



# COLLEGE OF MARINE AND EARTH STUDIES

## GRADUATE PROGRAMS

- **Geological Sciences (MS, PhD)**
- **Marine Studies (MS, PhD)**
- **Marine Policy (MMP)**
- **Oceanography (PhD)**
- **Marine Management (MMM)**
- **Ocean Engineering (MS, PhD)  
(Interdisciplinary Program)**

Telephone: Newark (302) 831-2841, Lewes (302) 645-4226  
<http://www.ocean.udel.edu>  
<http://www.geology.udel.edu>  
Faculty Listing: <http://www.ocean.udel.edu/research/faculty.asp>

### PROGRAM OVERVIEW

The College of Marine and Earth Studies offers programs leading to master's and PhD degrees. The MS degrees are offered in Geology, Marine Policy, Marine Science, Ocean Engineering, and Oceanography. A non-thesis Master of Marine Management (M.M.M.) degree also is now available. The PhD degrees are offered in Geology, Marine Studies, Oceanography, and Ocean Engineering.

The goal of the college is to educate scholars who will provide intellectual leadership in the areas of the geological sciences, marine biosciences, marine policy, oceanography, and physical ocean science and engineering. Graduates of the college are expected to understand the complex interactions of these areas in real-world situations, in addition to mastering advanced work in the area of their specialty.

The college has facilities in two locations: on the main campus of the University in Newark and on the Hugh R. Sharp Campus in the coastal city of Lewes at the mouth of the Delaware Bay. During the academic year, courses are taught at both sites. Interactive television linking the two sites minimizes the need for commuting between campuses. Students may live at either location depending on the nature of their research and the location of their advisor.

The college offers both field-oriented and laboratory-oriented research programs that take advantage of easy access to the Atlantic coast and Coastal Plain, the Delaware and Chesapeake Bays, and upland areas of the Piedmont and Appalachian Mountains. Additionally, there are many ongoing opportunities for research at a variety of locations around the world.

### RESEARCH FACILITIES

Robinson Hall, on the UD main campus in Newark, is CMES's administrative base, housing two programs, Marine Policy and Physical Ocean Science and Engineering. It is also home to two of the college's five research centers. The Center for Remote Sensing gathers and analyzes satellite data to yield valuable information about oceanic properties and coastal resources, ranging from the dispersion of oil slicks to global change in plant production. The Gerard J. Mangone Center for Marine Policy, the first of its kind to be established at an American university, conducts interdisciplinary

ocean and coastal policy research and education programs with a variety of local, national, and international partners.

Penny Hall is also located on the main campus in Newark. It houses undergraduate and graduate students in the geological sciences. The department has ready access to an x-ray diffractometer, paleomagnetic equipment, gas and liquid chromatographs, ground penetrating radar, multichannel seismic equipment, a variety of coring and drilling equipment, tripod mounted lidar, an electronic total station, an Autonomous Underwater Vehicle equipped with sidescan sonar and other sensors, and a variety of boats, including a 25-ft. vessel outfitted for geological research in the Delaware Bay. Through its cooperative programs with several nearby institutions, including the Delaware Geological Survey, the department has ready access to nearly all other commonly used tools of geological and geophysical research. The University of Delaware GIS laboratory is also located in Penny Hall.

Also based in Newark, the Lamont du Pont Chemistry, Biochemistry, and Marine Studies Laboratory provides state-of-the-art, contamination-free, "clean-lab" facilities for the study of trace metals in marine waters and sediments. The nearby Delaware Biotechnology Institute, a partnership among government, academia, and industry to help establish Delaware as a center of excellence in biotechnology and the life sciences, supports leading-edge interdisciplinary research in genomics and proteomics, including marine science initiatives.

Another major coastal research facility available at UD is the College of Engineering's Ocean Engineering Lab in the Center for Applied Coastal Research. CMES students may use the lab's flumes and wave basins through a joint degree program offered by the College of Marine and Earth Studies and the College of Engineering. The lab contains such novel equipment as the directional wave basin -- a 66-foot-long, 66-foot-wide, 3.3-foot-deep apparatus equipped with 34 wave-generating paddles for simulating a realistic sea. Faculty and students use the device to study the physics of waves and the effectiveness of various coastal protection measures.

At the Hugh R. Sharp Campus in Lewes, on the shores of Delaware Bay, CMES provides all the amenities for a thriving marine research and teaching program, including offices, research and teaching laboratories, classrooms, computer facilities, and a library. Cannon and Smith laboratories are equipped with recirculating seawater systems and controlled-environment rooms for maintaining saltwater fish and plants. Cannon Lab also is home to two research

centers: the Center for Marine Environmental Genomics focuses on deciphering the genetic code of marine organisms and determining the role that specific genes play, while the Ocean Information Center electronically archives a wide variety of marine data for use by scientists around the world.

Smith Lab includes a shellfish hatchery, algal culture facilities, fish aquaria, microbiology labs, and greenhouse space for halophyte (salt-tolerant plant) research. It also houses the Center for Halophyte Biotechnology, which is developing salt-tolerant plants for agricultural use and wetlands restoration in collaboration with local and international partners.

Two smaller laboratories in Lewes contain specialized research facilities. Henlopen Lab, adjacent to Cape Henlopen State Park, is home to one of the world's only tilting wind-wave tanks for studying physical phenomena at the air-sea interface. The Pollution Ecology Laboratory serves as supplemental space for marine geological research.

The Adrian S. Hooper Marine Operations Building and harbor support the seagoing research activities of the college. The harbor is home port of the 146-foot Hugh R. Sharp research vessel. Several smaller vessels are available for scientific exploration and sampling in nearby Delaware Bay and coastal Atlantic waters.

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## GEOLOGICAL SCIENCES

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Telephone: (302) 831-2569 or 831-8750  
<http://www.geology.udel.edu/>

### PROGRAM OVERVIEW

The University of Delaware offers academic and research programs leading to Master of Science and Doctor of Philosophy degrees in geology to qualified students who hold bachelor's degrees in the field of geology or related science and engineering disciplines. Major research emphases are Quaternary geology, geophysics, coastal and marine geology, stratigraphy, hydrogeology, and geomorphology.

### REQUIREMENTS FOR ADMISSION

Admission to the graduate program in the Department of Geological Sciences is evaluated on the basis of the applicant's GRE scores, undergraduate record, three letters of recommendation and research interests language. Applicants should have a combined verbal and quantitative GRE scores of at least 1050. A minimum TOEFL score of 600 is required for foreign applicants for whom English is not the first language. Admission to the graduate program in the Department of Geological Sciences is selective and competitive based on the number of qualified applicants and the availability of faculty and facilities. Students who meet the minimum academic requirements are not guaranteed admission.

### FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

### REQUIREMENTS FOR THE DEGREES

Requirements for the Master of Science degree include 30 credits of graduate study (6 of which are thesis credits) and the research, preparation, and defense of a thesis. Requirements for the Doctor of Philosophy degree include a Master of Science degree, an oral and written comprehensive exam, a course program developed with the student's dissertation committee (including 9 credits of dissertation research), and the research, preparation, and defense of the dissertation. All graduate students are required to register for GEOL 601 (Geological Sciences at Delaware) during their first fall term at the University. GEOL 605 (Stratigraphy) is also required of

all graduate students. For both the MS and PhD degrees, course programs are otherwise developed on an individual basis to meet the specific needs of the student. The program of study and research is formed by student consultation with the advisor and thesis or dissertation research committee. Because of the value of the teaching experience, PhD candidates are expected to teach a course or laboratory section for at least one semester.

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## MARINE BIOSCIENCES

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### PROGRAM OVERVIEW

Students in the Marine Biosciences Program at CMES are exposed to a broad spectrum of modern approaches to understand the organization and function of biological systems in marine environments. The M.B. Program is highly integrative and students are exposed to a wide range of subjects in their course work and research projects, from molecular biology and biochemistry to ecology and ecosystem studies. Areas of faculty interest within the program span the ecology, physiology, genetics, and molecular biology of plants, animals and microbes. Faculty research specializations are particularly concentrated in: microbial physiology and molecular ecology; larval ecology and molecular biology; chemical ecology; fisheries ecology; aquacultural genetics and genomics; wetland restoration. In addition to the sophisticated classroom and laboratory facilities available at CMES, students enjoy ready access to a variety of marine ecosystems near the Hugh R. Sharp Campus in Lewes: dunes, salt marshes, mudflats, estuaries, and the Atlantic Ocean. Field research takes place from the Arctic to the Antarctic, in environments ranging from coral reefs to deep-sea hydrothermal vents, to local salt marshes and coastal waters.

### REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1200 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

### FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

### REQUIREMENTS FOR THE DEGREES

All students in the master's program are required to complete 30 graduate credits. A course outside of the Marine Biosciences Program and the student's area of concentration is also required. All students must write a thesis. Students may bypass the master's degree and work directly toward the PhD upon petition. Written and oral qualifying examinations are required before students are admitted to candidacy for the PhD degree.

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## MS IN MARINE STUDIES with a concentration in MARINE BIOSCIENCES

### Required courses:

MAST 627	Marine Biology
MAST 634	Marine Biochemistry
MAST 821	Seminar (once each academic year)

**One course (minimum 3 credits) outside of the program.** This may be one of the specially designed introductory courses or a more advanced course.

Introductory courses include MAST 602 (Physical Oceanography), MAST 637 (Geological Oceanography), 646 (Chemical Oceanography) and MAST 670 (U.S. Ocean and Coastal Policy).

**Thesis:** 6 credits

Additional graduate-level course work as determined by advisory committee.

## PHD IN MARINE STUDIES with a concentration in MARINE BIOSCIENCES

### Required courses:

MAST 621 Coastal Field Biology  
 MAST 627 Marine Biology  
 MAST 634 Marine Biochemistry  
 MAST 821 Seminar (once each academic year)

**Dissertation:** 9 credits

Additional graduate-level course work as determined by advisory committee.

## MARINE POLICY

### PROGRAM OVERVIEW

The Marine Policy Program examines the economic, legal, political, and social aspects of the world ocean, the seabed, and the coastal zone. Students and faculty in the program analyze public issues regarding the law of the sea, ports and shipping, marine minerals, ocean and coastal zone management, fisheries, naval affairs, marine biotechnology, and the global environment, frequently making recommendations for policy at the regional, national, and international level.

The Master of Marine Policy prepares students for careers in research, management, and administration in marine-oriented government agencies, private associations, and business firms. For a few highly qualified students who already hold an advanced degree in marine policy or a related subject and who generally have some experience in policy research or management, the PhD in Marine (Policy) Studies is available.

The Master of Marine Management degree program is designed for individuals now active or employed in management or policy positions relevant to marine environments. The curriculum is a combination of courses in science and policy, and includes a methods course and an integrated case study course. No thesis is required.

### REQUIREMENTS FOR ADMISSION

#### Master of Marine Policy or Master of Marine Studies with a concentration in Marine Policy

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1100 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

Regarding Financial Aid, please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

#### Master of Marine Management

The requirements for admission to this program include a Bachelor's degree in an appropriate natural or social science program, an undergraduate grade point average of at least 3.0 (out of a possible 4.0), GRE scores (verbal and quantitative combined) of at least 1050, and a TOEFL score (for international students) of at least 600 (paper-based test) or 250 (computer-based test);

Evidence of professional experience is encouraged and will be

an important consideration for admission.

Regarding Financial Aid, it is expected that students matriculating in this program will not receive financial aid from university sources. Students will be either self-supporting or will be supported by outside funding sources.

### REQUIREMENTS FOR THE DEGREES

All students in the master's of marine policy program are required to complete 39 graduate credits. A course outside of the Marine Policy Program and the student's area of concentration is also required. Students pursuing this degree must write a thesis. Students may bypass the master's degree and work directly toward the PhD upon petition. Requirements for the PhD degree are similar to those for the master's degree, but are more intensive. Written and oral qualifying examinations are required before students are admitted to candidacy for the PhD degree.

All students in the master's of marine management program are required to complete at least 31 graduate course credits over the period of fall, winter and spring semesters of one year. There is no thesis required for this degree.

## MASTER OF MARINE POLICY (M.M.P.) or MASTER OF MARINE STUDIES with a concentration in MARINE POLICY

### Required courses:

MAST 670 U.S. Ocean & Coastal Policy  
 MAST 873 Marine Policy Seminar taken three times  
 MAST 675 Natural Resource Economics  
 MAST 676 Environmental Economics  
 MAST 677 International Ocean and Environmental Policy

MAST 817 Research Design and Methods  
 or  
 MAST 672 Applied Policy Analysis

### CMES course outside the marine policy program.

**Thesis:** 6 credits

**Elective courses** in policy and policy analysis approved by advisor (12 credits)

## MASTER OF MARINE MANAGEMENT (M.M.M.)

### Required courses:

#### (Fall Term):

MAST 663	Decision Tools for Policy Analysis	3
MAST 670	U.S. Marine Policy	3
or		
MAST 677	International Marine Policy	3
Science Elective		3
Policy Elective		3
MAST 821, 853, or 822	Science Seminar	1

#### (Winter Term):

MAST 801	Environmental Measurement Tools	5
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#### (Spring Term):

MAST 802	Case Study in Coastal and Ocean Management	3
Policy or Science Electives		9
MAST 873	Policy Seminar	1

Students select Science and Policy electives from CMES courses and other courses offered at the University. These selections are reviewed by the M.M.M. Advisory Committee.

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## PHD IN MARINE STUDIES with a concentration in MARINE POLICY

### Required courses:

Completion of M.M.P. or equivalent work at another university or M.M.P. bypass.  
MAST 873 Marine Policy Seminar taken three times \*

### CMES course outside the Marine Policy Program. \*

**Disciplinary concentration** approved by advisor (e.g., economics, political science)

**Additional Research and Methodology course** approved by advisor.  
**Dissertation:** 9 credits

**Additional graduate-level course work** as determined by advisory committee.

\*Does not apply to students who satisfied the requirement during M.M.P.

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## OCEANOGRAPHY

### PROGRAM OVERVIEW

Oceanography Program faculty and students conduct research on physical, geological, biological, and chemical problems in estuarine, coastal, and marine environments. Historically, the program's focus has been estuarine, coastal, and continental shelf studies in the Mid-Atlantic region. CMES studies have made the nearby Delaware, Chesapeake, and Delmarva Coastal Bays some of the most extensively studied estuaries in the world. More recently, however, faculty and students have had increasing interests in issues related to global environmental change in a number of other regions of the world.

Estuarine waters, salt marshes, and sediments provide ideal sites for work on the cycling of particulate material, trace metals, nutrients, and organic matter. An integrated picture of contrasting estuarine behavior is emerging from studies of circulation, chemistry, sedimentary geology, and planktonic biology in these contrasting environments. Faculty and students investigate topics at scales as large as paleohistorical circulation patterns, and as small as chemical cycles in algal mats. Multidisciplinary studies of the hydrology and ecology of intertidal groundwater seepage and the controls of harmful and noxious algal blooms are also explored. Together with the Center for Remote Sensing, faculty and students study the impact of land-use changes on wetlands and estuarine waters and the effects of oceanic circulation on climate. The Oceanography Program fosters an environment where a diverse faculty and student body work together to understand marine and environmental processes in the interest of solving environmental and societal problems.

### REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1200 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

### FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

### REQUIREMENTS FOR THE DEGREES

All students in the master's program are required to complete 30

graduate credits. A course outside of the Oceanography program and the student's area of concentration is also required. All students must write a thesis. Students may bypass the master's degree and work directly toward the PhD upon petition. Requirements for the PhD degree are similar to those for the master's degree, but are more intensive. Written and oral qualifying examinations are required before students are admitted to candidacy for the PhD degree.

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## MS IN MARINE STUDIES with a concentration in OCEANOGRAPHY

### Required courses:

Any two of the following core courses:

MAST 602 Physical Oceanography or equivalent  
MAST 646 Chemical Oceanography or equivalent  
MAST 637 Geological Oceanography or equivalent  
MAST 627 Marine Biology or equivalent

MAST 853 Oceanography Seminar or equivalent must be taken at least one semester during each year of residence.

**At least three (3) credits of 800-level courses** other than courses used to meet seminar and core required courses must be completed.

**One three (3) credit course in Marine Policy or one three (3) credit course outside of the student's declared sub-discipline of interest** (not including courses taken to meet the program core course requirement) as approved by the advisor and the program director must be completed.

**Thesis or Research:** 6 credits

**Additional courses** may be required by the student's advisory committee.

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## PHD IN OCEANOGRAPHY or PHD IN MARINE STUDIES with a concentration in OCEANOGRAPHY

### Required courses:

MAST 602 Physical Oceanography or equivalent  
MAST 646 Chemical Oceanography or equivalent  
MAST 637 Geological Oceanography or equivalent  
MAST 627 Marine Biology or equivalent

MAST 853 Oceanography Seminar or equivalent must be taken at least one semester during each year of residence.

**At least six (6) credits of 800-level courses** other than courses used to meet seminar and core required courses must be taken.

**One three (3) credit course in Marine Policy or one three (3) credit course outside of the student's declared sub-discipline of interest** (not including courses taken to meet the program core course requirement) as approved by the advisor and the program director must be completed.

**Dissertation or Research:** 9 credits

**Additional courses** may be required by the student's advisory committee.

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## PHYSICAL OCEAN SCIENCE AND ENGINEERING

### PROGRAM OVERVIEW

Students in the Physical Ocean Science and Engineering Program apply basic physical principals in their research in coastal physical oceanography, ocean acoustics, nearshore processes, environmental fluid dynamics, estuarine dynamics, and ocean engineering. Two degree plans are offered. The Master of Science and Doctor of Philosophy in Marine Studies are offered through the College of Marine and Earth Studies. The Master of Science and Doctor of Philosophy in Ocean Engineering are offered through a cross-disciplinary program operated jointly by the College of Marine and Earth Studies and the College of Engineering. (See the Ocean

Engineering section in the College of Engineering for specific degree).

This multidisciplinary academic program provides students with broad knowledge in physical oceanography as well as opportunities to focus on desired areas of expertise. The program is particularly appropriate for students with physics, mathematics, or engineering backgrounds.

### REQUIREMENTS FOR ADMISSION

Prospective students must submit Graduate Record Examination (GRE) scores. Applicants are encouraged to take the Biology Advanced test as well. Successful applicants typically have combined verbal and quantitative GRE scores above 1200 and grade-point averages above 3.0 (4.0 = A).

Applicants should also submit a letter of intent, stating specific interests and objectives for seeking graduate study. Early application for admission is advised. Please review the other requirements listed in the "Graduate Admissions" chapter in this catalog.

### FINANCIAL AID

Please refer to the chapter "Graduate Fellowships and Assistantships" in this catalog.

### REQUIREMENTS FOR THE DEGREES

All students in the master's program are required to complete a minimum of 30 graduate credits. A course outside of the POSE program and the student's area of concentration is required. All students must write a thesis. Students may bypass the master's degree and work directly toward the PhD upon petition. Requirements for the PhD degree are similar to those for the master's degree, but are more intensive. Written and oral qualifying examinations are required before students are admitted to candidacy for the PhD degree.

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## MS IN MARINE STUDIES with a concentration in PHYSICAL OCEAN SCIENCE AND ENGINEERING

### Required courses:

Minimum of 24 graduate course credits (including those listed below):

MEEG 690	Intermediate Engineering Mathematics
MAST 693	Waves in the Marine Environment
MAST 691	Ocean Fluid Dynamics
MASTS 882	POSE Seminar

### One of the following courses:

MEEG 864	Engineering Analysis II
MAST 800	Dynamical Physical Oceanography

**One course outside of the student's home program (minimum of 3 credits).** This may include one of the specially designed introductory courses or a more advanced course. Students may not test out of these classes. Introductory courses outside of this program include MAST 627 Marine Biology or MAST 670 U.S. Ocean and Coastal Policy. NOTE: MAST 601 Introduction to Oceanography will not meet this requirement. Physical oceanography courses will not meet this requirement.

**Thesis or Research:** 6 credits

**Additional graduate-level course work** as determined by advisory committee.

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## PHD IN MARINE STUDIES with a concentration in PHYSICAL OCEAN SCIENCE AND ENGINEERING

### Required courses:

MEEG 690	Intermediate Engineering Mathematics
MAST 693	Waves in the Marine Environment
MAST 691	Ocean Fluid Dynamics
MASTS 882	POSE Seminar
MEEG 864	Engineering Analysis II
MAST 800	Dynamical Physical Oceanography

**One course outside of the student's home program (minimum of 3 credits).** This may include one of the specially designed introductory courses or a more advanced course. Students may not test out of these classes.

**Dissertation:** 9 credits.

**Additional graduate-level course work** as determined by dissertation advisory committee.

