

Marine Science

Marine Science Minor

MARINE SCIENCE MINOR ADVISORY COMMITTEE: **Canuel** (co-director, Physical Sciences, School of Marine Science), **Macdonald** (co-director, Geology, Arts and Sciences), **J. Allen** (Biology, Arts and Sciences), **Chambers** (Environmental Science & Policy, Biology, Arts and Sciences), **Kuehl** (Chair of SMS Academic Council, Physical Sciences, SMS), **Tang** (Biological Sciences, SMS).

The undergraduate minor in Marine Science, which is jointly offered and administered by the School of Marine Science (SMS)/Virginia Institute of Marine Sciences (VIMS) and Arts & Sciences, provides interested students a coherent experience in this interdisciplinary field. As one of the leading marine research and education institutions in the United States, SMS/VIMS has a critical role and responsibility to provide high-quality information and educational resources concerning the marine environment to all segments of society in the Commonwealth of Virginia and the U.S. Moreover, the 2004 U. S. Ocean Commission Report highlights the importance of high-quality marine science education in cultivating a “broad public stewardship ethic” and for preparing “a new generation of leaders on ocean issues”. The undergraduate minor in marine science addresses the growing national demand for undergraduate education in the earth and environmental sciences in general, and in the marine sciences specifically.

The two required courses of all marine science minors are Introduction to Marine Science (MSCI 330) and Field Studies in Coastal Marine Environments (MSCI 331). Another field-based marine science course can be substituted for this field studies course with permission of the Marine Science Advisory Committee. We recommend that marine science minors take the Field Studies course during the summer following their freshman or sophomore year and before taking any of the Fundamentals of Marine Science courses.

Declaration Process: Each semester, the Marine Science Minor Advisory Committee will set a date by which students apply to declare the minor. To be eligible, students must have completed, or currently be taking, the required introductory course, MSCI 330. To declare, students must meet with one of the co-directors of the Marine Science Minor Program prior to this deadline.

Requirements for the Minor

Required Credit Hours: 18

Core Requirements: Distributed as follows:

1. Two required courses (six credits):
 - a. Introduction to Marine Science (3 credits) MSCI 330, BIOL 230, GEOL 330
 - b. Field Studies in Coastal Marine Environments (3 credits) MSCI 331, BIOL 404, ENSP 404, GEOL 407
2. Six credit hours in elective courses. Existing courses that can be used to meet this requirement are listed below. Additional courses may be used to satisfy this requirement with approval from the Marine Science Minor Advisory Committee.
 - a. Marine Science Seminars (1 cr) MSCI 398 – Topics vary from year to year. Seminars can be repeated for credit if the topic is different.
 - b. Oceans and Climate (2 cr) MSCI 460
 - c. Wetland Ecosystems (4 cr) BIOL 427/BIOL627/MSCI 579
 - d. Invertebrate Biology (4 cr) BIOL 457
 - e. Fundamentals of Ecotoxicology (3 cr) BIOL 404/MSCI 560
 - f. Ichthyology (3 cr) BIOL 404
 - g. Marine Ecology (3 cr) BIOL 460 (formerly BIOL 404)

- h. Marine Geology (3 cr) GEOL 306 (*only one of Marine Geology or Fundamentals of Marine Geology can be used for the marine science minor; the one course selected can count towards the fundamentals of marine science or the elective requirement, but not both*)
- i. Paleontology (3 cr) GEOL 423/BIOL 317
- j. Estuaries (3 cr) ENSP 440
- k. Coastal Marine Habitats in North Wales (2 cr) MSCI 332
- l. Advanced Marine Invertebrate Zoology, a Field Course (3 cr) MSCI 498
- m. Coastal Botany (2 or 3 cr) MSCI 527
- n. Water Pollution (2 cr) MSCI 562
- o. Environmental Chemistry (3 cr) MSCI 563
- p. Principles of Pathobiology (3 cr) MSCI 565
- q. Aquatic Microbial Ecology (3 cr) MSCI 575
- r. Effects of Global Change on Modern Marine Systems (2 or 3 cr) MSCI 610
- s. Seagrass Ecology (1 or 2 cr) MSCI 656
- t. Zooplankton Ecology (4 cr) MSCI 660
- u. Marine Conservation Biology (3 cr) MSCI 664
- v. Malacology (3 cr) MSCI 668
- w. Sustainable Commerce in the Sea (3 cr) BUAD 492/ENSP 440
- x. Additional MSCI 501 Fundamentals of Marine Science courses not used to satisfy the Fundamentals requirement for the Marine Science Minor

3. Three Marine Science Fundamentals courses selected from the six courses listed below (six credits) (3 courses @ 2 credits each.) Students will need to complete the form required for undergraduate enrollment in graduate courses (see the College Catalog for details).

- a. Fundamentals of Marine Science, Physical Oceanography (2 credits) MSCI 501A
- b. Fundamentals of Marine Science, Chemical Oceanography (2 credits) MSCI 501B
- c. Fundamentals of Marine Geology (2 credits) MSCI 501C **OR** Marine Geology GEOL 306 (3 credits)
- d. Fundamentals of Marine Science, Biological Oceanography (2 credits) MSCI 501D
- e. Fundamentals of Environmental Chemistry, Toxicology, and Pathobiology (2 credits) MSCI 501E
- f. Fundamentals of Marine Fisheries Science (2 credits) MSCI 501F

150/150W. Freshman Seminar.

Fall or Spring (3-4, 3-4) Staff.

Freshman Seminar in Marine Science. A course designed to introduce freshmen to topics in the study of marine science. Course number 150W satisfies the freshman writing requirement. Topics will vary.

330. Introduction to Marine Science

Spring (3) Patterson, Bronk, Tang. Prerequisites: BIOL 220 (formerly 204), CHEM 103, GEOL 101, GEOL 110, GEOL 150, PHYS 101, or PHYS 107 (for MSCI 330); GEOL 101 or 110 or 150 (for GEOL 330), OR BIOL 220 (for BIOL 230)

This course provides an overview of physical, chemical, biological, and geological processes operating in the world ocean. The interdisciplinary nature of marine science is emphasized, providing an integrated view of factors that control ocean history, circulation, chemistry, and biological productivity. (cross-listed with GEOL 330 and BIOL 230).

331. Field Studies in Coastal Marine Environments

Summer (3) Luckenbach, Brubaker, Perry and Smith. Prerequisites: MSCI 330, BIOL 230 (formerly 330), GEOL 330.

Course will be offered at VIMS Eastern Shore Laboratory

This course focuses on fundamental processes in marine science through the examination of the near shore, barrier island, coastal lagoon, and salt marsh environments along Virginia's outer coast. Through a series of field trips, lectures, laboratory exercises and independent projects, students will examine the fauna and flora of the region and learn how natural and anthropogenic factors shape these coastal ecosystems. Housing is provided in dormitories at the VIMS Eastern Shore Laboratory. Meals are included. Lab fee required.

332. Coastal Marine Habitats in North Wales

Summer (3) Luckenbach, Perry, Prerequisites: Permission of instructor

This is an intensive 16-day, field-based course conducted in north Wales, U.K. in association with the School of Ocean Sciences, Bangor University. The course emphasizes field-based instruction and student-led data collection in coastal marine environments in northern Wales, the Isle of Anglesey, and the eastern Irish Sea. Topics include the ecology of rocky shores, biological and physical processes affecting species distribution and ecology in high energy macrotidal coastal environments, paleoceanography, and geological history of the region.

398. Marine Science Seminar.

Fall and Spring (1) Staff.

Seminar in interdisciplinary topics in Marine Science. The course topic, prerequisites, and instructors will vary from year to year. Commonly the prerequisite for MSCI 398 is MSCI 330, BIOL230 (formerly 330), or GEOL 330. This course may be repeated for credit for different topics. Depending on the topic, a specific section may be cross-listed with GEOL 407 (Special Topics in Geology) and/or ENSP 249 (Environmental Challenges: Topics). Seminars can be repeated for credit if the topic is different.

460. Oceans and Climate.

Spring (2) Tang. Prerequisites: MSCI 330, BIOL 230 (formerly 330), or GEOL 330.

This course will examine how physical, geological, chemical and biological processes in the oceans together affect the planet's climate in different time and spatial scales. Abrupt climate change caused by recent human activities will also be discussed.

497 Problems in Marine Science.

Fall, Spring, or Summer (1-4) Staff

This is the avenue through which supervised projects are selected to suit the need of the upper level undergraduate student. Projects are chosen in consultation with the student's supervising professor and the instructor. Credit hours depend upon the difficulty of the project and must be arranged with the instructor in advance of registration.

498 Special Topics in Marine Science.

Fall, Spring, or Summer (1-3) Staff

This is the avenue through which subjects not covered in other formal courses are offered. These courses are offered on an occasional basis as demand warrants. Seminars can be repeated for credit if the topic is different.

501A. Fundamentals of Marine Science, Physical Oceanography.

Fall (2) Brubaker. Prerequisites: MSCI 330 and MATH 111; permission of instructor.

This course provides an introduction to the various types and scales of motion in the ocean, the global heat budget, major water masses, and processes controlling distributions of temperature and salinity. Discussions on phenomena associated with water motion will include global circulation, wind-driven circulation in ocean basins, tides, coastal upwelling, storm surge, waves, turbulence, and circulation in estuaries. Underlying dynamics governing water motion will be presented, elucidating the role of the rotation of the earth. The El Niño/La Niña oscillation will be examined as a key example of large-scale ocean-atmosphere interactions.

501B. Fundamentals of Marine Science, Chemical Oceanography

Fall (2) Dickhut. Prerequisites: MSCI 330 and CHEM 103 or permission of instructor.

This course presents an overview of the chemistry of estuaries and the ocean including chemical processes that occur in marine sediments and at the air/sea interface. Discussion topics will include the chemical properties of seawater, chemical equilibrium and kinetics, the seawater carbonate system and ocean acidification, the global and oceanic carbon and nitrogen cycles, ion speciation, trace metals, and nutrients, sediment diagenesis, and fundamentals of radioisotope and stable isotope biogeochemistry. Interdisciplinary applications are emphasized.

501C. Fundamentals of Marine Geology.

Fall (2) Kuehl. Prerequisite: MSCI 330.

This course provides an introduction to the major topics of marine geology without expecting the student to have a background in geology. The course addresses the age and internal structure of the earth, the processes of plate tectonics including the formation of oceanic crust, seamounts, hydrothermal vents, the characteristics and classification of sediments and the distribution of sediments in the deep sea. Also addressed is the interrelationships among and importance of paleoceanography, climate change, and sea-level change, and the processes and characteristics of various marine, estuarine, and coastal sedimentary environments. The course includes discussion of various types of field equipment and logistics and of some economic and societal implications. Note: GEOL 306 Marine Geology can be used as a substitute for MSCI 501C.

501D. Fundamentals of Marine Science, Biological Oceanography.

Fall (2) Steinberg. Prerequisites: MSCI 330 and BIOL 220 or permission of instructor.

This course examines the biology and ecology of marine organisms and how they interact with their environment. Topics include the organisms and their behavior, distribution, and underlying physiology; effects of biology on elemental and nutrient cycles and visa versa; and ecosystem structure and ecological interactions. An interdisciplinary approach will be taken, as biology both depends on and influences ocean chemistry, physics, geology, and climate. The course will emphasize open ocean, pelagic systems, but will include many examples from coastal and estuarine systems, as well as shallow and deep-sea benthic systems.

501E. Fundamentals of Environmental Chemistry, Toxicology, and Pathobiology.

Fall (2) Van Veld, Vogelbein. Prerequisites: MSCI 330; BIOL 220 and 225; CHEM 103.

This course emphasizes ongoing and emerging environmental concerns in the Chesapeake Bay and world ocean. Lectures will address basic concepts and mechanism of contaminant chemistry and toxicology, infectious and noninfectious diseases in aquatic organisms. Case histories will be used to illustrate sources, fate and effects of anthropogenic chemical contaminants, and the important role of environmental change on disease in marine and estuarine ecosystems.

501F. Fundamentals of Marine Fisheries Science.

Spring (2) Fabrizio, Graves. Prerequisites: MSCI 330; BIOL 220 and 225.

Other Requirements: MSCI 501F is only offered at VIMS

This lecture course will introduce the principles and techniques of fishery science. Lecture topics will include the theory and impacts of fishing, description and status of international, North American and regional fisheries, fisheries oceanography, recruitment processes, single-species and ecosystem-based approaches to stock assessment, and fisheries management, and the goals and problems of sustaining an open-access common pool resource.