):</b> Graduate standing and MSCI 141 or MSCI 142. Addresses the oceanographic dynamics of coastal environments, within an emphasis on eastern boundary current systems influenced by coastal upwelling. Focuses on how physical and geological oceanography interact with each other and how both affect coastal ecosystem dynamics.	
<b>MSCI 251. Marine Geochemistry.</b>	<b>4 Units</b>	<b>MSCI 285. Seminar in Marine Biology.</b>	<b>2 Units</b>
<b>Prerequisite(s):</b> MSCI 143, quantitative analysis, one year calculus or instructor permission. Geochemical processes in the oceans: thermodynamics of low temperature aqueous reactions, processes occurring at the sea floor and air-sea interface. Lecture two hours; laboratory six hours.		<b>Prerequisite(s):</b> Instructor permission. Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. Lecture two hours. <b>Note:</b> May be repeated once for credit.	
<b>MSCI 261. Ocean Circulation and Mixing.</b>	<b>4 Units</b>	<b>MSCI 285A. Social Biology.</b>	<b>2 Units</b>
<b>Prerequisite(s):</b> MSCI 142; college physics strongly recommended or instructor permission. Mathematical description of the distribution of properties (salinity density, etc.) in the oceans relating to physical and biochemical processes. Equations of motion, geotropic method, and theory of distribution of variables. Lecture two hours; laboratory six hours.		<b>MSCI 285B. Repro+Dev Marine Organism.</b>	<b>2 Units</b>
<b>MSCI 262. Satellite Oceanography.</b>	<b>4 Units</b>	<b>MSCI 285C. Recent Adv Deep-Sea Bio.</b>	<b>2 Units</b>
<b>Prerequisite(s):</b> MSCI 142, MSCI 144, or instructor permission. MSCI 263 strongly recommended. Physical principles of remote sensing with application to the oceans including satellite image processing methods. Labs involve use of PC and Unix workstation. Lecture two hours; laboratory six hours.		<b>MSCI 285D. Controversies Modern Biol.</b>	<b>2 Units</b>
<b>MSCI 263. Application of Computers in Oceanography.</b>	<b>4 Units</b>	<b>MSCI 285E. Paradigms In Commun Ecol.</b>	<b>2 Units</b>
<b>Prerequisite(s):</b> College math and instructor permission. Lecture, discussion and technical programming with MATLAB for computation and visualization with applications in marine sciences. Use of existing program libraries for data I/O and analysis. Semester project required. Lecture two hours; laboratory six hours.		<b>MSCI 285F. Appl Moleclr Tech Mar Bio.</b>	<b>2 Units</b>
<b>MSCI 271. Population Biology.</b>	<b>3 Units</b>	<b>MSCI 285G. Aspects Of Deep-Sea Biol.</b>	<b>2 Units</b>
<b>Prerequisite(s):</b> MSCI 103, MSCI 104; or instructor permission. Principles of the interaction among marine organisms that result in the alteration of population structures. Techniques for assessment and management of populations. Lecture two hours; laboratory three hours.		<b>MSCI 286. Seminar in Marine Geology.</b>	<b>2 Units</b>
<b>MSCI 272. Subtidal Ecology.</b>	<b>4 Units</b>	Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. <b>Note:</b> May be repeated once for credit.	
<b>Prerequisite(s):</b> MLML diver certification and marine ecology (knowledge of marine algae, invertebrates, and statistics recommended). Ecology of nearshore rocky subtidal populations and communities with emphasis on kelp forests. Lectures and discussions of original literature. Field work with SCUBA including group projects on underwater research techniques and community analysis, and individual research on ecological questions chosen by the student. Lecture two hours; laboratory six hours.		<b>MSCI 287. Seminar In Oceanography.</b>	<b>2 Units</b>
<b>MSCI 274A. Electron Micros+Microanl.</b>	<b>3 Units</b>	Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. <b>Note:</b> May be repeated once for credit.	
<b>MSCI 274B. Geol Central Ca Margin.</b>	<b>4 Units</b>	<b>MSCI 298. Research in the Marine Sciences.</b>	<b>1 - 4 Units</b>
<b>MSCI 274C. Chem Of Marine Pollution.</b>	<b>4 Units</b>	<b>Prerequisite(s):</b> Graduate standing and instructor permission. Independent investigations of an advanced character for the graduate student with adequate preparation. <b>Note:</b> CSUH students must file a petition with their home campus department before admission to this class. CSU Stanislaus students must file Individual Study forms. CSUF students must file Research Approval forms.	
<b>MSCI 274D. Global Change.</b>	<b>3 Units</b>	<b>MSCI 299. Master's Thesis.</b>	<b>1 - 4 Units</b>
<b>MSCI 280. Scientific Writing.</b>	<b>3 Units</b>		
<b>Prerequisite(s):</b> Graduate status and instructor permission. Techniques and strategies of scientific writing used for proposals, journal submissions, and abstracts for meetings. Students will develop their writing skills by preparing, editing, and rewriting manuscripts. Lecture three hours.			