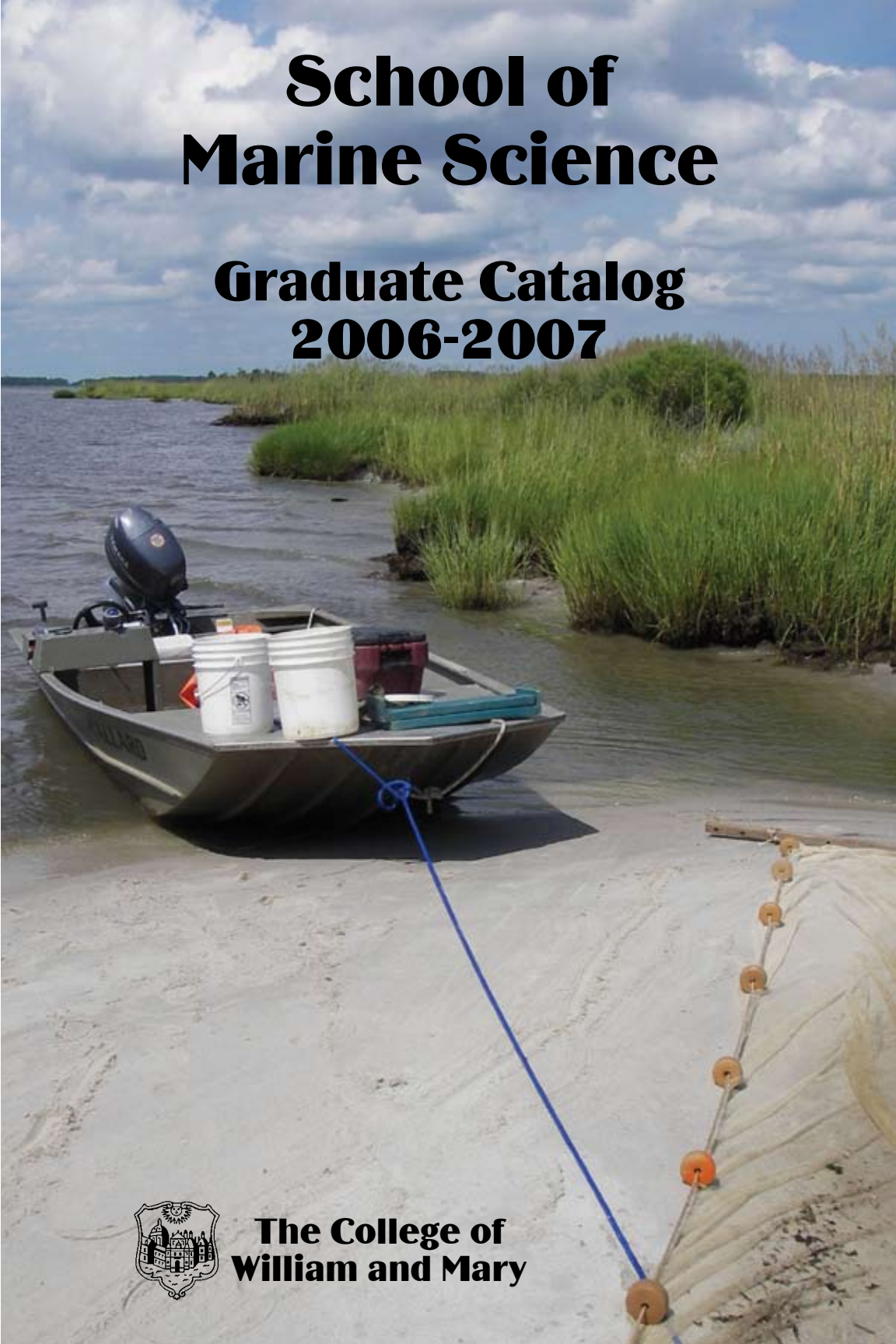
School of Marine Science

Graduate Catalog 2006-2007



The College of William and Mary

August 2006

NOTE: This catalog provides announcements for the 2006-2007 academic year. It is current until August 2007. The College reserves the right to make changes in the regulations, charges, and curricula listed herein at any time.

Catalogs are issued for College programs as follows:

Undergraduate
School of Business Administration
School of Education
Graduate Studies in Arts and Sciences
School of Marine Science
Marshall-Wythe School of Law
Summer Sessions
Special Programs

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The College of William and Mary
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Williamsburg, Virginia 23187-8795
(757) 221-2615

The policies in this catalog apply to students who matriculate into the School of Marine Science graduate program in the academic year 2006-2007.

Cover Photograph by Julia Ellis: Purtan Island, in the York River, is one of the VIMS Juvenile Striped Bass Seine Survey's 39 sampling sites.

School of Marine Science

Graduate Catalog 2006 - 2007

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Sue N. Presson ..... Graduate Registrar

Contents

Calendar

Fall Semester 2006

August

28	Mon.	Tuition and Fees for 2006 Fall Semester Due
28	Mon.	Orientation
28-29	Mon.-Tues.	General Registration & Registration for Incoming SMS Students
30	Wed.	FIRST DAY OF CLASSES: 8:00 am
30	Wed.	Beginning of Add/Drop Period for 2006 Fall Semester

September

4	Mon.	Labor Day (classes meet)
8	Fri.	Last Day to Add/Drop a Class for Fall 2006 Semester
9	Sat.	Withdrawal Period Begins

October

6	Fri.	NOTICE OF CANDIDACY FOR GRADUATION Forms due to SMS Registrar for May and August 2007 candidates
14-17	Sat.-Tues.	Fall Break

November

1	Wed.	Begin Advanced GRADUATE STUDENT REGISTRATION PERIOD FOR SPRING 2007
7	Tues.	End Advanced GRADUATE STUDENT REGISTRATION PERIOD FOR SPRING 2007
20	Mon.	Begin Spring 2007 Schedule Adjustment Period 1
22-26	Wed.-Sun.	Thanksgiving Holiday: 8:00 am

December

8	Fri.	END OF FALL CLASSES: 5 pm
8	Fri.	End Make-up of Spring 2006 “I’s” (Change to “F” after this date)
8	Fri.	LAST DAY TO SUBMIT THESES AND DISSERTATIONS FOR DECEMBER 2006 CONFERRAL OF DEGREES
8	Fri.	Last Day to Withdraw (see catalog for complete withdrawl policy)
8	Fri.	End Spring 2007 Schedule Adjustment Period 1
9-10	Sat.-Sun.	Reading Period
11-12	Mon.-Tues.	Examinations
13	Wed.	Reading Period
14-15	Thurs.-Fri.	Examinations
16-17	Sat.-Sun.	Reading Period
18-21	Mon.-Thurs.	Examinations
22	Fri.	Begin Spring 2007 Schedule Adjustment Period 2
23	Sat.	DECEMBER DEGREE CONFERRAL

Spring Semester 2007

January		
2	Tues.	Fall 2006 Semester Grades Due (by noon)
15	Mon.	Martin Luther King Jr. Holiday (no classes)
19	Fri.	End Spring 2007 Schedule Adjustment Period 2
24	Wed.	Beginning of Add/Drop Period for 2007 Spring Semester
24	Wed.	FIRST DAY OF CLASSES: 8 a.m.
February		
2	Fri.	Last Day to Add/Drop a Class for 2007 Spring Semester
3	Sat.	Withdrawal Period Begins
March		
10-18	Sat.-Sun.	Spring Break
19	Mon.	Begin Registration for Continuing Students for Summer 2007-Session 1
26	Mon.	Begin Advanced GRADUATE STUDENT REGISTRATION PERIOD FOR FALL 2007
April		
3	Tues.	End Registration for Continuing Students for Summer 2007-Session 1
3	Tues.	End Advanced GRADUATE STUDENT REGISTRATION PERIOD FOR FALL 2007
16	Mon.	NOTICE OF CANDIDACY FOR GRADUATION Forms due to SMS Registrar for December 2007 candidates
16	Mon.	Begin Registration for Continuing Students for Summer 2007-Session 2
16	Mon.	Begin Fall 2007 Schedule Adjustment
May		
4	Fri.	Last Day to Withdraw from Course
4	Fri.	End Fall 2007 Schedule Adjustment
4	Fri.	Deadline for Students to Complete Work for Fall 2006 Classes with "I" Grades
4	Fri.	END OF CLASSES: 5 pm
5-6	Sat.-Sun.	Reading Period
7	Mon.	LAST DAY TO SUBMIT THESES AND DISSERTATIONS FOR MAY 2007 CONFERRAL OF DEGREES
7-11	Mon.-Fri.	Examinations
12-13	Sat.-Sun.	Reading Period
14-16	Mon.-Wed.	Examinations
18	Fri.	Graduating Students Grades Due - Spring 2007
20	Sun.	COMMENCEMENT
23	Wed.	Remaining Students Grades Due - Spring 2007
29	Tues.	End Registration for Continuing Students for Summer 2007-Session 2

Summer Sessions 2007

SESSION I:	May 29 - June 29
SESSION II:	July 2 - August 3
August Graduation:	August 7, 2007

The College of William and Mary

The College of William and Mary in Virginia, founded in 1693, is the nation's second oldest institution of higher education. During its long history, the College has built an eminent reputation for excellence in education. The College's commitment to a thorough, well rounded education through exploration, innovation and involvement is the source of institutional coherence. Today the College is national and international in its character and contributions. Students and faculty from diverse backgrounds are attracted to both the undergraduate programs and the various schools offering graduate studies.

The College of William and Mary is a small, residential university currently enrolling approximately 5,400 undergraduate and 2,300 graduate students. The School of Arts and Science offers Masters and Doctorate degrees in several departments. Graduate degrees may also be pursued in four professional schools: Marshall-Wythe School of Law, the School of Business Administration, the School of Education and the School of Marine Science.

The College is accredited by the Southern Association of Colleges and Schools. In keeping with the College's mission as a state institution, a wide range of courses, seminars and programs both for credit and noncredit are offered on all campuses.

School of Marine Science/ Virginia Institute of Marine Science

Since it's founding in 1940, the Virginia Institute of Marine Science has functioned under a tripartite mission: to conduct independent research, to provide advisory services to the state and nation, and to provide education in Marine Science. The School of Marine Science is the academic program within the Virginia Institute of Marine Science. It is one of four graduate and professional schools of the College of William and Mary. The School of Marine Science awarded its first Masters degree in 1943 and inaugurated a Doctoral program in 1964. More than 700 marine scientists have earned graduate degrees from the School of Marine Science.

At present the School of Marine Science has 130 graduate students; about one-half are working on their Masters theses and one-half are working on Doctoral dissertations. The School receives approximately 110 applications per year from prospective students. Approximately 20 enter the program each academic year.

Statement of Purpose for the School of Marine Science

The purpose of the School of Marine Science is to provide a quality interdisciplinary education and opportunities in scholarly research to students pursuing advanced degrees in marine science. This is accomplished both by classroom instruction in the basic principles of marine science and through student involvement in basic and applied field and laboratory research under faculty supervision. Interdisciplinary research is encouraged.

Facilities

School of Marine Science students participate in graduate studies at an active, year round research facility with approximately 450 scientists, support technicians and staff. The 35-acre main campus of the School of Marine Science/Virginia Institute of Marine Science (SMS/VIMS) is located in Gloucester Point at the mouth of the York River, a major tributary and natural passageway to the Chesapeake Bay and Atlantic Ocean. Various service centers and special programs at the SMS/VIMS complement and enhance the student's experience.

Eastern Shore Field Laboratory (ESL): ESL offers access to coastal lagoons, salt marshes, barrier islands and coastal waters. Located in Wachapreague, about 2 hours from Gloucester Point, this facility is an important center for research on a wide variety of coastal issues with special emphasis on bivalve aquaculture. The facility houses a hatchery, nursery, seawater flume, nearby bivalve grow-out sites and has a well-equipped laboratory, small boat facility, and dormitory.

William J. Hargis, Jr. Library: The collections of Hargis Library are focused on the spectrum of literature, which supports the major programs of studies of the School of Marine Science as well as the research and advisory service programs of the Institute. These specialized collections are a blend of books, technical reports, online and print based journals as well as topographic maps and nautical charts. Many of the VIMS scientific reports have been digitized and are available for viewing by connecting to the library's website at www.vims.edu/library.

Current research literature can be identified by using the major scientific research databases such as the Web of Science, Science Direct, ASFA, CSA Biological Sciences, Environmental Sciences and Pollution Management, GeoRef, and Oceanic Abstracts. These and other electronic resources are accessible both on and off campus. Students, faculty and staff can connect to over 200 databases available through main campus connections and VIVA, the Virtual Library of Virginia, as well as materials in the collections of the other William and Mary Libraries. In addition to the College collections, research materials from other institutions can be acquired through Hargis Library's Inter-Library Loan Service. Librarians are available to provide help in locating information and identifying the best tools for research projects. More information on the Hargis Library can be viewed at www.vims.edu/library.

Vessels: SMS/VIMS maintains and operates a fleet of 40 vessels for research. Larger vessels are equipped with flow-through seawater, sample collection-analysis labs and electronics labs. In addition to the 65-foot R/V Bay Eagle, 29-foot Elis Olsson, 29-foot R/V Fish Hawk and 75-foot Pelican, there is a sizable trailerable fleet. State-of-the-art electronic systems can be transferred among the smaller boats. The diving facility includes a diver training room and classroom to support the 40-member dive team.

Information Technology and Networking Services Unit: ITNS provides technical support for Information Technology resources used on campus. Supported desktop and laptop systems are primarily Windows and Macintosh based systems. ITNS maintains a campus-wide backbone network, which has a high-speed link to the Internet (and Internet II) via NetWork Virginia. ITNS provides a plethora of IT services such as file, print, E-mail, web, database, data storage, high performance computing, and video conferencing. Students have access to up-to-date hardware and software in computing labs, the library and via mobile laptop systems that can be used in any classroom. ITNS assists students in configuring and using personally owned computer systems that meet or exceed minimum requirements.

Aquaculture Genetics and Breeding Technology Center (ABC): ABC operates an experimental shellfish hatchery for genetics and breeding studies of hard clams and oysters. The Gloucester Point Hatchery maintains varieties and stocks of native and non-native oysters. ABC's field operations include experimental farms at Gloucester Point, and six other locations throughout the Virginia portion of the Bay. The new Kauffman Aquaculture Center is a state of the art quarantine facility for brood stock isolation and conditioning.

Analytical Service Center: The Analytical Service Center (ASC) provides nutrient, physical and sediment analyses to students, scientists and governmental agencies managing and developing diversified environmental programs as well as thesis projects. The ASC has researched, refined and developed methodologies for analysis in a wide spectrum of environmental matrices. The quality of data is the result of thorough statistical controls, documentation, and training. ASC instrumentation is state-of-the-art, with computer control interfacing, background correction and optimization for saline matrix.


Andrews Hall

Nunnally Hall: Completed in 1992, Nunnally Hall houses modern laboratories, autopsy facilities for large vertebrates, and an extensive fish collection that includes approximately 85,000 specimens representing 295 families.

Chesapeake Bay Hall: Completed in spring 1997, this facility provides 60,000 sq. feet of research facilities, including labs for advanced research in chemistry, biogeochemistry, toxicology, pathobiology, microbiology, genetics, physiology, plankton ecology, nutrient cycling and parasitology.

Andrews Hall: Due to be completed in Spring 2007, this new facility will consolidate programs from Biological, Physical, and Fisheries Sciences. It will provide 71,000 square feet of space for 39 research laboratories, 25 faculty offices and space for nearly 100 students, technicians, and visiting scientists.

Seawater Facility: Due to be completed in Winter 2007, this 47,000 square foot facility will provide treated seawater to support both basic research projects as well as state-mandated research on finfish and shellfish.

Programs & Centers

Marine Advisory Service/Virginia Sea Grant Program: Provides expert science-based information and assistance to marine industry sectors to maximize efficiency, economy and safety in the judicious utilization of marine resources. Provides for the education of both the public and private sectors as to the importance of our sustainable marine environment and its resources.

Chesapeake Bay National Estuarine Research Reserve System: VIMS is the lead agency in Virginia, for this NOAA funded program with four designated sites preserved for estuarine research, monitoring, education, and conservation of key resources.

Center for Coastal Resources Management: Focuses on applied research, advisory service, and outreach activities in support of government agencies and nongovernmental organizations involved in resource management. Continuing work is conducted in tidal and non-tidal wetlands, estuarine and coastal shorelines, geographic and living resource inventories, and watershed management. The Center engages in a wide variety of interdisciplinary projects and provides a forum for multi-investigator and multi-institutional applied research.

Cooperative Marine Education and Research Program (CMER): The CMER Program is a formal agreement between the College of William and Mary and the National Marine Fisheries Service (NMFS) that stations a senior NMFS scientist as a faculty member at VIMS. The program also includes direct research funding that supports graduate students, and offers students a variety of opportunities to participate in NMFS research. Dr. Richard Brill, a noted fish physiologist, serves as director of the VIMS CMER Program.

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Graduate Study Programs

Research at SMS/VIMS emphasizes the study of marine environments from estuaries to the open ocean, but with special emphasis on coastal systems. Interdisciplinary programs are encouraged. In addition to teaching and conducting basic research, many faculty members are engaged in applied research of concern to industry and management agencies. Students often find that their assistantship duties and/or research activities offer opportunities that bring them in close contact with other departments at SMS and William and Mary, marine related industries, and state, regional, and federal management agencies.

Based on the primary academic and research disciplines represented at SMS/VIMS, graduate studies are offered in four major areas.

Biological Science

(www.vims.edu/bio)

The Department of Biological Sciences includes a diverse group of biologists working in a variety of disciplines ranging from biogeochemical cycling to organismal biology to whole ecosystem modeling using start-of-the-art approaches. Scientists in the department are elucidating the temporal and spatial patterns and processes controlling benthic, nektonic, and planktonic organisms in estuarine, coastal and open ocean regimes.

Major Programs

Benthic Ecology and Biodiversity: Studies focus on the examination of the major processes governing the structure and functioning of benthic systems. Current research programs include: experimental and observational studies of processes influencing recruitment, growth, and production of benthic organisms; the function and role of benthic communities and their biodiversity in the fate and transfer of nutrients, organic matter, and sediments; the effects of natural and anthropogenic disturbances on benthic community structure and function; consumer-prey relationships and the relationships between the benthic community and higher trophic levels; and evolutionary ecology. Component processes are addressed using approaches ranging from molecular genetic to biogeochemistry. Most research is focused on benthic systems of the land-sea margins, including tidal freshwater, estuarine and coastal regions, and coral reefs.

Ecosystem Modeling: The ecosystem modeling program develops and employs digital computer simulation models as integrative and synthetic tools for ecosystem analysis to address basic science and applied management questions. Past and current efforts include modeling studies of both temperate and tropical seagrass systems, the dynamics of littoral zones in estuaries, estuarine plankton nutrient interactions, higher-level multispecies trophic interactions, watershed nutrient cycling processes, and regional ocean ecosystem models. Working with hydrodynamic, fisheries, and water quality modelers, an over-arching goal of the program is to develop linked models that address both basic and applied ecological management questions.

Macrophyte Ecology: Studies in this program concentrate on submerged and emergent macrophyte species that dominate shallow subtidal and intertidal marine, brackish, and freshwater areas. Current research includes studies on plant distribution and abundance, restoration ecology, plant dispersal mechanisms, plant responses to environmental variability, plant growth and productivity, carbon and nitrogen cycling, and ecosystem simulation modeling. The program encourages multi-investigator and multi-institutional collaborative efforts.

Nutrient Cycling: Studies focus on the fate of nutrients in benthic and pelagic ecosystems and on the role they play in regulating primary and secondary production. Nutrient cycling is studied in habitats ranging from intertidal marshes and mudflats to shallow subtidal, littoral zone systems, coastal embayments, riverine systems, large estuaries such as Chesapeake Bay, and to the coastal ocean including that adjacent to Antarctica.

Physical Biology: Interdisciplinary studies investigate coral bleaching, neural networks as tools for population assessment of fishes, landscape level surveys of marine environments using Autonomous Underwater Vehicles, biomimetics as applied to the detection of hydrodynamic wakes, and the allometry of metabolic processes in lower invertebrates and algae. Ongoing research includes investigating the role of solitons in modulating secondary production in benthic environments, developing new technologies and methods for Autonomous Underwater Vehicles, and bleaching studies in the VIMS Coral Reef Microcosm, including the role of flow in modulating expressions of heat shock proteins.

Biological Oceanography/Plankton Processes: Research is focused on biological populations and processes as integral components of the dynamic, interconnected marine biosphere that provides half the food and absorbs half the anthropogenic carbon dioxide on the planet. Our research emphasis is on lower trophic levels in estuarine, coastal and oceanic foodwebs, including bacteria, phytoplankton, micro-, meso- and gelatinous zooplankton, harmful algal blooms and marine snow. Processes studied in all ecological provinces of the global ocean include fluxes of carbon and nitrogen between the various organic and inorganic pools, nutrient limitation, organic matter (dissolved and particulate) cycling, and biogenic trace gas production and consumption. The biotic processes regulating these transformations, the physical mixing and circulation mechanisms affecting their transport and redistribution, and the linkages and feed backs between the water column and all its boundaries (benthos, atmosphere, land margins) are emphasized. Collaborative research aimed at understanding the links between plankton dynamics and recruitment of economically important fisheries populations is also pursued.

Antarctic Oceanography: The Antarctic continent and the Southern Ocean together regulate the Earth's weather, and the Southern Ocean, a major component of the planetary carbon cycle, is a key engine of global climate change, a source

of rich fisheries, and haven for marine birds and mammals. VIMS/SMS programs provide an opportunity for graduate and undergraduate students to live and work in the Antarctic and on icebreakers; and to carry out research on production, nutrient cycling, organic matter diagenesis and ecosystem change. VIMS researchers work primarily in the Ross Sea (McMurdo Station) and the West Antarctic Peninsula (Palmer, Antarctica Long Term Ecological Research site). These programs also emphasize public education and outreach as important components of our work.

Research Facilities

The department is well equipped with state-of-the-art equipment for conducting field and laboratory research, including a new building scheduled for completion in Spring 2007. Major facilities include several light, temperature and humidity controlled environmental chambers, a greenhouse with running seawater for photosynthesis-related studies, and an expansive wet laboratory facility (under construction), and a large array of flow-through seawater mesocosm tanks. Laboratory instrumentation includes gas chromatographs fitted with various detectors, high performance liquid chromatograph, infrared gas analyzer, elemental analyzer, scintillation counter, a Lachat auto-analyzer for nutrient analyses, computer-assisted image analysis hardware and software, biosafety hoods, fluorometers, spectrophotometers, various microscopes including access to electron microscope facilities, a Coulter Altra flow cytometer, a FLOWCAM imaging cytometer, TOC/TON analyzer, Elzone particle counter/sizer, and microelectrode microprofiler.

An excellent assortment of field sampling gear is maintained by the department. Bottom samplers include an assortment of box corers; grab samplers, and piston-type corers. Sediment-profile and surface cameras as well as a bottom sled with profiling plow, video, and still photography capabilities allow rapid bottom mapping. A variety of nets are available for plankton sampling. An autonomous underwater vehicle (equipped with CTD, 600 kH2 sidescan sonar, and underwater video), and towed sensor packages including a towed undulating vehicle along with a variety of data sondes, fluorometers, dissolved oxygen sensors allow continuous, under-way monitoring of riverine and estuarine water quality. The department also has access to state-of-the-art facilities for molecular genetic analyses, including automated DNA sequencers and environmental chemistry laboratory facilities.

The department maintains close contacts with the Department of Physical Sciences and has access to their instrumentation, including an isotope ratio mass spectrometer coupled to an elemental analyzer. Computer facilities with support of both Windows and Macintosh platforms range from in-lab laptop units, to work stations supporting LANs, to an institute-wide network.

Preparatory Studies

A strong background in modern biology and basic science is required. This should include mathematics (ideally through calculus), chemistry (through organic chemistry) and basic statistics. Students should have strong writing and verbal communication skills. Past research experience and training is highly desirable. A foreign language such as German, French, Russian or Spanish is recommended. Students are strongly encouraged to contact and discuss plans with prospective advisors before applying.

Typical Course of Study

In addition to the core courses required of all SMS graduate students, Biological Sciences students are required to take MSCI 526 and MSCI 515 unless exemption is granted by the Dean of Graduate Studies. Additionally, courses related to the student's area of specialization should be included as appropriate, in consultation with the student's graduate committee, e.g., plankton and microbial ecology for specialization related to planktonic organisms; marine benthos and secondary production of invertebrates for those interested in benthic specializations. Theoretical ecology, ecological modeling and computer applications are recommended in any biological sciences study program that relies on modeling or theoretical mathematical formulations.

Environmental and Aquatic Animal Health

(www.vims.edu/env)

The mission of the Department of Environmental and Aquatic Animal Health is to identify and detect toxicological, pathobiological and biochemical agents in the Chesapeake Bay and its watershed that affect the health of important aquatic organisms and surrounding human populations. Our research determines the fates of contaminants, pathogens and nutrients in estuarine and marine environments and their effects on important species. A diverse faculty of environmental chemists, toxicologists, ecotoxicologists, biochemists, immunologists, microbiologists, and pathobiologists collaborate to achieve these goals. Research questions are pursued at all levels of biological organization from the molecular and cellular to the organismal and populational. Our activities reflect a strong commitment to provide technical advice to those who regulate and protect the waters and natural resources of the Commonwealth.

Some current projects exemplify this theme:

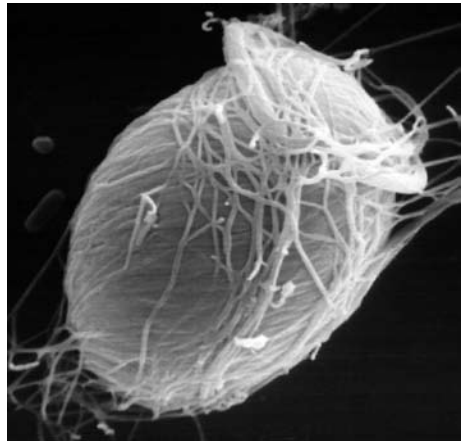
- Effects of carcinogenic contaminants in sediments on population genetics and adaptation
- The interaction of contaminants, nutrition and pathogens in the disease process
- The role of mycobacteria and other emerging pathogens on animal and human health
- The role of emerging chemicals in endocrine disruption and reproduction
- Development of molecular probes and other techniques to study immune defense mechanisms
- Use of molecular methods to identify and characterize pathogens, populations and disease resistance elements in bivalve molluscs

Major Programs

Environmental Chemistry: Research addresses the sources, transport, fate, bioavailability and impacts of contaminants in marine and estuarine systems. Some recent efforts include the behavior of anti-foulants, use of geographic information systems (GIS) for modeling spatial distributions of environmental data and development of environmentally friendly analytical procedures. Emerging contaminants are a particular interest. The faculty collaborates with international researchers, federal and state agencies (e.g. EPA, NOAA, DOE, and VA Dept of Environmental Quality VA Dept. of Health) and private industry. Recent student research has examined the binding of pesticides to natural organic matter and subsequent impact on bioavailability and toxicity; bioremediation of tributyltin-contaminated sediment in a created wetland; factors influencing the degradation rate of crop protectants in natural waters; the utility of supercritical fluid extraction for the determination of flame retardants in fish.

Environmental Microbiology: This program studies indicator or pathogenic microorganisms in waters used for recreation, aquaculture, and shellfish industries. Research includes development and validation of methods for detection of microorganisms of human health significance in marine environments, and studies to understand processes that contribute to eutrophication and microbial contamination of receiving waters. A particular strength of this program is multidisciplinary research on microorganisms that are pathogenic to fish.

Toxicology: Effects of toxic chemicals in water and sediment are measured at the molecular to population levels. Endpoints include 1) uptake and elimination of pollutants by individual organisms, 2) vital processes (mortality, growth, reproduction), and 3) mechanisms of internal distribution, biotransformation, and clearance of hazardous chemicals. Molecular, cellular, and whole organism responses are being evaluated as a basis for predicting population effects at sublethal concentrations.



Diseases of Marine Animals: Research in this field 1) focuses on infectious and noninfectious diseases of fish and shellfish, 2) determines the mechanism(s) by which pathogens cause disease in the host organisms, 3) examines pathological consequences of exposures of estuarine animals to contaminants, 4) studies etiology and epidemiology of pathogens in estuarine and marine organisms, 5) investigates host defense mechanisms in order to develop diagnostics, therapeutics and vaccines for use in aquaculture, and 6) seeks to understand the impact of toxic materials on disease processes. The pathobiology group has developed an Aquatic Animal Disease Diagnostic Laboratory using modern histological, microbiological, immunological, and molecular techniques to study diseases in shellfish and fish. Additional studies focus on marine genomics and disease mechanisms, molecular phylogenetics, population genetics and the development of molecular diagnostics for pathogens.

Environmental Risk Assessment: Risk assessment tools are applied to evaluate the risk associated with exposure to hazardous chemicals, pathogens, bacterial agents, both individually and collectively in complex mixtures. The goal is to provide a conceptual framework that will improve environmental management by allowing resource agencies to focus their limited resources on those issues of greatest importance.

Research Facilities

Laboratories of the Department of Environmental and Aquatic Animal Health are located in Chesapeake Bay, Watermen's and Byrd Halls. The Department laboratories in Chesapeake Bay Hall are equipped with state-of-the-art instrumentation for studies on environmental chemistry, toxicology, immunology, electron microscopy, pathobiology, and microbiology.

Analytical instrumentation is available to identify and quantify a wide range of organic and inorganic contaminants in water, sediment and biota. This allows faculty and students to develop new analytical methodologies, detect emerging contaminants and track pollutants in the environment at trace levels. For example, an atomic absorption spectrophotometer is available for measuring heavy metals at low ambient concentrations. Gas chromatographs, high performance liquid chromatographs, mass spectrometers and enhanced solvent extractors are maintained for the determination of organic pollutants.

Genetic analyses of pathogenic organisms are performed using DNA sequencers, PCR thermal cyclers, and associated electrophoretic and imaging equipment. State-of-the-art electron microscopes allow identification of microorganisms (e.g. harmful algae) and ultrastructural analysis of diseased organisms, supplementing traditional light microscopy.

Instrumentation is available for sophisticated research on enzyme systems that play a role in detoxification of chemicals and lipids that are involved in accumulation of hydrophobic chemicals and in resistance to some disease organisms. The immunology laboratory has the capability to produce monoclonal antibodies for a variety of antigens.

A large marine research flowing seawater exposure facility Lab will be completed in 2007. It will provide increased space and substantially expanded opportunities for toxicant and pathogen challenge studies and includes a Level 3 biosafety facility

The present facilities and equipment available in the department are described in more detail on the departmental website.

Preparatory Studies

Students entering the Environmental and Aquatic Animal Health program should possess a degree in an applicable natural science (e.g. biology, chemistry, or a related sub discipline). Courses in advanced biology (e.g. biochemistry, molecular biology, and genetics), chemistry (inorganic and organic), physics, calculus and probability/statistics are strongly encouraged. Students should have strong written and oral communication skills. Students applying to the Department should discuss academic background, research experience and career objectives with prospective mentors before applying.

Typical Course of Study

The educational program prepares students for careers as environmental scientists, educators and managers. Since departmental research and educational programs are interdisciplinary, incoming students are expected to have strong backgrounds in biology and chemistry. Following satisfactory completion of the institutional core curriculum, students may pursue courses and research in any of the major program areas (environmental chemistry, toxicology, environmental risk assessment, environmental microbiology or pathobiology). The department offers a number of relevant courses including Protein Biochemistry in Marine Organisms (MSCI 558), Parasitology (MSCI 559), Fundamentals of Ecotoxicology (MSCI 560), Water Pollution (MSCI 562), Environmental Chemistry (MSCI 563), Aquatic Toxicology (MSCI 564), Principles of Pathobiology (MSCI 565), Diseases of Marine Organisms (MSCI 566), Comparative Immunology (MSCI 567), Nutrition and Energy Reserve in Marine Organisms, Environmental Microbiology (MSCI 573), Molecular Genetic Data Analysis, Bioinformatics (MSCI 583), Fish Histology and Histopathology (MSCI 638), Quantitative Ecotoxicology (MSCI640) and Environmental Risk Assessment (MSCI 641). Students are expected to select at least two departmental offerings and typically complement their curriculum with additional courses offered by this and other departments.

Fisheries Science

(www.fisheries.vims.edu)

Research within the Department of Fisheries Science is focused on understanding the dynamics and biology of fish, crab and mollusk species of commercial, recreational and ecological importance. Also included within the research framework of the department is the Aquaculture Genetics and Breeding Technology Center. Collaborative research and teaching efforts are common among department faculty. In addition to furthering knowledge through publication, members of the department are expected to advise local, regional, and national management agencies, providing opportunities for students to become directly involved in fisheries management. Also available to students are highly equipped laboratories and many opportunities for fieldwork in estuarine and marine environments, especially the Chesapeake Bay.

Major Programs

Anadromous Fishes Program: Research and monitoring of the abundance, reproductive ecology, life history and exploitation of important migratory species such as striped bass, Atlantic sturgeon, river herrings and American shad that spawn in Virginia's tidal fresh waters. Studies include monitoring commercial and recreational landings, monitoring stock status with fishery-independent surveys, developing novel approaches to stock assessment, conducting surveys of juvenile abundance, and mark/recapture methods for estimation of fishing rates.

Aquaculture Genetics and Breeding Technology Center: Research includes development of brood stocks in shellfish species of interest to Virginia and the region, including selective breeding (especially for disease resistance), chromosome set manipulation, and evaluation of non-native species.

Bivalve Ecology: Studies focus on recruitment of bivalves, particularly oysters, and the effects of the environment on physiology and behavior of larval oysters and other bivalves, oyster population assessments, and the development of disease-resistant hybrids.

Commercial Fisheries Development: Research includes gear selectivity and bycatch as well as management and regulatory strategies for seafood production, processing and utilization.

Crustacean Ecology: Investigations of the ecology, population dynamics, and conservation of the blue crab in Chesapeake Bay and spiny lobster in the Caribbean.

Fisheries Ecosystem Modeling and Assessment Program: Research and monitoring of the abundance, predator-prey, and competitive interactions among fish populations within Chesapeake Bay. Primary objectives of the program are the development of multispecies stock assessments for the purpose of understanding the joint impact of harvesting and biological interactions on these populations. Information derived from these assessments is designed to yield advice for ecosystem-based approaches to fisheries management.

Fisheries Genetics: Examines the application of molecular genetic techniques to address problems in fisheries science. Studies focus on analysis of stock structure, use of molecular characters to identify early life history stages of marine organisms, and the evaluation of taxonomic and biogeographic hypotheses with molecular genetic information.

Marine Conservation Biology: Ecology and conservation of the blue crab, Caribbean spiny lobster, queen conch, Nassau grouper, and marine bivalves. Emphasis on metapopulation and source-sink dynamics, marine reserves and dispersal corridors, habitat fragmentation and loss effects on marine invertebrates, recruitment processes, and predator-prey interactions.

Marine Finfish Dynamics: Investigations on the recruitment dynamics of finfish in coastal ecosystems based on data from long-term bottom-trawl and beach seine surveys in Chesapeake Bay. A primary goal of these studies is to calculate recruitment indices to gauge the strength of the current year class and permit informed management of coastal fisheries. Another goal is to integrate observations from the surveys with field and laboratory research to understand large-scale patterns in the distribution and habitat use of coastal fishes. Such research may include individual-based behaviors as evidenced by acoustic tagging studies or physiological responses to habitat change.

Marine Resource Policy and Fisheries Management: Research to support determination of socially optimal rates of exploitation and optimum allocation of marine resources among competing user groups. Studies emphasize assessment and estimation of net social benefits to society and the economic impacts of proposed management and regulatory options. Additional research focuses on numerous international aspects of marine resource management, including, but not limited to, reducing the capture of sea turtles and other undesirable outputs, enhancing technical and economic efficiency of fishing gear, designing capacity reduction programs, and promoting ecosystem-based management.

Marine Vertebrate Ecology: Continuing studies into the comparative morphology, reproduction, and population dynamics of sharks; long term research on the distribution, migration, abundance, ecology and energetics of sea turtles; and investigations of the life history and community structure of finfish taxa. Emphasis on the development of stock assessment methods to promote conservation of long-lived species.

Stock Assessment Methodology: Program involves the systematic evaluation of stock assessment procedures and the development of new mathematical models and statistical methods for studying populations and their responses to exploitation. Tagging, survey, and landings data are used to estimate population size, mortality rates, components of mortality, yield, spawning potential, and effects of changes in fishery regulations. Applications include invertebrates and vertebrates in temperate and tropical sport and commercial fisheries.

Systematics and Taxonomy: Taxonomically diverse studies that focus on the morphology, evolution, taxonomy and zoogeography of various vertebrate and invertebrate groups. The program promotes a total evidence approach to phylogenetic research, including molecular techniques and morphological studies of larval, juvenile and adult forms. This research is supported by a large fish collection housed in Nunnally Hall and collaborations with museums and experts throughout the world.

Research Facilities

The Department of Fisheries Science comprises several programs, each with a fully equipped laboratory, a variety of collection and sampling equipment, and extensive computer facilities.

The Fisheries Science Laboratory has a dedicated age and growth laboratory equipped with multiple high quality optical microscopes linked to an image analysis system. The facility supports rapid analysis of hard structures for age determination and automated morphometric measurements. Also available are otolith sectioning and grinding equipment, hydraulic scale presses, and digital scale projectors. The fish-processing laboratory is a large, multi-user facility designed for the work-up of field samples and storage of field equipment. The lab is equipped with automated fish measuring boards and electronic balances that are linked to the departmental computer network.

The Crustacean Ecology Program maintains the GEM Lab with two large (1800 gal) benthic mesocosm tanks monitored by IR-sensitive, computer-controlled cameras with time-lapse image recorders.

The Bivalve Ecology Program's laboratory is well equipped for physiological and ecological studies with a UV-VIS spectrophotometer, centrifuges, a fluorescence microscope, compound and dissecting microscopes, and an image analysis system.

The Fisheries Genetics Program maintains a large laboratory with a walk-in cold room and is fully equipped to undertake a variety of genetic analyses. Major equipment includes an automated DNA sequencer, five thermal cyclers, refrigerated centrifuges, ultracentrifuges, a vacuum concentrator, a digital imaging system, and several ultra cold freezers.

Nunnally Hall contains a fish collection with approximately 85,000 specimens representing 295 families. This research and teaching collection incorporates extensive holdings from Chesapeake Bay, the Middle Atlantic Bight, Appalachian freshwater habitats, and an internationally recognized collection of deep-sea fishes.

Two wet lab facilities are available to department faculty and students. The general wet lab contains a flow-through system with several wet tables and tanks. In addition, a special greenhouse/wet lab houses the large sea turtle holding tanks, which are supplied with re-circulated filtered seawater. Adjacent to the sea turtle greenhouse is a 7,560-gallon tank used for research.

A physiology laboratory supplied with running seawater is available at the Eastern Shore Laboratory. The facility contains equipment for measuring metabolic rates, as well as conducting a broad range of advanced procedures relevant to environmental physiology, including cardio-respiratory physiology and sensory biology.

Monthly surveys of juvenile fishes and crabs are conducted throughout the Bay and on three major rivers. Plankton studies, larval fish research, and reproductive studies of recreational fishes are conducted in the Bay as well as offshore.

The present facilities and equipment available in the department are described in more detail on the departmental website.

Preparatory Studies

Students interested in graduate study in Fisheries Science should have substantial undergraduate coursework in biology including: physiology, biochemistry, comparative morphology or developmental biology, genetics, ecology and related topics, and evolutionary biology. College physics, chemistry (through organic) and math through calculus are required. Courses in statistics, marine biology and fishery biology may be helpful but are not prerequisites.

Typical Course of Study

In addition to the core courses required of all SMS graduate students, Fisheries students are required to take Marine Fisheries Science (MSCI 528) and an additional quantitative course such as Multivariate Analysis and Time Series (MSCI 625), Experimental and Quantitative Ecology (MSCI 667), Stock Assessment Methods (MSCI 670), or Applied Regression and Forecasting (MSCI 672). Fisheries students are also expected to enroll in the departmental noon seminar (MSCI 515) each spring semester. Other courses offered by the Fisheries faculty include Modeling Biological and Ecological Systems (MSCI 530), Quantitative Methods for Coastal and Ocean

Policy Analysis (MSCI 549), Early Life History of Marine Fishes (MSCI 657), Larval Ecology (MSCI 658), Deep Sea Biology (MSCI 663), Marine Conservation Biology (MSCI 664), Ichthyology (MSCI 666), Malacology (MSCI 668), Statistical Analysis of Fisheries Data (MSCI 669), Fisheries Population Dynamics (MSCI 671), Marine Molecular Genetics (MSCI 673), Marine Molecular Genetics Laboratory (MSCI 674) and Fish Physiology (MSCI 698).

Physical Sciences

(www.vims.edu/physical)

The objectives of the Department of Physical Sciences are to generate, communicate and apply knowledge concerning the physical, chemical and geological processes that operate in the coastal ocean and estuaries. The emphasis of the physical oceanography group is the study of water properties and water movement in estuarine, coastal and continental shelf environments. Geological oceanography includes the study of the processes of sediment erosion, transport and accumulation as well as the resulting stratigraphy. Marine chemistry emphasizes the study of marine biogeochemical processes, and environmental fate and transport of natural and anthropogenic substances. Interdisciplinary studies are strongly emphasized in the Department of Physical Sciences.

Major Programs

The Chemical Oceanography/Marine Geochemistry Program: Comprises a diverse faculty with numerous cross-disciplinary interests. Work is currently being conducted across riverine, estuarine, continental margin and open ocean environments on a variety of projects intended to help better understand the cycling of both natural and anthropogenic organic materials. Individual faculty and students in this program collaborate actively not only with other programs in Physical Sciences, but also with the departments of Biology and Fisheries Science. Examples of current and on-going projects within the Chemical Oceanography/Geochemistry group include: cycling and diagenesis of dissolved and particulate organic matter in estuaries and open ocean settings; carbon and nitrogen transport and cycling in rivers, estuaries, and the coastal ocean, physico-chemical exchanges of organic contaminants across aqueous and particle interfaces and using natural and anthropogenic substances as tracers of ecological processes.

The Geological Oceanography Program: Conducts local and international research on a variety of both disciplinary and interdisciplinary topics. Research sites span the full range of marine/nearshore environments from coastal plain and river floodplains, through estuaries and across the margin to the base of the continental rise. Although much of our effort addresses questions in Chesapeake Bay and surrounding areas, federal funding supports research in many other areas in the U.S. and around the world (including New Zealand, China, Bangladesh, and New Guinea), which generates generic knowledge about geological phenomena in the coastal ocean. Some of the major focal areas include: sediment transport and boundary layer processes; sediment flux and fate; seabed dynamics; shoreline erosion/sand resource issues;

and Quaternary stratigraphic development. Interdisciplinary research efforts involve faculty from the departments of Biological Sciences and Environmental and Aquatic Animal Health, as well as colleagues from other institutions worldwide.

The Physical Oceanography Program: Focuses on water motion in estuaries and on the continental shelf along with the associated transport of buoyancy, suspended particles, nutrients and pollutants. Physical Oceanography at VIMS is extremely interdisciplinary, with ongoing collaborations with chemists and geologists within our department, biologists and resource managers elsewhere at VIMS, and scientists from various disciplines throughout the country and around the world. We have ongoing field projects in the Chesapeake Bay and its tributaries as well as on the shelves of the east and west coasts of the U.S., and we are applying three-dimensional numerical models to study circulation and associated dissolved and particulate transport in estuarine and shelf environments. Cooperative research projects are underway with scientists from countries including Korea, The Netherlands, Taiwan, and the U.K. Some of the major focal areas of scientists in our group include: wind- and buoyancy driven circulation on the inner shelf; effects of stratification on the bottom boundary layer; the dynamics of estuarine fronts; three-dimensional modeling of estuarine sediment transport and water quality; the association of characteristic density- and tidally-driven estuarine circulation patterns with the fate and transport of pollutants; wind wave evolution in estuaries and on shelves; and the physics governing sediment transport on shelves and in the surf zone.

Research Facilities

The department maintains state-of-the-art equipment for conducting high-quality field and laboratory research. Major field equipment includes: Laser In-Situ Scattering and Transmissiometry (LISST); sea-bed hydraulic flume; a meteorological station with precipitation collectors; high-volume air samplers; a rotating drum surface microlayer sampler; and bottom boundary layer instrumental tetrapod systems for measuring bed stress, wave and currents, sediment resuspension, and bed-level changes. A variety of instrumentation including tide gauges, current meters, conductivity- temperature-depth (CTD) profilers, fluorometers, dissolved oxygen (DO) meters, fathometers, dual-frequency side-scan sonars, variable frequency seismic profiling systems, directional wave gauges, turbidity sensors, acoustic Doppler current profilers (ADCP), and Kasten and box corers available for field studies. Microwave and GPS navigation systems are maintained by the department for accurate positioning of research vessels.

The department houses extensive laboratory instrumentation, including: microwave-assisted solvent extraction system; large-capacity, refrigerated, programmable centrifuge; ultra-cold (-80 deg. C) freezers; ThermoElectron Flash elemental analyzer; UV/Vis spectrophotometer; gas chromatographs with flame ionization and electron capture detectors; two quadrupole mass spectrometers; EDS system with full SEM imaging capabilities; nitrogen adsorption surface area and porosity analyzer; high performance liquid chromatograph with UV absorbance and liquid scintillation detectors; two laboratory flumes (recirculating and annular); five intrinsic germanium gamma spectrometers; eight channel alpha spectroscopy system; X-ray radiography unit; sedigraph automatic particle analyzer; rapid sediment analyzer. Computer facili-

ties range from laptop units for field use to work stations supporting LANs (local area networks) to the institute-wide network. Computer users have ready access to external networks. Pentium-PC and Macintosh systems are supported by departmental staff and by the Institute's computer center. For numerical modeling, department personnel also use a multi-processor UNIX machine maintained by VIMS, and the College of William & Mary's zoo-processor SCI-CLONE super-computer cluster.

Preparatory Studies

In all aspects of the Department of Physical Sciences' education and research programs, there is a heavy reliance on quantitative skills. Our incoming students are expected to have a strong background in the physical sciences and mathematics. Undergraduate majors providing preparation for graduate study in Physical Sciences include physics, applied mathematics, engineering, chemistry and geology. Biological Sciences majors interested in pursuing graduate work in Physical Sciences are encouraged to include introductory physics and calculus through ordinary differential equations in their backgrounds.

The present facilities and equipment available in the department are described in more detail on the departmental website.

Typical Course of Study

Graduate students in marine chemistry may specialize in any of the various aspects of marine and environmental chemistry. Required courses include Principles of Chemical Oceanography (MSCI 524), and Advanced Aquatic Chemistry (MSCI 630) is recommended. Specialized course work in other aspects of marine and environmental chemistry can be selected through recommendation of the student's thesis committee.

Students interested in geological oceanography may pursue tracks emphasizing sedimentary environments and stratigraphy, sediment geochemistry, or physical transport/morphodynamic processes. Courses include marine sedimentation, coastal morphodynamics, benthic boundary layers, multivariate and time-series analysis, and isotope geochronology. Geological Oceanography students are required to take Geological Oceanography (MSCI 522). In addition, depending on a student's particular emphasis, geological students may be required to take advanced courses in physical, chemical or biological oceanography.

For students majoring in physical oceanography, required courses include Principles of Coastal and Estuarine Physical Oceanography (MSCI 520). Advanced courses address estuarine hydrodynamics and water quality, providing an in-depth focus on

estuarine physics and its influence on biogeochemical processes. Additional courses address other advanced topics in ocean dynamics and apply three-dimensional numerical modeling to estuarine and coastal issues.

Marine and Environmental Policy Tracks

The School of Marine Science recognizes the critical need to improve communication between marine scientists and resource managers, policy makers, and the public. This requires literacy in the language of policy. Students enrolled in the M.S. and Ph.D. programs in Marine Science will receive instruction in Marine and Environmental Policy as part of their core courses. Coastal and Estuarine Processes and Issues (MSCI 502) is required for all students. It provides a basic introduction to the policy disciplines (economics, law, government, sociology) and their application to coastal and estuarine problems using case studies derived from Federal legislation such as The Clean Water Act, The Coastal Zone Management Act, and The Magnuson-Stevens Fisheries Management and Conservation Act.

Students interested in further exposure to Marine and Environmental Policy can elect one of the following options:

- A combined marine science and public policy program is available in which students may obtain both a Master of Science in Marine Science and a Master of Public Policy degree in three years, instead of the four years that would be required if each degree were pursued separately. Candidates interested in this concurrent degree program must apply to and gain acceptance by both the School of Marine Science and The Thomas Jefferson Program in Public Policy.

- SMS is in the process of developing a joint program in Marine and Environmental Policy with the Thomas Jefferson Program in Public Policy (TJPPP) at the main campus. Currently, a series of three courses are recommended for SMS/VIMS students and two courses for TJPPP students. Students in any of the Marine Science sub-disciplines are welcomed into this program. Courses currently available include: Policy Analysis and Implementation for Environmental Sciences and Law , which will serve as a prerequisite to entering the joint program; Climate Change: Science, Policy, and Law (MSCI 688) and Environmental Policy (MSCI 687. Students exercising this option will receive a notation to their degree indicating additional coursework in policy in addition to the degree in Marine Science.

- Within the SMS, students can access a wide range of cross-departmental policy and resource management-oriented courses that are designed to provide a more complete understanding of marine and environmental policy and its application to marine problems. In addition, courses related to environmental law are available through the Marshall-Wythe School of Law at the main campus.

Course Descriptions

Graduate Courses

The courses presented below may be offered in a different format than listed under the course description if the number of students registering for the course is such that the listed format is inappropriate. For example, if only one student registers for a course listed as being taught in a lecture format, the instructor may decide that the content is better presented through directed readings and one-on-one discussion. MSCI 691 to MSCI 696 are cross-listed courses taught by staff of the College of William and Mary's School of Law on the Williamsburg campus. Students wishing to take any of these courses must contact the School of Law instructor to gain permission.

MSCI 501 A-D - Fundamentals of Marine Science. Fall (6) Mr. Brubaker, Ms. Dickhut, Mr. Hobbs, Ms. Steinberg
An interdisciplinary overview of marine science with emphasis on processes of open ocean systems. Topics include the physics of ocean circulation, processes influencing the vertical and horizontal distributions of properties, the chemistry of aqueous species (inorganic and organic), the influence of past and present processes on the ocean's sediments and basins, and the structure and function of pelagic communities. The course is divided into modules emphasizing physical, geological, chemical and biological oceanography, with interdisciplinary aspects of a wide variety of oceanic systems, such as upwelling regions, polar systems, hydrothermal vents, and oceanic gyres, highlighted at the course's end. Required of all students unless an exemption from a module has been obtained by taking a written exam administered by the responsible faculty member prior to the beginning of class.

MSCI 501L - Fundamentals of Marine Science Lab. Fall (1) Mr. Tang, Staff
A hands-on introduction to lab and field methods commonly used in marine science. The course will include exercises from the fields of biological, chemical, geological and physical oceanography. Lab exercises are designed to complement lectures in MSCI 501, and prepare students for MSCI 502. Sample collection and analysis will be emphasized with additional focus on data analysis and interpretation. Required of all students unless exemption is approved by the Dean of Graduate Studies upon recommendation by the course coordinator.

MSCI 502 - Coastal and Estuarine Processes, Issues and Investigations. Spring (3) Ms. Bronk, Ms. Fabrizio, Ms. Harris, Mr. Taylor
An interdisciplinary classroom introduction to the science and management issues of the coastal zone, including estuaries and continental shelf environments. Physical, geological, chemical and biological processes and process interactions are the major foci. The implications of these processes for fisheries, conservation, management and policy development are discussed. The class will be a combination of lectures, class discussions, class exercises, problem sets and exams. Required of all students unless exemption is approved by the Dean of Graduate Studies upon recommendation by the course coordinator.

MSCI 502L – Coastal and Estuarine Processes Research. Spring (2). Mr. Brush, Mr. McNinch
A field-based laboratory course applying concepts from MSCI 501, 501L, and 502 to a semester-long study of the estuarine and coastal environments of the Lower Chesapeake Bay and Virginia's Eastern Shore. Students will organize in groups around biological, chemical, geological and physical topics, and develop and conduct a research project centered primarily on field observations obtained through a series of class cruises. Particular emphasis will be placed on spatial and temporal patterns of biotic and abiotic processes and their interactions, along with sample design, collection, analysis, and interpretation of data. Developing sound scientific methodology with a hypothesis-driven approach will be stressed. Students will also be exposed to utilizing historical and ongoing databases as well as collaborative data from other groups. Required of all students unless exemption is approved by the Dean of Graduate Studies upon recommendation by the course coordinator.

MSCI 504 - Fundamentals of Statistical Methods and Data Analysis. Fall (3) Mr. Evans
Stochastic model of observational data; introduction to probability, probability distributions, discrete and continuous; parameter estimation, confidence intervals, hypothesis testing; linear regression and analysis of variance methods, including multiple regression and dummy variables; data transformations; propagation of errors; distribution fitting; non-parametric tests. An introduction to sampling and experimental design. Selection of appropriate statistical tests for various sampling and design strategies will be covered. Required of all students unless justification for exemption is approved by the Dean of Graduate Studies upon recommendation of the course instructor.

MSCI 506 - Scientific Communication Skills. Spring (2) Mr. Milliman
Review of the important elements of oral and written presentation skills for communicating scientific research. Critical evaluation of literature, development of scientific questions and rationale for research, formulation of conceptual models for developing high-quality scientific research projects. Oral and written presentation skills are emphasized through written exercises and class presentations, with peer review.

MSCI 515 - Marine Science Seminar. Fall and Spring (1-3) Staff
Multidisciplinary review of significant areas of marine science. The topic will vary each semester. Guest speakers will present a variety of views. Course participants will organize and present talks related to the seminar theme. Credit will be determined by the level of participation. One credit hour (pass/fail only) for attendance and participation at seminars; two credits (pass/fail or grade option) for additional participation by contribution to discussions and presentation of seminar; three credits (pass/fail or grade option) for additional submission of written critical literature review/synthesis.

MSCI 520 - Principles of Coastal and Estuarine Physical Oceanography. Spring (3) Mr. Brubaker, Mr. Friedrichs
Following a review of the governing equations, lectures and discussions will focus on dynamics of currents and waves on continental shelves and in estuaries. Topics to be covered include fundamentals of wind and density-driven flow; aspects of fronts,

mixing and secondary circulation; and time-dependent motion such as surface gravity waves, internal waves, coastally trapped waves and tides.

MSCI 522 - Principles of Geological Oceanography. Fall, even years (3) Mr. Kuehl, Staff
A brief review of the tectonic history of the oceans followed by detailed study of the ocean margins including sea-level history and near shore geological processes in the coastal zone and continental shelf regions. The geological effects of bottom currents on oceanic sediments will be examined along with ocean basin sediment history and approaches to pale oceanography.

MSCI 524 - Principles of Chemical Oceanography. Spring (3) Mr. Bauer, Ms. Canuel. Prerequisite: Instructor's consent
This course covers in a comprehensive and integrated manner the important factors controlling the chemical composition of seawater. Basic principles of chemical thermodynamics will be applied to the seawater medium and will serve to introduce contemporary, global-scale chemical processes such as the role of the oceans in global climate change. Selected topics include distributions of the bio limiting elements; chemistry of marine sediments; trace metal chemistry; marine organic chemistry; and ocean-atmosphere interactions.

MSCI 526 - Principles of Marine Ecology. Spring, odd years (3) Mr. Ducklow, Mr. Duffy, Staff
Lecture, reading and discussion of the fundamental processes underlying structure and functioning of marine ecosystems. Emphasis on physical processes supporting primary production, planktonic and benthic dynamics, distribution and functional importance of marine biodiversity, biotic interactions structuring communities, vertical and horizontal distributions, food web structure, ecological role of higher and lower trophic levels, and responses of marine ecosystems to anthropogenic pressures and global change. The course concludes with an exercise in proposal writing and reviewing.

MSCI 527 - Coastal Botany. Fall (3) Mr. Perry
A general survey of maritime vascular plant communities. Marshes, swamps, beaches, dunes, maritime forests and submerged aquatic communities of the coastal region. Field trips, laboratory and lectures.

MSCI 528 - Marine Fisheries Science. Fall, (3) Mr. Olney, Mr. Latour
Principles and techniques, including the theory of fishing, age and growth, definition of stocks, catch statistics, description of world fisheries, goals and problems in managing a common property resource. Lectures, laboratory hours and field trips.

MSCI 529 - Economic Principles of Fisheries Management. Fall (3) Mr. Kirkley
An introduction to economic theories and principles that determine the exploitation, utilization, and management of marine fisheries. Theories and principles are presented in a graphical format, but the interpretation and under- standing of policies and solutions are emphasized. The course provides a balanced understanding of the

underlying economics of conflicting user groups. Methods of fisheries management and regulation are emphasized with respect to economic and social concerns.

MSCI 530 - Modeling Biological and Ecological Systems. Spring, even years (3) Mr. Brush , Mr. Latour
An introduction to quantitative modeling, with an emphasis on the process of constructing mechanistic models of biological and ecological processes. General topics include determination of modeling objectives, assumptions, model construction and analysis, calibration, validation, and sensitivity analysis. Age/size-structured models, stochastic, deterministic, and spatially explicit models will be discussed. Readings from the current literature on applications of modeling and simulation in biology and ecology will be assigned. An individual modeling project, preferably related to the student's research interests is also required.

MSCI 543 - Law and Resource Management. Fall (3) Mr. Taylor
A course designed to introduce scientists, resource managers and environmentalists to the legal principles and tools used to address the causes of environmental degradation and resource depletion. The argument is not for more or less environmental law, but better environmental law. The approach reflects the view that law governs activities not the environment. Rather than using a traditional approach to teaching the law, environmental and resource law is explained as it relates to human and societal activities from the time resources are allocated to their manufacture and disposal. Activities are examined from resources to recovery within three major domains: harvesting, energy and feedstocks. Geographic scope and history, the laws governing the activity and an evaluation of goals and effectiveness are provided in case studies. Attention is given to the role of law in altering human and societal behaviors in favor of a better environment and resource conservation. (Cross-listed with PUBP 626 and LAW 341).

MSCI 545 - Marine Sedimentation. Spring, even years (3) Mr. Milliman, Staff
Introduction to continental margin sedimentary environments with emphasis on physical, biological and chemical controls on the development of sedimentary strata over a range of spatial and temporal scales. Case studies from modern settings will be used to illustrate concepts of strata formation. Laboratory exercises include petrographic, textural and mineralogical analysis.

MSCI 548 - Technical and Continuing Education in Marine Science. Fall, Spring and Summer (1-3) Staff. Prerequisite: Instructor's consent
Graduate-level instruction to public school teachers and other professionals who require postgraduate certification or special training. Courses are offered on an occasional basis as demand warrants. Instructors or teams of faculty identify a client group and formulate a course description that serves individual professional needs. Courses may include lecture laboratory components, field trips and demonstrations. An example of a course offered recently is experimental design in the marine science laboratory, a lecture and laboratory course for science teachers that addressed standards of learning in Virginia.

MSCI 549 - Quantitative Methods for Coastal and Ocean Policy Analysis. Fall (3) Mr. Kirkley, Staff
An introduction to mathematical and statistical methods commonly used to formulate and assess environmental and natural resource policy. Instruction is focused on the application of quantitative methods to environmental and resource policy problems. The student will become familiar with the use of quantitative methods to promote policy goals and management efforts. Topics covered include regression analysis, risk assessment, cluster analysis, non-parametric analysis and regression, time series analysis, forecasting and prediction, simulation, and mathematical analysis and optimization in a policy context. Students will also be introduced to social, economic and scientific principles necessary for quantitative policy analysis. Each topic will be introduced and discussed with reference to case studies. Students will learn to frame problems analytically and to use software packages in numerical analysis for practical policy advice.

MSCI 550 - Rivers: Processes and Problems. Spring, odd years (3) Mr. Milliman
Rivers form the main link between land and the ocean, discharging more than 35 thousand km ^ 3 of water and more than 20 billion tons of suspended and dissolved solids annually to the global ocean. Three central themes are stressed: 1) How do rivers work: the hydrologic cycle and water budget, basin character, physical and chemical erosion; 2) Temporal and spatial variations, ranging from seasonal to millennial, with particular emphasis on catastrophic events; 3) Human interactions: land degradation, river management, future impact of climatic change and anthropogenic activities. Includes a one-week field trip.

MSCI 551 - Integrated Coastal Zone Management. Fall (3) Mr. Kirkley
A course designed to examine the methodologies for applying an integrated approach to coastal zone management to improve the understanding of the interactions between various ecosystems in coastal environments and their close connection to society and human communities in the coastal zone. Emphasis is placed on incorporating social, cultural and economic values into coastal management. Theory and case studies are used to develop a practical knowledge of this approach.

MSCI 552 - Coastal Sedimentary Environments. Fall (3) Mr. McNinch
This course examines the depositional systems of coastal sedimentary environments such as sand-dominated (barrier islands), mixed (modern deltas), and mud-dominated (wetlands, tidal flats). Modern and ancient examples will be explored in field trips and

lectures. Controlling physical and sedimentary processes will be emphasized. Depositional environmental parameters, particularly hydrodynamics, will be interpreted from geomorphology and sedimentary structures. Observational techniques, such as satellite imagery, near-bottom current measurements, seismic profiles, and vibracores will be discussed in lecture and utilized during field trip exercises.

MSCI 553 - Introduction to Benthic Boundary Layers and Sediment Transport. Fall, even years (3) Ms. Harris, Mr. Wright
Physical and geological aspects of coastal and estuarine benthic boundary layers, their dynamic forcing and the associated suspension and transport of sediments. Principles of waves, tides and currents are introduced with emphasis on shallow-water processes. Boundary layer structure and shear stress on the seabed, wave boundary layers and turbulence are considered in relation to the coastal environment. Forces on sediment particles, initiation of sediment movement and principles of sediment transport are treated at an intermediate level.

MSCI 554 - Principles of Numerical Computing. Fall (3) Ms. Harris, Mr. Wang
An introduction to computer methods for mathematical computations. Topics include principles of floating-point computation, linear systems of equations, interpolation, numerical integration, ordinary differential equations, least square method, optimization and the fundamentals for partial differential equations. Two lecture hours and one hour of computer laboratory with assigned problems using MATLAB.

MSCI 556 - Biogeochemical Modeling. Spring (3) Ms. Dickhut
This course will focus on developing mathematical descriptions for biogeochemical processes, as well as on using mathematical models to design experiments to verify specific biogeochemical mechanisms in a system. Equations describing biogeochemical processes will be derived. Discussion will include descriptions of the conditions and assumptions of the models, as well as situations where specific models apply. The course will emphasize mathematical derivations, graphical visualization and use of model fitting software.

MSCI 558 - Protein Biochemistry in Marine Organisms. Spring (3) Mr. Van Veld, Staff
Synthesis, structure and function of proteins with an emphasis on proteins and enzymes involved in health and disease of marine organisms. Unique protein adaptations in response to environmental stress. Protein signaling networks. Methods of detection, purification and characterization of proteins including new proteomic approaches.

MSCI 559 - Parasitology. Fall, even years (3) Mr. Shields. Recommended: Invertebrate Zoology or comparable course
This course covers the biology and ecology of protozoan, helminth and crustacean parasites. Focus is on parasites of medical and veterinary importance. Emphasis is placed on life cycles, pathology, control methods and ecological impacts of parasitic infections. Three lecture and three laboratory hours. (Cross-listed with Bio 404 and Bio 504)

MSCI 560 - Fundamentals of Ecotoxicology. Spring (3) Mr. Newman. Prerequisite: Basic Ecology
This course is an introduction to ecotoxicology, the science of contaminants in the biosphere and their effects on constituents of the biosphere, including humans. The course provides a general survey of environmental toxicology and risk assessment from an ecological vantage.

MSCI 562 - Water Pollution. Fall (2) Mr. Hale
This course will introduce students to processes impacting aquatic environments. Emphasis will be on pollution by man-made chemicals and metals. Additional topics include consequences of excessive nutrients, habitat modification and introduction of exotic or elimination of native species.

MSCI 563 - Environmental Chemistry. Fall (3) Mr. Unger
Overview of the major classes of environmental toxicants. Fundamentals of aquatic, atmospheric, and geo/soil chemistry. Emphasis on the environmental significance of chemical processes, fate and transport of contaminants and how this affects bioavailability will be stressed.

MSCI 564 - Aquatic Toxicology. Fall (3) Mr. Van Veld
Factors influencing the fate and behavior of major environmental toxicants in aquatic organisms. Mechanisms involved in their uptake, distribution, biotransformation and clearance. Effects of toxicants on aquatic organisms ranging from effects at the biochemical and cellular level to effects on individuals, populations and communities. Current methods of laboratory and field toxicity testing.

MSCI 565 - Principles of Pathobiology. Fall (3) Ms. Chu, Mr. Kaattari, Mr. Shields
This course focuses on the molecular and cellular mechanisms of pathogenesis in important emerging diseases in the medical, veterinary, and aquacultural fields. Students will learn how current molecular and cellular techniques are being applied to the resolution of a variety of infectious and non-infectious diseases. Mammalian models provide a foundation for application to the diseases of fish and shellfish.

MSCI 566 - Diseases of Marine Organisms. Fall, odd years (4) Mr. Burreson, Mr. Vogelbein
Identification, life histories, host defense mechanisms, pathology and control of noninfectious and infectious disease agents including viruses, bacteria, protozoa, helminthes and arthropods in marine fishes and shellfishes. Three lecture and three laboratory hours.

MSCI 567 - Comparative Immunology. Fall, odd years (3) Ms. Chu, Mr. Kaattari Prerequisites: Genetics and biochemistry, and permission of instructor. Recommended: An introductory immunology course
Current theories and applications of molecular and cellular immunology. A comparative approach to the understanding of invertebrate and vertebrate immune function. Topics include morphology and function of hemocytes, lectins, hydrolytic enzymes, and antimicrobial peptides, host-pathogen interactions and evasion mechanisms, antibody

and antigen structure and function, immune cell networks, major histocomptability complex and disease resistance, mechanisms of pathogen recognition and elimination, general principles of vaccine design and modification. Three hours of lecture.

MSCI 570 - Nutrition and Energy Reserve in Marine Organisms. Fall, even years (3-4) Ms. Chu. Prerequisite: Instructor's consent
Biochemistry of food sources; feeding strategies; nutrient upgrading and transfer in pelagic food web; energy reserves and metabolism; nutrition and reproduction; nutrition and larval development and ecology; nutrition and fish health; factors affecting energy requirements and metabolism. Lecture and laboratory.

MSCI 572 - Estuarine Benthic Processes. Fall, odd years (3) Mr. Moore, Ms. Schaffner
This course examines current concepts in estuarine benthic processes, especially the major factors governing productivity and biodiversity. It is organized around the theme of major habitats from the upper to lower estuary and open bay, and the coastal bay mouth region. Lectures and readings will draw on examples from the Chesapeake Bay and other estuarine systems. The format consists of lectures and discussions of the primary literature.

MSCI 573 - Environmental Microbiology. Fall, even years (3) Ms. Anderson, Mr. Kator
The study of microorganisms and their activities in natural environments. Specific topics include water-borne pathogens; microbial processes in wastewaters; aquaculture, created marshes, subsurface groundwater and sediments; and methodologies for detecting microorganisms and measuring processes in a variety of environments. Attention will be focused on interactions and transformations of microbial communities and pollutants (organic and inorganic) and will include discussion of biodegradation and bioremediation processes, biological nutrient reduction, and public health microbiology.

MSCI 575 - Aquatic Microbial Ecology. Fall, odd years (3) Ms. Anderson, Mr. Kator. Recommended: Organic chemistry or biochemistry
An introduction to the role that microorganisms play in the biogeochemical cycling and production of dissolved and particulate inorganic and organic matter in freshwater and marine ecosystems. The approach will be ecological, relating environmental physiochemical properties to regulation of microbial processes, distributions, and biodiversity. Topics will include state of the art methods for detecting distributions, biomass, and activities of microorganisms in the natural environment, the energetics regulating microbial processes, microbial biochemical pathways, biodegradation, microbial interactions, and the role that microorganisms play in the food webs of various ecosystems. Although emphasis will be placed on marine systems, processes in lacustrine, riverine, and groundwater ecosystems will also be discussed. Readings will draw heavily on the primary literature.

MSCI 576 - Evolutionary Ecology. Fall, even years (3) Mr. Duffy
A conceptual and empirical exploration of interactions between environment and evolution of organismal structure, function, and behavior in deep time through

contemporary ecological time scales. Topics include natural selection and adaptation, sexual selection and mate choice, evolution of life histories, speciation, coevolution, human evolutionary ecology, and evolutionary responses to human-induced environmental change. Reading, discussions and writing projects draw from the primary literature, concentrating on examples involving marine organisms.

MSCI 577 - Biomechanics of Marine Organisms. Spring, odd years (3) Mr. Patterson
Principles from the physical sciences (fluid and solid mechanics, mass and heat transfer theory) applied to the analysis of form, function, ecology, and evolution of marine organisms. Topics covered include suspension and deposit feeding in invertebrates, allometry of metabolic processes, locomotion of fishes and plankton, thermal transactions in intertidal organisms, the biology of the benthic boundary layer, and the properties of biomaterials and biological structures. Engineering methods and measurement techniques applicable to biomechanical investigations will be presented.

MSCI 578 - Ocean Observing Systems: Technology and Applications. Fall, odd years (3) Mr. Patterson
Ocean Observing Systems (OOSs) are oceanography's newest tools. This course aims to make graduate students expert in ocean observing system technology and applications. The course includes weekly "hands-on" experience with Autonomous Underwater Vehicles (Fetch AUV provided by Sias Patterson LLC), sensor platforms like the VIMS buoy in the York River, and other online resources at other OOSs planet-wide. Topics include but are not limited to hardware components of OOS platforms (buoys, AUVs, gliders, shore-based radars), sensors, navigation techniques and georeferencing, integration of OOSs with models, OOS data management issues, and science and dual use (homeland defense, search and rescue, shipping commerce) aspects. Students from all disciplines are qualified to take this course. Student presentation of original work with an OOS required.

MSCI 579 - Wetlands Ecology. Fall (4) Mr. Chambers, Mr. Perry. Prerequisite: Instructor's consent
Structural and functional attributes of tidal and non-tidal wetlands. Emphasis on analysis of wetland systems at the landscape and community level. Introduction and practical experience in common research techniques including wetland classification, vegetation mapping, functional assessment models, and field sampling techniques. Individual research projects and/ or paper expected. Lectures and field trips. (Cross-listed with BIOL 427, BIOL 627).

MSCI 580 - Asian Environmental Issues of the 21st Century, Spring, (3) Mr. Perry , Ms. Schaffner, Mr. Taylor
Purpose of the course is to provide students with a working knowledge of past, current, and future environmental issues in East Asia in relation to societal, economic, and regulatory structures. Emphasis will be placed on large-scale environmental issues that impact ecological, social, and economic processes. Students will be expected to assimilate the course material into hypothetical development of future East Asian and global environmental policies. Grading will be based on a presentation, written

mid-term prospectus, and final term paper on an individual environmental topic. (Cross-listed with ENST 440-02).

MSCI 581 - Estuaries Management, Spring, (3) Mr. Taylor
This course is designed to introduce students to the concepts and ideas related to estuarine ecosystems, their management and preservation, and the place and purpose of humans in their ecology and evolution. The approach will be unusual. We will begin with the hypothesis that natural environments and human cultures are mutually evolved and that one is very often the determinant of the other whenever humans come to inhabit natural space. The way that humans interpret, construct and incorporate their environments is both reactive and proactive, as they actualize geographic space and transform it according to need and aesthetic. Among all possible habitats, estuaries have been proven to be among the most attractive to the human species. This is due to the extraordinary productivity of estuaries, their abundant resources, rich soils and water supply, as well as accessible avenues of communication and transport. Our examples are the City of Venice and Venice Lagoon, the Chesapeake Bay, the Columbia River Estuary, the Thames Estuary and the Mekong Delta. (Cross-listed with ENST 440-01).

MSCI 583 - Molecular Genetic Data Analysis, Bioinformatics. Spring, even years (3) Ms. Reece
Lecture and largely computer-based laboratory course covering the principles and practice of analyzing and interpreting population genetic, phylogenetic and genetic mapping datasets. Molecular datasets including sequences and genotypic profiles will be generated on agarose gels or the automated sequencers/gel scanners.

MSCI 599 - Thesis. Fall, Spring, and Summer (hours to be arranged)
Original research in biological, physical, chemical or geological oceanography, environmental science, marine fisheries science and marine resource management. Project to be chosen in consultation with the student's major professor and the Dean of Graduate Studies.

MSCI 611 - Estuarine Hydrodynamics I. Spring, even years (3) Mr. Wang. Prerequisite: MSCI 520
Classification of estuaries, time scales of motions, tidal dynamics in estuaries, nontidal circulation, mechanism of arrested salt wedge, gravitational circulation, diffusion induced circulation, turbulence in stably stratified flows.

MSCI 612 - Estuarine Hydrodynamics II. Fall, even years (3) Mr. Wang. Prerequisite: MSCI 611
Zero-, one- and two-dimensional descriptions of estuaries, salt intrusion, and pollutant flushing sediment transport through estuaries, field experience in estuaries, model laws for estuarine models.

MSCI 613 - Ocean Dynamics. Fall (3) Mr. Brubaker, Mr. Friedrichs. Prerequisite: MSCI 520 or Instructor's consent
Development of illustrative conceptual and analytical models to elucidate the effects of the rotation of the earth, stratification, and friction on the dynamics of oceanic

motion at various scales. Topics include: wind-driven gyre circulation, coastal upwelling, and turbulence in stratified flows, large-scale waves, and internal waves with and without rotational influence.

MSCI 615 - Hydrodynamic Modeling of Estuarine and Coastal Waters. Spring (3) Mr. Wang. Prerequisite: MSCI 613 or Instructor's consent
This course will survey numerical methods for the solution of partial differential equations describing the estuarine and coastal water motion and transport. Topics include stability, accuracy, consistency and convergence analysis of numerical scheme, formulation of primitive and scalar transport equations, and the pre- and post-processing for numerical computational models. The course will involve classroom lectures, seminar readings, application of models for operational environmental prediction.

MSCI 617 - Estuarine Water Quality Models. Fall, odd years (3) Staff. Prerequisite: MSCI 611
Principles of mass balance, physical transport processes, diffusion and dispersion in estuarine environments. Water quality processes, representation of biochemical transformations, dissolved oxygen modeling, survey of available models.

MSCI 621 - Morphodynamics of Deltaic Coasts and Shelves. Fall, odd years (3) Mr. Friedrichs, Mr. Wright
This course focuses specifically on morphodynamic processes operating on coasts and shelves that receive large inputs of mud from rivers. The term morphodynamics implies the coupled suite of mutually interdependent hydrodynamic processes, coastal and seafloor morphologies, and sequences of change. As in the case of non-deltaic coastal morphodynamic systems, mutual adjustments among coastal physical oceanographic flows, depositional morphologies and sediment transport processes are fundamental and current understandings and data on these phenomena will be presented.

MSCI 623 - Isotope Geochronology. Fall, odd years (3) Mr. Kuehl
Principles of radioisotope dating techniques with emphasis on those applicable to marine settings. Equations of radioisotope decay and in growth will be detailed along with the geochemical systematics of each technique.

MSCI 624 - Ocean Waves: Theory, Measurement and Analysis. Fall, even years (3) Mr. Maa. Prerequisite: Instructor's consent
Introduction to linear water wave theory and its applications. Topics include mechanisms of wave generation (wind waves and tides), the governing equations, wave properties, wave transformation, special cases for tidal wave propagation (e.g., Kelvin waves), wave

bottom boundary layer, nonlinear properties (i.e., radiation stress). Practical applications of numerical models for wind wave generation, wave transformation, the spectrum analysis for wave measurements, and harmonic analysis for tides will be introduced and demonstrated.

MSCI 625 - Multivariate Analysis and Time Series. Spring (3) Staff
Eigenvector methods, principal component analysis and factor analysis; regression methods; Fourier and stochastic models applied to geophysical and other time series data sets. Two lecture hours and one hour of computer laboratory with assigned problems.

MSCI 626 - Advanced Quantitative Methods for Marine Scientists. Spring (3) Staff
Introduction to matrices. Advanced topics in regression including multiple regression, sensitivity analysis, non-linear function-fitting techniques. Empirical eigen function methods with applications. Complex notation as applied to the description of sinusoidal variations. Fourier transforms spectra and filtering.

MSCI 627 - Marine Organic Geochemistry. Spring, even years (3) Mr. Bauer, Ms. Canuel Prerequisite: Organic Chemistry
Characterization of organic carbon, nitrogen, phosphorus and sulfur in marine water column and sediments. Modern methods of organic analysis that enhance our understanding of how organic materials cycle through the oceans will be discussed. Topics include the role of organic matter in the C, N, S, and P cycles; chemical composition of marine organic matter; diagenetic transformations of organic materials; organic matter degradation and preservation; and petroleum geochemistry.

MSCI 627L - Marine Organic Geochemistry Lab. Spring, even years (1) Mr. Bauer, Ms. Canuel Prerequisite: Organic Chemistry
In this 1-credit lab module students will conduct a lab project to complement the lecture portion of the course.

MSCI 629 - Environmental Organic Chemistry. Fall, odd years (3) Ms. Dickhut
Overview of partitioning, transport, and transformation processes controlling the environmental fate of organic contaminants. Fundamentals of thermodynamics and chemical kinetics relevant to organic chemical fate and transport mechanisms. Elementary mass transfer equations and application to chemical transport in the environment.

MSCI 630 - Advanced Aquatic Chemistry. Fall, even years (3) Mr. Evans
Discussion of the principles of chemistry focusing on the chemistry of natural waters. Topics include: chemical kinetics and thermodynamics, structure and properties of liquid water, electrolyte solution chemistry, carbonate equilibria, precipitation-dissolution reactions, basic coordination chemistry, and redox reactions with reference to the physical chemistry of biochemical and aquatic systems.

MSCI 638 - Fish Histology and Histopathology. Spring, even years (4) Mr. Vogelbein
Detailed examination of the normal microscopic structure and function of tissues and organs in fishes and the morphological and functional changes that occur in tissues during disease. Infectious and non-infectious diseases, including pathological changes elicited by chemical toxicants and environmental factors will be evaluated. Lab will consist of in-depth training in routine methods of paraffin histology and histochemistry. Three lecture and 3 laboratory hours. Restricted to 6 students.

MSCI 640 - Quantitative Ecotoxicology. Spring (4) Mr. Newman
Essential ecotoxicology principles and quantitative methods for the analysis of ecotoxicological data. Laboratory exercises will include method applications with PC-based software. Emphasis will be placed on the scientific and statistical soundness of techniques.

MSCI 641 - Environmental Risk Assessment. Fall (3) Mr. Newman
Basic structure and methods for environmental risk assessment are presented for retrospective and predictive assessments. Concepts associated with ecological and human hazard and risk assessments are covered. Discussions of associated logic and methods are framed around NRC Paradigm of Problem Formulation/Hazard Identification, Effects Characterization, Exposure Characterization, and Risk Characterization. (Cross-listed with LAW 340).

MSCI 648 – An Introduction to Mathematical Biology. Fall (3) Mr. Schreiber
An introduction to developing, simulating, and analyzing models to answer biological questions. Mathematical topics may include matrix models, non-linear difference and differential equations, and stochastic models. Biological topics may include ecology, epidemiology, evolution, molecular biology, and physiology. (Cross-listed with MATH 345).

MSCI 650 - Analysis of Discrete Data. Spring (3) Mr. Diaz. Prerequisite: Instructor's consent
Design, analysis and interpretation of field and laboratory studies that rely on discrete or count data, including rates and proportions. Models based on Chi-squared and other nonparametric distributions for uni-, bi-, and multi-variate data will be covered. Topics include sample size experimental design, single and cross-classification, covariate inference, and numerical classification techniques. Lecture and computer laboratory.

MSCI 652 - Marine Plankton Ecology. Fall, odd years (3) Mr. Ducklow, Mr. Smith, Ms. Steinberg, Mr. Tang. Prerequisite: MSCI 524 or 526 or consent of the instructors
Contemporary topics in cellular, population, community and ecosystem level dynamics of plankton systems, including nutrients and organic matter, viruses, bacteria, phytoplankton, protists and zooplankton. Lectures and student-led discussions.

MSCI 653 - Marine Benthos. As required (3) Staff. Prerequisite: MSCI 501, MSCI 502 or permission of the instructor
Ecology of marine and estuarine benthos. Emphasis is placed on determining how ecological processes affect function and structure of benthic communities. Consideration is given to interactions among autotrophs, microheterotrophs and larger metazoans and interactions between these organisms and their physical-chemical environments.

MSCI 654 - Secondary Production of Invertebrates. Fall (3) Mr. Diaz
Principles and theories of secondary production. Physical and biological factors influencing production, role of habitat complexity, implications for community structure, estimation of trophic resources and techniques of measuring secondary production.

MSCI 655 - Stable Isotope Biogeochemistry. Fall, even years (2) Ms. Anderson, Ms. Bronk
Survey of applications that use stable isotopes of carbon, nitrogen, oxygen, and sulfur to define elemental flow through experimental and natural systems. Topics include stable isotope theory; tracer versus natural abundance techniques; quantifying processes of elemental uptake, regeneration, and respiration; and defining trophic relationships using multiple tracers.

MSCI 656 - Seagrass Ecosystems. Spring, odd years (1-2) Mr. Moore, Mr. Orth
A lecture-seminar course covering topics related to seagrass ecosystems. Emphasis on the structure and function of seagrass communities, submerged angiosperm physiology, primary and secondary production, and integration of seagrass communities to the marine environment. Students will be assigned projects to complete. Credit, which must be arranged in advance of registration, will depend upon difficulty of the assignments.

MSCI 657 - The Early Life History of Marine Fishes. Fall, odd years (3) Mr. Olney. Prerequisite: MSCI 666 or consent of instructor
Ontogeny, systematics, physiology, behavior and ecology of egg, larval and juvenile stages of fishes with special reference to adaptations for survival. Population dynamics and the importance of early life history in the recruitment process are emphasized. Ichthyoplankton sampling methods are outlined. In the laboratory, eggs and/or larvae of 100+ families of teleostean fishes are examined, and characters useful in identification are presented. Two lecture and two laboratory hours.

MSCI 658 - Larval Ecology. Spring, odd years (3) Mr. Mann. Prerequisite: Instructor's consent
A broad discussion within the marine invertebrates of the following topics: the concept of the larval form, spawning and developmental patterns, limitations on the fertilization process and embryology, the Reynolds number environment at typical larval size, feeding and nutrition in the larval size range, larval size and parental investment, larval dispersal and supply in maintaining community structure, roles of physical versus biological processes in inducing metamorphosis, early post-metamorphic survival, and larval ecology in extreme environments.

MSCI 659 - Phytoplankton Ecology. Fall, odd years (3) Mr. Smith. Prerequisites: MSCI 501 (may be taken concurrently with Instructor's consent.)
This course will examine the factors, which influence the growth, losses and distributions of phytoplankton in marine systems. Topics include photosynthesis, pigmentation, productivity, biochemical fractionation, grazing, and nutrient uptake and interactions. A laboratory will introduce students to modern methods used in the study of phytoplankton such as isotopic measurements, HPLC analysis of pigments, fluorometry, and image analysis. Samples from the local estuaries will be used in the laboratories to illustrate the principles discussed in class.

MSCI 660 - Zooplankton Ecology. Spring (4) Ms. Steinberg, Mr. Tang
This course will examine the ecology, natural history, basic cell or body design features, physiology, and life histories of all the major groups of zooplankton. Food webs, specialized habitats, physical-biological coupling, and behavior are also discussed. Laboratories will concentrate on the groups or topics that are being discussed that week in lecture. The laboratories will be devoted to studying freshly collected (live local net tows), laboratory cultured, and occasionally museum specimens of the various taxa, and to introducing students to methods of study of zooplankton ecology (microscopy, biomass measurement, grazing experiments). There will also be field trips (e.g. night plankton tow to catch vertical migrators).

MSCI 663 - Deep-Sea Biology. Spring (2-3) Mr. Vecchione. Prerequisite: MS 526 and consent of instructor. Six students maximum.
Introduction to the animals of the deep-sea and characteristics of deep-sea and polar ecosystems. Lectures will survey the major metazoan groups found in deep-sea habitats, as well as physical characteristics of the environments and adaptations to life in these cold, dark, hyperbaric regions. Opportunity to participate in a deep-sea trawling cruise may be coordinated with the course.

MSCI 664 - Marine Conservation Biology. Spring, even years (3). Mr. Lipcius
Study and application of multidisciplinary scientific principles to the protection, enhancement and restoration of marine biodiversity (genetic, species, community and ecosystem). Ecological emphasis on the conservation of biodiversity threatened by habitat degradation and loss, overexploitation, invasive species, and global change. Discussion of social, legal, economic and political influences. Practical application through case studies and training in population viability analysis. Lectures and laboratory

MSCI 666 - Ichthyology. Spring (3 - 5) Mr. Musick
Functional morphology, behavior, ecology, zoogeography and evolution of fishes. Seven lecture, laboratory and field hours. Three credits without laboratory; five credits with laboratory.

MSCI 667 - Experimental and Quantitative Ecology. Spring, odd years (3) Mr. Lipcius
The design, conduct, analysis and interpretation of field and laboratory experiments in ecology. Includes lectures, discussion and supervised field and laboratory projects designed to illustrate the diversity of experimental and quantitative approaches in use by ecologists. Topics include the scientific method, experimental design, the use and abuse of statistical techniques, modeling and manuscript preparation, with emphasis on topical ecological issues such as those dealing with predator-prey interactions, recruitment phenomena, environmental science (e.g., dose-response assays) and metapopulation dynamics. Lecture and laboratory.

MSCI 668 - Malacology, Spring, even years (3) Mr. Mann
The fossil record and the ancestral mollusk. Structure and function of the molluscan shell. Review of molluscan taxonomy. Reproductive biology, physiology, ecology, and feeding mechanisms of the molluscs.

MSCI 669 - Statistical Analysis of Fisheries Data. Fall (3) Ms. Fabrizio. Prerequisite: MSCI 528 or consent of instructor, and MSCI 698-SAS and Data Management (or ability to program in SAS or R).
This course emphasizes the design and analysis of field data (e.g., retrospective studies, experimental manipulations in the field), rather than design and analysis of controlled laboratory experiments. Students will gain a working knowledge of statistical methods useful in the analysis of fisheries data. Both theoretical development and application of statistical methods will be presented, including General Linear Models, Generalized Linear Models, and Multivariate Analyses such as principal component analysis, discriminant analysis, and clustering.

MSCI 670 - Stock Assessment Methods. Spring (4) Mr. Hoenig
Survey of methods for assessing the status of exploited populations given various combinations of data types. Emphasis is on deriving statistical methods using maximum likelihood and other analytical techniques, and on computing estimates for a variety of datasets. Use of population models to integrate information on stock status in order to determine appropriate management measures. Analysis of uncertainty in assessment results and implications of uncertainty for management. Analysis of research survey, commercial catch, fishing effort, and tagging data will be considered.

MSCI 671 - Fisheries Population Dynamics. Fall, (3) Mr. Latour
Theory and practice of stock identification, growth, abundance, mortality, recruitment, and biomass production in fisheries stocks. Objectives of fishery management. Responses of stocks and fisheries to exploitation. Fluctuations in abundance, population growth forms, and population regulation. Theory, interpretation, and application of fisheries stock assessment models. Examples drawn from finfish and shellfish stocks.

MSCI 672 - Applied Regression and Forecasting. Spring (3) Mr. Kirkley. Prerequisite: MSCI 504 or equivalent
Course introduces theory and practice of quantitative methods in marine science. Methods of regression and time-series analysis will be emphasized. Topics include

linear and nonlinear regression, model validation and testing, univariate and multivariate models, transfer functions, intervention analysis, and forecasting.

MSCI 673 - Marine Molecular Genetics. Spring, (3) Mr. Graves, Ms. McDowell, Ms. Reece. Prerequisite: Undergraduate Genetics or permission of instructor
A study of the evolutionary processes responsible for the intra- and interspecific genetic relationships of marine organisms with an emphasis on the application of current molecular methodologies. 3 hrs. lecture.

MSCI 674 - Marine Molecular Genetics Laboratory. Spring (2) Mr. Graves, Ms. McDowell, Ms. Reece. Prerequisite: Undergraduate Genetics or permission of instructor
Students will elucidate intra- and interspecific genetic relationships by employing a variety of molecular techniques for the analysis of proteins and nucleic acids, 5 hrs. laboratory.

MSCI 685 - Practical Application of Marine Resource Management Techniques. As required (1-3) Mr. Hershner, Staff
Students participate in real world management activities under the guidance of involved faculty members and in association and consultation with members of various levels of government. May include issue identification and resolution, committee involvement at local, regional, state, interstate, and federal levels of government, development of management plans, drafting position papers, developing draft legislation and exposure to policy making mechanisms. Requirements will vary depending on the issue(s) addressed. Students will be evaluated on participation, written work (memoranda, position papers, etc.) and knowledge gained as evidenced by interaction with staff and by other means. Students may repeat the course provided the instructor determines there is no duplication of material. Credit, which must be arranged in advance of registration, will depend upon difficulty of the assignment.

MSCI 686A or 686B - The Public Commons Project I or II - Fall or Spring (3) Mr. Taylor (Permission of the Instructor)
The Public Commons Project is offered to upper level undergraduate, graduate and professional students in Education, Law, Marine Science and Public Policy, who have been nominated by their School or Department, or who have applied with a letter of faculty recommendation. The Public Commons Project seeks to develop a culture of service learning and life-long civic engagement among participating students through interdisciplinary work to develop a multi-year inventory and assessment of historic, cultural, and natural resources held in the Commons that are protected under the Public Trust Doctrine. Emphasis in the early years will be on the environmental commons. Students enrolled in the The Public Commons Project will be introduced to the concepts and the importance of service learning and civic engagement as an essential part of professional development and citizenship. They will then be introduced to the legal and environmental construct of the Public Trust, the requirements of comprehensive planning in local government and the planning documents, an overview of data and the recognition of ecological scaling, the identification and assessment of ecological services, the economic valuation of ecological services, and the legal and regulatory environment

of the Public Trust. As students progress, they will begin to work as interdisciplinary teams to build a comprehensive inventory of the public commons, determining hierarchies of value and importance, and identifying the scientific, social, economic and legal issues surrounding elements contained within the inventory.

MSCI 687 - Environmental Policy, Fall, (3) Mr. Hicks
This course will explore policy making for environmental problems and will focus on issues that are local, national, and international. The course will primarily focus on national environmental policy, and the procedures by which policy is implemented at both local and regional levels. Issues explored will include water pollution policy and land-use in the Chesapeake Bay, U.S. Marine Mammal Policy, and U.S. water and air quality regulations. For each of these issues, U.S. laws and regulations as well as federal agencies' approaches for quantitatively assessing the benefits and costs of environmental policy will be examined. (Cross-listed with PUBP 622)

MSCI 688 - Climate Change: Science, Policy, and Law, Spring (3) Ms. Ivanova
This seminar will examine climate change as one of the most critical environmental and economic challenges facing humanity. The course will review the interplay among science and policy regarding each discipline's understanding of the sources and impacts of climate change. It will also focus on the history and future of the legal negotiations and examine the ethical implications of climate change. Topics will include humans as a geophysical force, the science of climate change, measuring the impacts, international legal perspectives and negotiations, market forces, and political constraints. The course will also analyze the energy economies and the rationale for climate change policies in key actors, including the European Union, the United States, Russia, and major developing countries such as India, China, and Brazil. Weekly sessions will include lectures and discussions led by the instructor, invited speakers, and students. Assignments will comprise discussion facilitation, presentations, and written work. Students will participate in small groups that explore in detail a particular aspect of climate change and produce a substantial term paper. (Cross-listed with PUBP 629)

MSCI 690 - Progress and Process - The Relationships of Science and Law in Determining Public Policy on the Environment. Spring (3) Mr. Taylor
This course is given from the perspective of the working scientist, and it is intended to provide an understanding of the relationships between the disparate cultures of science and law in the arena of public policy. We will examine the two professional cultures, their historic and ethical foundations, their place with the constitutional framework of the United States, and their origins in the Age of Reason. The dynamic tension of their respective roles in determining the outcome of environmental policy in the contemporary American context will be examined along with alternatives to the status quo. Readings, lectures and discussion.

MSCI 693 - (LAW 424). Environmental Law. As required (3) Law School Staff. Prerequisite: Consent of instructor
A study of the nature and causes of environmental pollution and of the main legal techniques for its control. The course will consider the common law, the environmental impact assessment process (e.g., the National Environmental Policy Act), and

the basic regulatory framework for air, water and solid and hazardous waste control (the Federal Clean Air Act, Clean Water Act and Resource Conservation and Recovery Act), with attention given under each statute to the basic regulatory framework and the main policy issues presented by it. Other topics will include the role of the federal courts in reviewing agency action, new developments in federal administrative law (including current efforts at administrative law reform), natural resource management and allocation issues involved in the division of scarce resources (e.g., air and water) among competing users, toxic and hazardous substance regulation, and enforcement of environmental laws.

MSCI 694 - (LAW 425). Land Use Control. As required (3) Law School Staff, Ms. Butler. Prerequisite: Consent of instructor
An analysis of the legal principles governing the use and management of land and the fundamental values underlying those principles. While focusing primarily on government regulation of land use, the course also will examine common law rules, which affect the way that land is used. Topics that might be considered include judicial control of land use, zoning and the rights of landowners, zoning and the rights of neighbors, land use planning, public regulation of land development, aesthetic regulation, and the preservation of natural and historic resources.

MSCI 695 - (LAW 453). Administrative Law. As required (3) Law School Staff. Prerequisite: Consent of instructor
A study of practice in the administrative process, examining the procedures for administrative adjudication and rule making; legislative and judicial control of administrative action; and public access to governmental processes and information.

MSCI 697 - Problems in Marine Science. Fall, Spring and Summer (1-4) Staff
Supervised projects selected to suit the needs of the graduate student, including those wishing to perform an internship as part of the Curricular Practical Training Program. Projects to be chosen in consultation with the student's major professor and the instructor. Acceptable research outlines and project reports are required. Amount of credit depends upon difficulty of course. Examples of projects offered in recent years include: management issues in shellfish sanitation; groundwater nutrient processes; bacterioplankton methods and techniques; pesticide analysis in environmental samples; marine molecular population genetics; and law and policy relating to the introduction of non-indigenous plants. Subjects will be announced prior to registration and after approval by the Educational Policy Committee (EPC). Hours to be arranged with instructor prior to registration.

MSCI 698 - Special Topics in Marine Science. Fall, Spring and 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. Examples of courses offered in recent years include: continental margin sedimentation; biomineralization in marine organisms; molecular markers and evolution; oligochaete biology; quantitative methods of image analysis; and organism-sediment interactions

in coastal systems. Subjects will be announced prior to registration and after approval by the EPC. Hours to be arranged.

MSCI 699 - Dissertation. Fall, Spring and Summer (hours to be arranged).
Original research in biological, physical, chemical or geological oceanography, environmental science, marine fisheries science, or marine resource management. Project to be chosen in consultation with the student's major professor with the approval of the Dean of Graduate Studies.

Undergraduate Courses

Undergraduates can take 500- level courses with the permission of instructor

MSCI 330 - Introduction to Oceanography. Spring, even years (3) Mr. Bauer, Mr. Patterson
Description of physical, chemical, biological and geological processes operating in the world's oceans. The interdisciplinary nature of oceanography is emphasized, providing an integrated view of factors, which control ocean history, circulation, chemistry and biological productivity. (Cross-listed with BIOL 330 and GEOL 330)

MSCI 497 - Problems in Marine Science. Fall, Spring and Summer (1-4) Staff
Supervised projects 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.

MSCI 498 - Special Topics in Marine Science. Fall, Spring and 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. Subjects will be announced prior to registration. Hours to be arranged.

Academic Program

General Program Description

The academic program of the School of Marine Science is intended primarily for the student who wishes to specialize in marine science at the graduate level. Degrees offered are the Master of Science and Doctor of Philosophy in Marine Science. The school offers research opportunities and instruction at the graduate level in four general areas: Biological Sciences, Environmental and Aquatic Animal Health, Fisheries Science and Physical Sciences. For students interested in resource management and policy an educational track in Marine and Environmental Policy offers courses both at SMS and in conjunction with the Thomas Jefferson Program in Public Policy at the Williamsburg campus.

Though the courses offered by the School are primarily for graduate students, advanced undergraduates (juniors and seniors), who have received permission of the instructor, may participate. For instance, biology, chemistry, and physics majors can enroll in suitable 500- level marine science courses for credit toward the Bachelor's degree provided certain conditions are met (see College of William and Mary Undergraduate Program Catalog) are met. Undergraduates also may enroll for research credit to work on problems in marine science. The student is responsible for making the necessary arrangements with an individual School of Marine Science faculty member, and the consent of the chairperson of the student's major department is also required.

General Preparatory Requirements

Students who are interested in pursuing marine science as a profession should consult with their academic advisor or the Dean of Graduate Studies, School of Marine Science, early in their college careers to identify an academic program that will prepare them for graduate study in marine science. Students interested in Biological Sciences, Environmental and Aquatic Animal Health, or Fisheries Science should have a strong background in basic science, including a suite of contemporary biology courses, physics and chemistry (through organic), and mathematics through calculus and differential equations. The prospective chemical, geological or physical oceanography student should have an undergraduate degree with appropriate course work in chemistry, geology or related geophysical science, physics, meteorology, mathematics or engineering, and a solid quantitative background. Course work in statistics and competence with computers are particularly important.

Degree Requirements

General

Students generally are bound by the requirements stated in the catalog that is in effect when they enter the School. The department in which the student specializes and individual advisory committees may prescribe additional requirements for their students.

Residency

To fulfill the full-time academic residency requirement of the School of Marine Science, students must:

1. Successfully complete the core course requirements
2. Be a full-time student in good standing for two consecutive semesters

Satisfactory Progress

To continue in a degree program, a student must make satisfactory progress towards the degree. If the faculty of a department in which a student is enrolled determines that satisfactory progress is not being made, a student may be required to withdraw because of academic deficiency. The Academic Status and Degrees Committee reviews the progress of all students to insure that they have completed milestones toward completion of degrees in a timely fashion.

Registration Requirements

All active students (i.e., those working toward completion of a degree program who have not been granted leave) must register for a minimum of nine paid hours each semester, and one paid hour for each term of the summer session. Students must be registered in the semester during which they graduate. For a single semester, the student may be given research graduate status. This generally would be the semester in which the student completes the thesis and graduates.

Changes in Registration

All changes in students' schedules after the close of registration require approval of the instructors involved and the Dean of Graduate Studies. Students may not add courses after the last day for changes in registration as indicated in the calendar. If the student drops a course or courses before mid-semester but remains registered for other academic work, the course or courses dropped will be removed from the student's record. If the student drops a course or courses after mid-semester through the last day of classes but remains registered for other academic work, the grade of "W" or "F" will be awarded by the instructor in the course depending upon whether or not the student was passing at the time the course was dropped.

A student wishing to withdraw from a course (or courses) due to medical reasons after mid-semester may apply to the Academic Status and Degrees Committee for approval. With the approval of the request, a grade (or grades) of "W" will appear on the transcript.

Students may not drop a course after the last day of classes. If a student does not complete a course for medical reasons, "W" with appropriate notation will be entered on the record upon approval of the Dean of Graduate Studies and the appropriate authorities at the College.

System of Grading and Quality Points

The grades A (excellent), B (good), C (satisfactory), P (pass), in certain courses, D (unsatisfactory), and F (failure) are used to indicate the quality of work in a course. "W" indicates that a student withdrew from the College before mid-semester or dropped a course between mid-semester and the last day of class and was passing at the time that the course was dropped.

For each semester credit in a course in which a student is graded A, 4 quality points are awarded; A-, 3.7; B+, 3.3; B, 3; B-, 2.7; C+, 2.3; C, 2; C-, 1.7. P carries credit but is not included in a student's quality point average; D and F carry no credit, but the hours attempted are included in the student's average.

In addition to the grades A, B, C, P, D, F, and W, the symbols "G" and "I" are used on grade reports and in the College records. "G" is given to work in progress towards Masters (MSCI 599) or Ph.D. (MSCI 699) research, since there is insufficient evidence upon which to base a grade. "I" indicates that because of illness or other major extenuating circumstances, the student has postponed, with the explicit consent of the instructor, the completion of certain required work. "I" automatically becomes "F" at the end of the next semester if the postponed work has not been completed.

Required Courses

All students

By the end of a student's second year in the School of Marine Science, the student must have passed the following core courses with a grade of B- or better: MSCI 501 A-D, MSCI 501L, MSCI 502, MSCI 502L and MSCI 504.

Students in Biological Science

MSCI 526, MSCI 515A (Spring semester).

Students in Environmental and Aquatic Animal Health

Students must take at least two departmental offerings as well as MSCI 515B (Fall and Spring semesters).

Students in Fisheries Science

MSCI 528, MSCI 515C (Spring semester) and one of the following: MSCI 625, MSCI 667, MSCI 670, MSCI 671 or MSCI 672.

Students in Physical Science

Required courses for the different disciplines in Physical Sciences are as follows: Physical Oceanography: MSCI 520; Geological Oceanography: MSCI 522; Marine Chemistry: MSCI 524, Marine Science Seminar: MSCI 515D (Fall and Spring semesters; required for all Physical Sciences students.) In addition, all students in Physical Sciences must take at least one advanced course (550-level or higher) appropriate to the student's specialty.

Language Requirement

Proficiency in a foreign language is not required; however, a student's advisory committee may require demonstration of foreign language skills. All graduate students who submit TOEFL scores are also required to take the SPEAK test. Unlike TOEFL, the SPEAK test can only be taken on the William & Mary campus. Its purpose is to determine whether ESL (English as a Second Language) courses would be appropriate for the student.

Retaking a Course

Degree credit is granted only for non-core coursework in which a student earns a grade of "C" or above. A graduate student may repeat one non-core course in which a grade of "C" or lower is received. In the case of core courses a student must receive a grade of B- or above. Students will be allowed to make up for a core class deficiency either by taking a comprehensive exam or by repeating the course. When a course is repeated the initial grade earned remains a part of the student's record and is included in computations of quality point requirements. Any student receiving more than one "D" or "F" in a program of study will not be permitted to continue in the School of Marine Science.

Transfer of Academic Credit

On the recommendation of the Academic Status and Degrees Committee and the approval of the Dean of Graduate Studies, a regular student may apply up to 15 hours of graduate credit for courses equivalent to the SMS core courses (MSCI 501-504) earned at another accredited institution. Command of material in the core courses must still be demonstrated. In the case of MSCI 501, A-D, the student requesting transfer credits for any of the modules must successfully pass an examination for the applicable modules before applying to the AS&DC. A written examination in MSCI 501L also is required of students applying for transfer credit in that course. Depending upon the recommendation of the core class instructors, students may also be required to pass a final examination in MSCI 502.

Students can petition for up to six hours of other graduate work not already applied toward another degree, but the total transfer credits cannot exceed 15 hours. The credits must have been earned in courses appropriate to the students' programs in SMS and must fall within the time specified by the general college requirements for degrees.

Credit may be transferred only for courses in which the student received a grade of "B" or better and may not be counted in compiling his/her quality point average at William and Mary.

Qualifying Exam

The qualifying examination is an oral examination designed to test a student's scientific competence and ability to pursue her/his graduate research project. The exam consists of two components: (1) questions that address knowledge specific to the proposed research project and (2) questions concerning the general knowledge in the student's field of study.

The qualifying examination will be administered by the Students Advisory Committee and chaired by a Moderator who is not a member of the students Committee (AC 19 May 95). The Moderator must be identified at least two weeks prior to the examination. Students must file appropriate paperwork for the scheduling and announcement of the qualifying examination with the office of the Dean of Graduate Studies. Consistent with SMS procedures, the examination will be advertised and open to all interested faculty members. The examination should be taken by the end of the third semester (M.S.), or fifth semester (Ph.D.), and should in every case occur well before the final defense in order to be consistent with the SMS Milestones.

If the student does not pass the Qualifying Examination s/he must retake the examination within six months. A no-pass on the second examination is grounds for dismissal from the graduate program. In cases of conditional passes or no-passes, it is the Moderator's responsibility to notify the Dean of Graduate Studies of the outcome as soon as possible following the conclusion of the examination.

Leave of Absence

A student may request a leave of absence from the program for a specific period of time. Leaves of absence will relieve the student of the obligation of paying tuition during the approved absence from the program. It is understood that a student on leave of absence is not present on campus and drawing upon campus resources. A student must terminate the leave of absence and be a registered student in the semester in which his or her degree requirements are completed or in which he or she graduates. A leave of absence does not automatically extend the time limit for completion of degree requirements.

Probation

Students will be placed on probation if their cumulative average is less than B (< 3.0). In the case of a grade deficiency in a core course, the student must retake the course and receive a grade of B- or better, or successfully pass a comprehensive exam. The grade of any retaken course will not be counted in the student's cumulative average. Probation will last until a student's cumulative average is raised to at least a B (3.0), and will in no circumstances last longer than one calendar year. Failure to raise their cumulative grade average to B within one calendar year will result in dismissal from the School of Marine Science. Reinstatement is possible only after successful appeal to the Academic Status and Degrees Committee.

Withdrawal from the Program

Withdrawal from the program constitutes termination of the student's program of study in the School of Marine Science. Withdrawal may be voluntary on the part of the student or be imposed by the School of Marine Science for reasons of academic deficiency. A student, who fails to register for a regular semester (Fall or Spring) once the student has begun his/her graduate study and who has not requested a leave of absence or permission to withdraw, will be placed on a leave of absence for one semester by the Dean of Graduate Studies. If the student has not applied for a leave of absence prior to the end of registration for the next regular semester, or if the Dean of Graduate Studies is not able to justify continuing the leave of absence, the student's record will be marked "withdrawn unofficially."

If the student withdraws from the College before mid-semester, a grade of "W" will appear on the record for each course in progress at the time of withdrawal. After mid-semester through the last day of classes, students who withdraw from the College will be awarded a "W" or "F" by the faculty member teaching each course in progress at the time of withdrawal.

Reinstatement after Withdrawal

A student wishing reinstatement after withdrawal must reapply to the School of Marine Science under the procedures in effect at the time of reapplication.

Extension of Time Limit

Classified (regular) students who have exceeded the time limit for degree completion and who have not been granted a time extension by the Dean of Graduate Studies will not be permitted to register in the School of Marine Science.

Degree of Master of Science

The milestones to be accomplished and requirements for the degree are:

1. The student must select a suitable major professor, who must be a faculty member of SMS/VIMS, as soon as possible following admission. The student and the major professor will choose an Advisory Committee, which must be approved by the Dean of Graduate Studies. The major professor and Advisory Committee direct the student's program.

2. The Advisory Committee, chosen by the student and approved by the Dean of Graduate Studies, must consist of at least four members. A majority of the Committee's members must be members of the faculty of SMS/VIMS, although persons with appropriate qualifications from outside SMS/VIMS may serve on the committee. For students with a specialty in biological or fisheries sciences, at least one member must be from the discipline of physical or environmental science. For students with a specialty in physical or environmental science, at least one member must be from the discipline of biological or fisheries science.

3. At least one academic year of each student's program must be spent as a full-time resident student as defined in the general degree requirements.

4. At least 36 credit hours of advanced work, of which at least nine (9) credit hours must have been earned in courses numbered 550 or above with a cumulative grade point average of 3.0 or better, are required for the M.S. degree. In addition, a student must have registered for thesis (MSCI 599) for at least one semester. No more than six (6) thesis credits may be counted toward the minimum 36 credits required for the M.S. Students also will be expected to register for seminar as required by their respective departments; however, only two (2) credits will be applicable to the degree.

   Credits more than seven (7) years old and earned in the program in which the student is currently enrolled will be deleted from the accumulation of credits required for a degree. Credits acquired while enrolled in previous programs here or elsewhere generally are not subject to this limitation.

5. Upon a favorable recommendation of the student's Advisory Committee and the Academic Status and Degrees Committee, followed by a majority vote of the Academic Council and the approval of the Dean of Graduate Studies, a student may be admitted to candidacy after completion of the following requirements:

a. The student must have achieved a grade point average of B (3.0) or better, averaged over all courses taken for credit at the time of application for admission to candidacy.

b. All core courses required by the School of Marine Science (MSCI 501A-D, MSCI 501L, MSCI 502, MSCI 502L, MSCI 504) must be passed with a grade of B- or better (or successful completion of a comprehensive examination administered by core class instructor) or officially exempted, based on prior coursework and all other courses specifically required by the student's department and Advisory Committee must be completed.

c. The qualifying examination and prospectus must be completed.

6. The student must present a seminar to the marine science faculty, staff and students on a thesis topic approved by the major professor, the Advisory Committee and the Dean of Graduate Studies, and must defend this thesis before his/her major professor and committee. The defense of the thesis shall be separate from any other examination. Full details of this requirement can be obtained from the Office of the Dean of Graduate Studies.

7. All requirements for the degree must be completed within three calendar years after commencing graduate study. In exceptional cases, if recommended by the Academic Status and Degrees Committee, the Dean of Graduate Studies may approve time extensions.

Degree of Doctor of Philosophy

The milestones to be accomplished and the requirements are:

1. The student must select a suitable major professor, who must be a faculty member of SMS/VIMS, as soon as possible following admission. The student and the major professor will choose an Advisory Committee, which must be approved by the Dean of Graduate Studies. The major professor and Advisory Committee direct the student's program.

2. The Advisory Committee, chosen by the student and approved by the Dean of Graduate Studies, must consist of at least five members, at least one of whom must be from outside the College of William and Mary. A majority of the Committee's members must be members of the faculty of SMS/VIMS, although persons with appropriate qualifications from outside SMS/VIMS may serve on the committee. For students with a specialty in biology or fisheries science, at least one member must be from the discipline of physical or environmental science. For students with a specialty in physical or environmental science, at least one member must be from the discipline of biological or fisheries science.

3. A minimum of three years of graduate study beyond the baccalaureate is required. At least one academic year must be spent in residence at SMS/VIMS as defined in the general degree requirements.

4. At least 42 credit hours of advanced work, of which at least 15 credit hours must have been earned in courses numbered 550 or above with a grade point average of 3.0 or better, are required for the Ph.D. degree. In addition, a student must have registered for dissertation (MSCI 699) for a least one semester. At least nine (9) but no more than 12 dissertation credits may be counted toward the minimum 42 credits required for the Ph.D. degree. Students also will be expected to register for seminar as required by their respective departments; however, only two (2) credits will be applicable to the degree.

   Credits more than seven (7) years old and earned in the program in which the student is currently enrolled will be deleted from the accumulation of credits required for a degree. Credits acquired while enrolled in previous programs here or elsewhere generally are not subject to this limitation.

5. Upon a favorable recommendation of the student's Advisory Committee and the Academic Status and Degrees Committee, followed by a majority vote of the Academic Council and the approval of the Dean of Graduate Studies, a student may be admitted to candidacy after completion of the following requirements:

   a. The student must have achieved a grade point average of B (3.0) or better, averaged over all courses taken for credit at the time of application for admission to candidacy.

   b. All core courses required by the School of Marine Science (MSCI 501 A-D, MSCI 501L, MSCI 502, MSCI 502L, MSCI 504) must be passed with a grade of B- or better (or successful completion of a comprehensive examination administered by core class instructor) or officially exempted, and all other courses specifically required by the student's department and Advisory Committee must be completed.

   c. The qualifying examination and prospectus must be completed.

6. The student must present a seminar to the marine science faculty; staff and students on a dissertation topic approved by the major professor, the Advisory Committee and the Dean of Graduate Studies, and must defend this dissertation before his/her major professor and committee. The defense of the dissertation shall be separate from any other examination. Full details of this requirement can be obtained from the Office of the Dean of Graduate Studies.

7. All requirements for the degree must be completed within the following time frame:

   4 years with a Master's Degree from the School of Marine Science

   5 years with a Master's Degree from another Institution

   6 years with direct admittance (bypass Master's Degree)

In exceptional cases, if recommended by the Academic Status and Degrees Committee, the Dean of Graduate Studies may approve time extensions.

8. Dissertations will be published by having a master microfilm negative made from each original dissertation. Each dissertation, when submitted, must be accompanied by two copies of an abstract of not more than 350 words. This abstract or summary will be published in Microfilm Abstracts for national distribution. No dissertation will be accepted without this abstract. The candidate for the Doctor of Philosophy degree must pay a fee for the above services before it is conferred. All dissertation research, however, should be planned, conducted and reported with a view toward publication of the results in peer-reviewed scientific journals.

General Statement of Policy

The School of Marine Science and the College of William and Mary have an Affirmative Action Policy and are committed to attracting underrepresented students into marine science. The School's Admissions Committee considers applicants without regard to sex, race, color, religion, national origin, sexual orientation, or disability. Admissions criteria are based on past and potential academic and research performance.

The facilities and services of the College are open to all enrolled students on the same basis, and all standards and policies of the institution, including those governing employment, are applied accordingly.

Senior citizens of Virginia who wish to take advantage of fee waiver privileges in order to attend courses at William and Mary are invited to contact the Dean of Graduate Studies for full details.

The College reserves the right to make changes in the regulations, charges and curricula listed herein at any time.

Honor Code

The Honor Code, first established at William and Mary in 1779, remains one of the College's most cherished traditions. It assumes that principles of honorable conduct are familiar and dear to all students, and hence dishonorable acts will not be tolerated. Students found guilty of cheating, stealing or lying are subject to dismissal. The principles of the Honor Code and the method of administration are described in the Student Handbook (www.wm.edu).

Graduate Regulations

Application for Admission

Application forms are available electronically at: http://www.vims.edu/sms/admissions

If applicants do not have access to a computer, requests for application forms and completed application materials should be sent to:

Dean of Graduate Studies
School of Marine Science
College of William and Mary
P.O. Box 1346
Gloucester Point, Virginia 23062

SMS Applicant Statistics	Fall 2002	Fall 2003	Fall 2004	Fall 2005	Fall 2006
# of Applicants	157	150	152	112	103
# Admitted	57	45	48	34	37
# Enrolled	29	28	34	27	20
Mean GPA	3.36	3.36	3.39	3.48	3.50
Mean GRE	1275	1239	1221	1220	1194

Students are encouraged to apply for admission during the winter of each calendar year, with a closing date of January 15. Applicants will be notified after April 15. Admission will be valid for matriculation for the following summer, fall and winter semesters. Most students should anticipate a Fall matriculation. The Dean of Graduate Studies should be contacted prior to submitting applications at any other time or regarding any special circumstances the student's application or matriculation might present.

Students applying to SMS should make contact with faculty members, with whom they share similar research interests. Generally only students with an identified faculty mentor are admitted to SMS.

The following are required of applicants to the School of Marine Science:

1. One (1) copy of the completed application form.
2. A non-refundable processing fee of $50. This fee is not credited to the student's account. There is no fee for application for admission as an unclassified (post-baccalaureate) student.
3. Three (3) letters of recommendation.
4. Official transcripts of all college work. (Final degree transcripts are required of admitted students before they matriculate).
5. Official Scores of the Verbal, Quantitative and Analytical sections of the Graduate Record Examination (GRE).

Scores in an advanced section of the Graduate Record Examination in the applicant's undergraduate major field or an area appropriate to the applicant's proposed concentration in marine science are informative but are not required. GRE scores more than 5 years old are not acceptable, and the examination must be retaken. Applicants are encouraged to take the Graduate Record Examination at scheduled dates that will allow for receipt of scores by the aforementioned closing date. The Faculty cannot evaluate applications lacking GRE scores or other critical materials after the closing date.

In general, minimum requirements for acceptance to the School of Marine Science are a GPA of 3.0 or higher; GRE score (Verbal plus Quantitative) of 1100 or higher.

International Students

In addition to the verbal and quantitative sections of the Graduate Record Examination (GRE), international applicants whose primary language is not English must submit the results of the GRE English Language Proficiency Test, Test of English as a Foreign Language (TOEFL).

In general, the minimum acceptable TOEFL score is 550 or 5.0. The TOEFL requirement may be waived if the applicant has completed an undergraduate or graduate degree at an accredited U.S. institution or other appropriate institution in which the language of instruction is English. Students with marginal proficiency in English will be required to register for an appropriate English course offered at the Williamsburg campus. A reduced load of graduate courses is suggested for these students.

Transcripts, certificates of degrees and similar documents submitted by international applicants must be accompanied by an English translation and must include titles of all courses taken and the grade received in each course.

International students admitted to the School must present proof that they have available funds sufficient to meet all costs they will incur while studying at the School of Marine Science. The form I-20 will not be mailed until this proof of financial support is received. For those students offered financial aid by the School of Marine Science, such aid may be included as a source of funds.

For additional information on the process of obtaining a student visa, please contact the Global Education Office (globe@wm.edu) or (757) 221-3594. Their website: www.wm.edu/revescenter/iss also contains valuable information for international applicants as well as current international students.

Admission Information

Applicants are encouraged to visit the campus to contact faculty members about specific research interests, funding opportunities, and program information.

Admission to the School of Marine Science is highly competitive; there were 103 applicants for the entering class of 2006, of which only 37 were accepted. The Faculty carefully evaluates criteria of performance, which include GRE scores, overall GPA and GPA in area of concentration, the applicant's statement of purpose, letters of recommendation, and prior experience. Although it is neither possible nor desirable

to provide absolute values of criteria that will ensure admission, see the figure on page 60 for GPA and GRE scores of students offered admission in 2002 – 2006.

Degree-Seeking Students

Students are admitted as regular or provisional graduate students in either the M.S. or Ph.D. Programs. For matriculation as a regular graduate student, an applicant must have completed the requirements for a bachelor's degree at an accredited college, with a record of high performance, and must have the recommendations of the faculty and officials of the School of Marine Science.

Students may be admitted to either the Master of Science or Doctor of Philosophy programs. Direct admission into the Doctor of Philosophy program is available to qualified applicants with a Master's degree. Students without a Master's degree, except in exceptional cases as identified by the Dean of Graduate Studies, must enter the program as a Master's student; however, students wishing to continue directly to a Ph.D. degree can apply to by-pass the M.S. degree, provided they meet the criteria for the by-pass (see Masters of Science bypass option). By-pass requires approval of the student's advisory committee, the Academic Status and Degrees Committee, and the Dean of Graduate Studies.

Applicants judged deficient in preparatory studies or other areas may be admitted as provisional students. A provisional student may petition for regular student status after successful completion of those requirements stipulated in his/her notification of admission. Petition for change in status shall be reviewed by the Academic Status and Degrees Committee, using as criteria overall academic performance and performance standards previously specified on the student's notification of admission. Graduate credit earned by a provisional student will be applied toward the graduate degree upon conversion to regular student status.

Master of Science Bypass Option

A superior student originally accepted to the master's program and who has demonstrated potential to conduct Ph.D. level research may petition to bypass the Master of Science degree and proceed directly toward the doctorate. A petition should be submitted to the Academic Status and Degrees Committee (AS&DC), with the following elements:

1. Completion of the core course requirements for the M.S. degree (MSCI 501, MSCI 501L, MSCI 502, MSCI 502L, MSCI 504).

2. A student must be in good academic standing (cumulative GPA of B or better with no core course grade lower than B-). There will be no exceptions to this requirement.

3. Submission of a CV and 1-2 page statement by the student describing the student's achievements and demonstrated potential to conduct independent research.

4. Submission of a 1-2 page statement by the student's advisor describing the student's achievements and demonstrated potential to conduct independent research.

5. Recommendation by the student's Advisory Committee to bypass the Master's degree.

6. Formal acceptance of a Ph.D. prospectus by the student's committee.

7. Successful completion of the qualifying exam at the Ph.D. level.

Evidence of scholarly potential in the form of independent research, professional presentations, submitted or accepted manuscripts and research proposals will strengthen a student's petition for the bypass. The AS&DC will recommend to the Dean of Graduate Studies whether or not permission to bypass should be granted. Appeals of an adverse decision of the Academic Status and Degrees Committee may be made in accordance with the procedures set forth in the Bylaws of the School of Marine Science. It is important that a student submit the bypass form in a timely fashion; typically, no later than the start of the third year. In order to apply the doctoral program milestones equitably, the AS&DC will determine an "effective completion date" of the doctoral program, which normally will be designated as 72 months from date of matriculating at SMS/VIMS.

Non Degree-Seeking Students

Students who have received a Bachelor's degree from an accredited college or university and who wish to take courses in the School of Marine Science but who are not entering an advanced degree program may apply for unclassified student status (post-baccalaureate). Graduate credit earned as an unclassified student may be applied toward the graduate degree upon matriculation as a regular graduate student.

Financial Information

Tuition and Fees

The College reserves the right to make changes in its charges for any and all programs at any time, after approval by the Board of Visitors.

For Fall 2006, the tuition and general fee for full-time students in the School of Marine Science is $4,707 per semester for residents of Virginia and $11,119 per semester for non-residents.

Special Note: All incoming students registered for nine hours or more in 500-level courses or above, or for twelve hours or more at any level, are considered full-time students and charged the full-time rates unless qualified to be a Research Graduate Student.

Tuition for part-time students, at both the undergraduate and graduate levels, is as follows:

$260 per semester hour for Virginia residents.

$725 per semester hour for out-of-state students.

Regularly enrolled degree-seeking students of the College will be charged these rates during the regular session for part- time work, based on their established domiciliary status.

Rates for students who enroll in the Summer Session will be charged on the same basis, with an additional $25 registration fee.

Part-time students who are not regularly enrolled at the College of William and Mary, and for whom, therefore, no domiciliary status previously has been determined, will be charged on the basis of their satisfactorily established domiciliary status. (See statement regarding Eligibility for In-state Tuition Rate).

Auditing fees are the same as those specified for part-time students, unless the auditor is a full-time student. Permission to audit must be obtained from the instructor.

Graduate Assistantships

Graduate research and graduate teaching assistants work an equivalent of twenty hours a week. For graduate research assistants, every effort will be made to ensure that assistantship duties are relevant to the student's course of study and research program. Graduate assistants must satisfactorily carry out the duties assigned by the School of Marine Science, must make satisfactory progress on their programs as defined by the College degree requirements and the regulations of the School of Marine Science, and may not hold any other employment or appointment of a remunerative nature during the term of their assistantships without approval of the Dean of Graduate Studies. Failure to comply with these conditions will lead to revocation of appointments.

Graduate Fellowships

A limited number of outstanding applicants are awarded fellowships that consist of "tuition remission" in addition to a graduate assistantship. These fellowships are awarded via a priority ranking system and are renewable annually for up to 24 months (M.S. students) or 36 months (Ph.D. direct admit or by-pass), contingent upon satisfactory performance. All fellowship students are expected to participate (equivalent to twenty-hours a week) in their advisor's group activities and in a research project or program as determined jointly with their faculty advisor.

Research Graduate Student Status

Upon the recommendation of a student's major professor, advisory committee, and the Academic Status and Degrees Committee, the Dean of Graduate Studies may approve a student obtaining Research Graduate status for a single semester. This generally would be the semester in which the student completes the thesis and graduates.

The following conditions must be met:

1. The student has completed all SMS and departmental required coursework.
2. The student is not employed significantly in any activity other than research and writing in fulfillment of degree requirements.
3. The student is present on the campus or is engaged in approved fieldwork related to his/her thesis or dissertation.

While classified as a Research Graduate, a student may register for a maximum of 12 credit hours of Thesis or Dissertation per regular semester upon payment of the part-time rate for only three credit hours of Thesis/Dissertation. The student may elect to utilize up to two (2) of the three paid credit hours for formal coursework.

A Research Graduate student may register for additional course credit only upon payment of the generally applicable additional part-time tuition.

A Research Graduate student is eligible for services (e.g. student health and athletic events) only if required fees are paid.

Eligibility for In-state Tuition Rate

To be eligible for the lower tuition rate available to in-state students, a student must meet the statutory test for domicile set forth in Section 23-7.4 of the Code of Virginia. Detailed information may be obtained from the State Council of Higher Education for Virginia at http://www.schev.edu/students/vadomicile.asp?from=students.

Domicile is a technical legal concept, and a student's status is determined objectively through the impartial application of established rules. In general, to establish domicile students must be able to show (1) that for at least one year immediately proceeding the first official day of classes their permanent home was in Virginia and (2) that they intend to stay in Virginia indefinitely after graduation. Residence in Virginia primarily to attend college does not establish eligibility for the in-state tuition rate. On admission to the College an entering student who claims domiciliary status is sent an application

form and instructions on how to fill it out. The Office of the Registrar evaluates the application and notifies the student of adverse decisions only. A student re-enrolling in the College after an absence of one or more semesters must re-apply for domiciliary status and is subject to the same requirements as an entering student.

A matriculating student whose domicile has changed may request reclassification from out-of-state to in-state; since reclassification is effective only prospectively, however, it must be applied for before the beginning of the academic semester. Any student may ask for written review of an adverse decision, but a change in classification will be made only when justified by clear and convincing evidence. All questions about eligibility for domiciliary status should be addressed to the Office of the Registrar, (757) 221-2808 or jkbell@wm.edu.

Payment of Accounts

Charges for the tuition and general fees are payable by each semester's due date as established by the Office of the Bursar. Any unpaid balance remaining on an individual's account after the end of the add/drop period may result in cancellation of registration. In most cases tuition and fees for SMS students are paid for by the student's advisor.

Payment may be made in U.S. dollars only by cash or check money order or cashiers check made payable to the College of William & Mary. Checks returned by the bank for any reason will constitute nonpayment of fees and may result in cancellation of registration. The option of paying your account in full by credit card or electronic check is offered through our payment plan provider, TMS(Tuition Management Systems);however, TMS does charge a convenience fee for these services. Additional information may be obtained from the Bursar's Office website at www.wm.edu/financialoperations/studentaccounts/AboutYourBill.

Any past due debt owed the College,(telecommunications, emergency loans, parking, health services, library fines, etc) may result in cancellation of registration and/or transcripts being withheld. In the event a past-due account is referred for collection, the student is required to pay all costs associated with the collection and/or litigation, as well as the College's late payment fee.

Students Who Withdraw from the College

Subject to the following regulations and exceptions, all charges made by the College are considered to be fully earned upon completion of registration by the student.

Full-time Graduate Students Who Withdraw From College

Full-time students who withdraw from the College are charged a percentage of the tuition and fees based on the school week within which the withdrawal occurs. A school week is defined as the period beginning on Monday and ending on the succeeding Sunday. The first school week of a semester is defined as that week within which classes begin. Full-time students who withdraw from the College within the

first school week of the semester are eligible for a refund of all payments for tuition and fees less the required enrollment deposit for entering students or a $50.00 administrative fee for continuing students. After week 1 of the semester, the amount of the tuition and fees charged /refunded will be determined based on the following schedule:

Week	Percentage Charged	Percentage Refunded
1	0%	100%
2	20%	80%
3	30%	70%
4	40%	60%
5	50%	50%
6	60%	40%
After week 6	100%	0%

Students will not be eligible for any refund of tuition and general fees if required to withdraw by the College.

It is College policy to hold the enrolled student liable for charges incurred, therefore in the case of refunding any overpayment, refund checks will be issued in the name of the student.

Part-time Graduate Students Who Withdraw From College

Part-time students who withdraw from the College within the first school week of the semester are eligible for a full refund of tuition and fees less a $50.00 administrative fee. After the first week, the amount of the tuition and fees to be charged will follow the full-time withdrawal schedule.

Students will not be eligible for any refund of tuition if required to withdraw from the College.

Graduate Students Who Withdraw From a Course

A part-time student who withdraws from a course(s) after the add/drop period and remains registered for other academic work will not be eligible for a refund.

Withholding of Transcripts and Diplomas in Cases of Unpaid Accounts

Transcripts or any other information concerning scholastic records will not be released until College accounts are paid in full. Diplomas will not be awarded to persons whose College accounts are not paid in full.

Student Facilities and Services

Housing

There is no student housing on the SMS/VIMS campus, and most students live in Gloucester Point or in surrounding communities. Rental housing is somewhat limited in the Gloucester Point area, but apartments in nearby Gloucester, Mathews, Yorktown, and Newport News are more plentiful if one is willing to commute a short distance., One-bedroom apartments generally range from $350 to $500, while multiple bedroom apartments will generally cost about $250-$350 per occupant,. These figures do not include utilities or amenities. Students often elect to share housing in order to keep costs to a minimum. A limited number of apartments for graduate students are available on the Williamsburg campus. Located next to the Marshall-Wythe School of Law, the Graduate Housing Complex is within walking distance of the College's main campus and historic Colonial Williamsburg. Information and application forms can be obtained from the Office of Residence Hall Life located on the main campus (757) 221-4134, or email living@wm.edu.

Cultural Life at William and Mary

As part of the William and Mary community, School of Marine Science students may participate in a broad range of cultural activities on the Williamsburg campus. Under the auspices of the Committees on Concerts and Lectures and the Speakers Forum, the College provides its students opportunities to enjoy a full spectrum of public lectures and concerts. In recent years, College audiences have enjoyed performances by nationally and internationally recognized theatre arts performers. In addition, the William and Mary Theatre annually present four full-length plays in public performance. The Speakers Forum offers subscription series featuring prominent national personalities from the worlds of politics, entertainment and the arts. Under the sponsorship of the Fine Arts Department, the Campus Center, and the Muscarelle Museum of Art, exhibits in painting, sculpture, and architectural design, theatre and industrial arts are shown throughout the year.

Numerous small and large cities including the major metropolitan areas of Norfolk, Virginia Beach, and Richmond are within easy driving distance of Gloucester Point. Each provides a broad array of cultural and entertainment events throughout the year.

Opportunities for nightlife and other cultural outings exist in numerous nearby metropolitan areas. One can drive to Norfolk, Virginia Beach and Richmond in about an hour or to Washington, DC in about two and a half hours. These cities offer a variety of nightclubs, sporting events, cuisine, concerts, fine arts, and many other diversions for the busy student. On the other hand, many students find the offerings of Gloucester Point and surrounding areas to be quite sufficient. The Yorktown Pub and Cruisers Sports Bar are very close to the SMS/VIMS campus and are frequented by students and faculty alike.

Campus Parking

Many students drive a motor vehicle to the SMS/VIMS campus, and parking can sometimes be at a premium. However, space is usually available in one of the many campus-parking areas. All motor vehicles, including motorcycles and motorbikes, parked on SMS/VIMS property must be registered with Parking Services. Registration includes the purchase of a College of William and Mary parking decal, which must be displayed on or in the vehicle. Illegally parked or unregistered vehicles are subject to citation, and students with unresolved citations are not allowed to register for classes or to receive degrees. A full description of campus motor vehicle regulations is contained in a brochure available from Parking Services. To contact Campus Parking, telephone (757) 221-4764 or email parked@wm.edu.

Outdoor Life and Athletics

The Recreational Sports Department provides a variety of recreational opportunities to all students, faculty and staff through intramural, sports clubs, informal recreation, fitness/wellness and outdoor programs. Facilities include the Student Recreation Center, Adair Gymnasium, William and Mary Hall and various outdoor facilities. Facilities are open seven days per week during the academic year with a modified schedule during the break periods. Facility schedules and procedures for checking out equipment are available at the Student Recreation Center. Also see our Recreational Sports calendar for building hours, Intramural schedule, sports club listing and fitness/wellness services.

Intramural play is held for each of over 25 sports/activities during the year. Informal or open recreation, generally considered "free play", is offered in swimming, racquetball, squash, basketball, volleyball, weightlifting and cardio machines. The Sport Club program consists of 43 clubs, each self-governing and self-supporting and dictated simply by participants' interest in the activity. Clubs include Badminton, Ballroom Dancing, Baseball, Men's Basketball, Women's Basketball, Brazilian Jiu-Jitsu, Croquet, Cycling, Equestrian, Fencing, Field Hockey, Golf, Gymnastics, Ice Hockey, Kendo, Men's Lacrosse, Women's Lacrosse, Martial Arts, Outdoors, Racquetball, Rock Climbing, Rowing, Men's Rugby, Women's Rugby, Running, Sail and Paddle (VIMS), Sailing (Racing), Shotokan Karate, Men's Soccer, Women's Soccer, Softball, Squash, Surfing, Swimming, Synchronized Swimming, Tae Kwon Do, Men's Ultimate Frisbee, Women's Ultimate Frisbee, Men's Volleyball, Women's Volleyball, Wrestling, and Yoga.

The use of the Recreational Sports facilities is included in the payment of full-time tuition. Graduate students who pay for fewer than 9 credit hours per semester may use the facilities by paying an annual activities fee. For information on the annual fee, any activity, program or service offered by Recreational Sports, please call (757) 221-3310.

Student Health Service

The Student Health Center provides high-quality, primary medical care for students becoming ill or experiencing minor emergencies while away from home.

The Health Center delivers a wide variety of services, many of which are covered by the Student Health Fee included in the Tuition and General Fee. All matters between a student and the Health Center staff are confidential and, except in the case of life-threatening situations, medical emergencies, or when required by law, will not be released without the student's written consent.

Virginia State law requires all full-time students enrolling for the first time in a four-year public institution to provide a health history and an official immunization record.

The College of William and Mary further requires ALL full-time students (including previously matriculated students) to submit a physical examination performed within twelve-months preceding the student's enrollment or re-enrollment, as well as providing documentation of meeting the same immunization requirements. Previously enrolled students re-entering as full-time students after an absence from campus of greater than 10 years must also revalidate their immunization record. This information MUST be submitted on William and Mary's Health Evaluation Form.

Medical services are provided for all full-time students and for those graduate students certified by the Dean of their school to be doing the "equivalent of full-time work." In order to be eligible for medical care both groups of students must have paid the Student Health Fee for the current semester and have met the Health Evaluation Form requirements including a physical examination and submission of an official immunization record.

Students choosing to seek care at an off-campus site are responsible for charges incurred. Likewise, if a Health Center physician deems it medically necessary to refer a student to an off-campus specialist, this also becomes the student's financial responsibility. Students are strongly encouraged to carry health insurance to assist with the cost of health care obtained outside the Student Health Center.

Students experiencing severe emotional or psychological distress, making a threat or a gesture of suicide, or attempting suicide, will be evaluated by the College's medical/emotional emergency response team and appropriate measures instituted. Anyone having knowledge of such circumstances should immediately contact the Dean of Students at (757) 221-2510, or the Student Health Center at (757) 221-4386.

The Student Health Center is located on Gooch Drive, South of Zable Stadium (Cary Field). Hours of operation are Monday, Tuesday, Thursday and Friday from 7:45 A.M. to 4:00 P.M.; Wednesday from 10:00 A.M. to 4:00 P.M.; (limited services only). Appointments with physicians and nurse practitioners may be scheduled by calling (757) 221-2998.

William and Mary Counseling Center

The Counseling Center offers a wide range of psychological and counseling services for William and Mary students. For example, we provide professional help in the following areas: psychological issues, personal concerns, interpersonal issues, and crisis intervention. Staff members are available to discuss any important personal concerns a student may be facing and work with that student to develop new ways of resolving the problem or mastering the concern.

The staff of the Counseling Center consists of both male and female mental health professionals, including psychologists, counselors a social worker, and a psychiatrist. A sport psychologist is available for students interested in learning how to enhance their athletic performance. Psychiatric consultation is available when needed. All staff are trained and experienced in dealing with problems university students encounter. Students are initially seen by a counselor individually. Continuing services are free of charge to full-time enrolled students.

Appointments may be made by calling the Counseling Center at (757) 221-3620 or by coming to the office located in Blow Memorial Hall, Room 240. Office hours are 8:00am-noon and 1pm-5pm, Monday through Friday. Appointments will be scheduled as soon as possible after the initial request, usually within a week, depending upon the urgency of the situation and staff availability. If appropriate, a student may be referred to other sources of help after an initial evaluation. Emergency services during the Fall and Spring semesters are also available after hours and on weekends by calling the Campus Police at (757) 221-4596 and asking to speak with the Counseling Center "on-call" counselor.

Counseling is confidential. Therapy is most effective when a student can be direct and honest with a counselor without fear that personal information will be divulged. Information about a student is not released with that student's written permission, except in the case of imminent danger to self or others, child/adult abuse, court order, or where otherwise required by law. Notations of counseling are not a part of a student's College record.

Office of Career Services

The Career Center, located in Blow Memorial Hall on the William and Mary campus, offers individual career advising and assessment for VIMS students as well as support in the job search. The staff is available to present workshops and seminars at

VIMS in addition to those presented on the William and Mary campus through the Graduate Center. Call (757) 221-3231 to make an appointment or to talk with Mary Schilling, Director.

The Graduate Student Association

The Graduate Student Association (http://www.vims.edu/sms/students) is a voluntary organization open to all graduate students in the School of Marine Science. The purpose of the Association is to advance the academic and social interests of its members. Students can also find information on the GSA website about funding opportunities and housing availability. Officers are elected each spring for the following academic year.

Disabilities Services

The College of William and Mary welcomes a widely diverse population of students including students with disabilities. In order to provide an accessible educational environment and to meet the individual learning needs of students, we invite self-declaration of disabilities to the College's Assistant Dean of Students for Disability Services, Campus Center 109, College of William and Mary, P.O. Box 8795, Williamsburg, VA 23187-8795, (757)221-2510 (Voice), (757)221-2302 (TDD), (757)221-2538 (Fax).

Documentation of disability need not precede arrival on the VIMS campus, but must be filed with Disability Services before reasonable accommodation will be considered. Please refer to the Disability Services website for specific details related to documentation criteria (http://www.wm.edu/deansofstudents/disable.php). All documentation will be handled confidentially and shared only with the student's express written permission for accommodation purposes.

Sexual Harassment Policy Procedures

The College of William and Mary is committed to an environment in which students, faculty, staff and guests are free from sexual harassment. Sexual harassment threatens the legitimate expectation of all members of the campus community that academic achievement or employment progress is determined by classroom and job performance. Particularly unacceptable in a college setting, sexual harassment seriously undermines the atmosphere of trust essential to the academic enterprise. Sexual harassment is prohibited at The College of William and Mary and in its programs, activities and functions. Sexual harassment may also constitute violations of the criminal and civil laws of the Commonwealth of Virginia and the United States.

This policy is also available from the website of the Office of Equal Opportunity and Affirmative Action located at http://www.wm.edu/eo/. Should you have any questions, please contact the Office of Equal Opportunity/Affirmative Action at (757) 221-2615.