



NOTE:

This document is specific to the
2002-2004 printed catalog.



marine sciences

MASTER OF SCIENCE

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.

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.

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.

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 Quantitative Marine Science, and three of the following five courses are prerequisites for classified graduate standing: MSCI 103 Marine Ecology, MSCI 141 Geological Oceanography, MSCI 142 Physical Oceanography, MSCI 143 Chemical Oceanography, and MSCI 144 Biological Oceanography. 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;
- completed writing proficiency requirement (according to home campus requirements) and

- 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.

DEGREE REQUIREMENTS

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;
- the student has completed the following 30-unit curriculum requirements:

A. Required Courses (6 units)

- (2) Select one of the following:
- MSCI 285 Seminar in Marine Biology
 - MSCI 286 Seminar in Marine Geology
 - MSCI 287 Seminar in Oceanography
- (4) MSCI 299 Master's Thesis

B. Electives* (24 units)

- (9) Electives from MSCI 200-level courses
- (15) Electives from MSCI 100-level or above courses as approved by the thesis committee. The following courses may be used:
- MSCI 112 Marine Birds and Mammals (Upper division college vertebrate zoology; MSCI 103 recommended)
 - MSCI 113 Marine Ichthyology (College zoology or equivalent)
 - MSCI 124 Marine Invertebrate Zoology I (College zoology or instructor permission; MSCI 103 recommended)
 - MSCI 125 Marine Invertebrate Zoology II (College zoology or instructor permission; MSCI 103 and MSCI 124 recommended)
 - MSCI 131 Marine Botany (MSCI 103 recommended)
 - MSCI 161 Marine Fisheries (College mathematics, MSCI 104 or instructor permission; MSCI 103 recommended)
 - MSCI 173 Topics in Marine Biology
 - MSCI 174 Topics in Oceanography
 - MSCI 175 Topics in Marine Sciences
 - MSCI 177 Microscopic Techniques (One semester college physics)
 - MSCI 202 Marine Instrumental Analysis (MSCI 142, MSCI 143)
 - MSCI 211 Ecology of Marine Birds and Mammals (MSCI 103, MSCI 104, MSCI 112)
 - MSCI 212 Advanced Topics in Marine Vertebrates (MSCI 112 or MSCI 113)
 - MSCI 221 Advanced Topics in Marine Invertebrates (MSCI 124)
 - MSCI 222 Biology of the Mollusca (MSCI 124)
 - MSCI 231 Biology of Seaweeds (MSCI 131 or instructor permission)
 - MSCI 233 Advanced Topics in Marine Ecology (MSCI 103)

- MSCI 234 Advanced Biological Oceanography (MSCI 144)
- MSCI 242 Plate Tectonics (MSCI 141 or instructor permission)
- MSCI 244 Paleooceanography (MSCI 141 or instructor permission.)
- MSCI 245 Deep-Sea Sedimentation (MSCI 141)
- MSCI 251 Marine Geochemistry (MSCI 143, MSCI 104, one year calculus or instructor permission)
- MSCI 261 Ocean Circulation and Mixing (MSCI 142; college physics strongly recommended)
- MSCI 271 Population Biology (MSCI 103, MSCI 104; or instructor permission)
- MSCI 272 Subtidal Ecology (MLML diver certification and marine ecology; knowledge of marine algae, invertebrates, and statistics recommended)
- MSCI 274 Advanced Topics in Oceanography
- MSCI 280 Scientific Writing (Graduate standing and instructor permission)
- MSCI 298 Research in Marine Sciences

* 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.

UPPER DIVISION COURSES

MSCI 103. Marine Ecology. A 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. **Prerequisite:** Ecology, statistics; or concurrent registration in MSCI 104. Fall only. 4 units

MSCI 104. Quantitative Marine Science. The 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. **Prerequisite:** College mathematics. Fall only. 4 units.

MSCI 105. Marine Science Diving. Scientific SCUBA diving course. Lecture topics: diving physics, physiology, dive planning, research diving techniques, marine life identification, and diver rescue. Open water diving training: navigation, search/light salvage, scientific methods, small boat/night diving, photography/videography. Successful completion gives NAUI and MLML/CSU diving certification. Lecture 1 hour; laboratory 6 hours. **Prerequisite:** Certified Scuba Diver (or equivalency determined by instructor), upper division science major status, thorough physical examination, ability to pass swimming test, instructor permission. 3 units.

MSCI 110. Introduction to Marine Animal Behavior. Basic theoretical concepts of animal behavior, stressing the causation, development, and evolution of behavior. Emphasis is on the marine environment. Lecture three hours; laboratory three hours. **Prerequisite:** MSCI 103. 4 units.

MSCI 112. Marine Birds and Mammals. Systematics, morphology, ecology and biology of marine birds and mammals. Lecture two hours; laboratory six hours. **Prerequisite:** Upper division college vertebrate zoology; MSCI 103 recommended. 4 units.

MSCI 113. Marine Ichthyology. A 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. **Prerequisite:** College zoology or equivalent. 4 units.

MSCI 124. Marine Invertebrate Zoology I. A field oriented introduction to the structure, systematics, evolution and life histories of the major invertebrate phyla. Lecture two hours; laboratory and field six hours. **Prerequisite:** College zoology or instructor permission; MSCI 103 recommended. 4 units.

MSCI 125. Marine Invertebrate Zoology II. 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. **Prerequisite:** College zoology or instructor permission; MSCI 103 and MSCI 124 recommended. 3 units.

MSCI 131. Marine Botany. 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. **Prerequisite:** MSCI 103 recommended. 4 units.

MSCI 135. Physiology of Marine Algae. A 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. **Prerequisite:** MSCI 103, MSCI 131, and MSCI 144. Lecture two hours; laboratory six hours. 4 units.

MSCI 141. Geological Oceanography. A study of the structures, physiography and sediments of the sea bottom and shoreline. Lecture two hours; laboratory and field six hours. **Prerequisite:** MSCI 142, MSCI 143; may be taken concurrently. Fall only. 4 units.

MSCI 142. Physical Oceanography. An introduction to the nature and causes of various oceanic motions including currents, waves, tides, and mixing and the physical properties of seawater including transmission of sound and light. Calculus not required. Lecture three hours; laboratory three hours. **Prerequisite:** College algebra; college physics recommended. Fall only. 4 units.

MSCI 143. Chemical Oceanography. An 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. **Prerequisite:** One year of college chemistry. Spring only. 4 units.

MSCI 144. Biological Oceanography. The 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. **Prerequisite:** General biology, general chemistry. Spring only. 4 units.

MSCI 161. Marine Fisheries. An introduction to fishery biology, including the concepts stock, recruitment, and yield, emphasizing the parameters abundance, age, growth, and mortality. Discussion of hydrography and fishery ecology, management

problems, world fisheries and mariculture, and collection and analysis of fishery data. Lecture two hours; laboratory six hours. **Prerequisite:** College mathematics, MSCI 104 or instructor permission; MSCI 103 recommended. 4 units.

MSCI 173. Topics in Marine Biology. The study of a selected area in marine biology (morphology, physiology, ecology, etc.). Subjects will vary depending on student demand and availability of instructors. Offered on demand. 1-4 units.

MSCI 174. Topics in Oceanography. The study of a selected area in oceanography. The subjects will vary depending on student demand and availability of instructors. 1-4 units.

MSCI 174D. Coastal Processes of the Monterey Bay Region. An introduction to the principles of coastal morphology and sediment dynamics; effects of coastal erosion and cliff retreat along the northern margin of the bay; longshore drift near Moss Landing, the differences between summer and winter (storm) beaches with special emphasis on El Niño impacts; hazards to development produced by rapidly increasing population along the coastal margin and the role that tectonics and submarine canyons (Monterey Canyon) play in coastal processes. Graded Credit/No Credit. 1 unit.

MSCI 175. Topics in Marine Sciences. An advanced undergraduate course in a special subject area; lecture, discussion, laboratory and field components; topics change each semester. May be repeated for credit. 1-4 units.

MSCI 177. Microscopic Techniques. Principles and techniques of light and electron microscopy. Consideration of brightfield, darkfield, phase contrast and interference contrast light microscopy; episcopic and diasopic illumination systems; photomicrography; preparation of materials for and operation of the scanning electron microscope. Lecture two hours; laboratory three hours. **Prerequisite:** One semester college physics. 3 units.

MSCI 180. Independent Study. Faculty-directed study of selected research problems; open to undergraduate students with adequate preparation. Three hours work per unit. 1-4 units.

GRADUATE COURSES

MSCI 202. Marine Instrumental Analysis. Theory and use of advanced instrumentation; advanced field and laboratory techniques for the interpretation of data collected in marine science research. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 142, MSCI 143. 4 units.

MSCI 204. Sampling and Experimental Design. 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. **Prerequisite:** MSCI 103, MSCI 104. 4 units.

MSCI 208. Molecular Ecology: Concepts and Methods. 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. **Prerequisite:** Basic cellular/ molecular biology course; consent of instructor. 4 units.

MSCI 211. Ecology of Marine Birds and Mammals. 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. **Prerequisite:** MSCI 103, MSCI 104, MSCI 112. 4 units.

MSCI 212. Advanced Topics in Marine Vertebrates. Advanced consideration of the ecology, physiology and phylogeny of fishes, birds, or mammals, emphasizing current literature and research. Topics and emphasis will vary with term and instructor. Can be repeated for credit when topics change. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 112 or MSCI 113. 1-4 units.

MSCI 221. Advanced Topics in Marine Invertebrates. Advanced considerations of the ecology, physiology and phylogeny of the various invertebrate phyla emphasizing current literature and research. Topics and emphasis will vary from term to term. Can be repeated for credit when topics change. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 124. 1-4 units.

MSCI 222. Biology of the Mollusca. Systematics, functional morphology, ecology and physiology of the Mollusca with emphasis on the marine forms. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 124. 4 units.

MSCI 231. Biology of Seaweeds. 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. **Prerequisite:** MSCI 131 or instructor permission. 4 units.

MSCI 233. Advanced Topics in Marine Ecology. Selected topics and current issues in marine ecology. The subjects will vary depending on student demand and availability of instructors. **Prerequisite:** MSCI 103. Offered on demand. 1-4 units.

MSCI 233C. Coastal Ecology-Gulf of California. A 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. **Prerequisite:** MSCI 103, MSCI 104, MLML SCUBA certified, graduate standing, instructor permission. 3 units.

MSCI 234. Advanced Biological Oceanography. 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. **Prerequisite:** MSCI 144. 4 units.

MSCI 242. Plate Tectonics. Historical background, modern theory, and geo-physical evidence of continental drift. Sea floor spreading and plate tectonics. Examination of the impact of the recent revolution in historical geology. **Prerequisite:** MSCI 141 or instructor permission. 3 units.

MSCI 244. Paleooceanography. Interdisciplinary studies of the provenance, biologic and geologic composition of marine sediments and of the organisms contributing to their formation; sedimentary processes affecting these sediments. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 141 or instructor permission. 4 units.

MSCI 245. Deep-Sea Sedimentation. Study of the types of marine sediment found in the deepest part of all oceans; the sedimentary processes responsible for the deposition, preservation and re-deposition of these sediments. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 141. 4 units.

MSCI 251. Marine Geochemistry. Geochemical processes in the oceans: thermodynamics of low temperature aqueous reactions, weathering, oxidation-reduction and biologically mediated reactions, processes occurring at the sea floor and air-sea interface. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 143, MSCI 104, one year calculus or instructor permission. 4 units.

MSCI 261. Ocean Circulation and Mixing. The mathematical description of the distribution of properties (density, dissolved oxygen, etc.) in the oceans relating to physical and biochemical processes. Theory of distribution of variables, geostrophic method. Lecture three hours; laboratory three hours. **Prerequisite:** MSCI 142; college physics strongly recommended. 4 units.

MSCI 262. Satellite Oceanography. Physical principles of remote sensing of earth's oceans, including satellite systems, oceanographic applications of satellite imagery and image processing methods. Labs involve use of PC and UNIX work station image processing. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 142, MSCI 144; MSCI 263 and computer literacy recommended. 4 units.

MSCI 263. Application of Computers in Oceanography. Practical experience with a multi-user computer for marine science applications: use of existing programs and subroutine libraries; computer communications; scientific programming for data I/O and analysis. Semester project required. Lecture, discussion. **Prerequisite:** MSCI 104 and college math. 4 units.

MSCI 271. Population Biology. Principles of the interaction among marine organisms which result in the alteration of population structures. Techniques for assessment and management of animal populations. Lecture two hours; laboratory three hours. **Prerequisite:** MSCI 103, MSCI 104; or instructor permission. 3 units.

MSCI 272. Subtidal Ecology. The 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. **Prerequisite:** MLML diver certification and marine ecology (knowledge of marine algae, invertebrates, and statistics recommended). 4 units.

MSCI 274. Advanced Topics in Oceanography. The study of a selected area in oceanography. The subjects will vary depending on student demand and availability of instructors. 1-4 units.

MSCI 280. Scientific Writing. Students will develop their writing skills by preparing, editing, and rewriting manuscripts. Strategies and techniques of scientific writing will be used for proposals, journal submissions and abstracts of meetings. **Prerequisite:** Graduate standing and instructor permission. 3 units.

MSCI 285. Seminar in Marine Biology. Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. May be repeated once for credit. 2 units.

MSCI 286. Seminar in Marine Geology. Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. May be repeated once for credit. 2 units.

MSCI 287. Seminar in Oceanography. Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. May be repeated once for credit. 2 units.

MSCI 298. Research in the Marine Sciences. Independent investigations of an advanced character for the graduate student with adequate preparation. 1-4 units.

MSCI 299. Master's Thesis. 1-4 units.