

MEEES MARINE ESTUARINE ENVIRONMENTAL SCIENCES GRADUATE PROGRAM

ions ■ atoms ■ molecules ■ proteins ■

habitats ■ ecosystems ■ planets ■



membranes ■ cells ■ tissues ■ organisms ■

populations ■ niches ■ communities ■

Guide for Prospective Students

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University of Maryland Baltimore County (UMBC)
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Graduate School (410) 455-2537; <http://www.umbc.edu/gradschool/>
Application <http://www.umbc.edu/gradschool/admissions/apply.html>

University of Maryland College Park (UMCP)
General Information (301) 405-1000; <http://www.umd.edu>
Graduate School (301) 405-0376; <http://www.gradschool.umd.edu/>
Application http://www.gradschool.umd.edu/welcome/degree_seeking_masters_phd.html

University of Maryland Eastern Shore (UMES)
General Information (410) 651-2200; <http://www.umes.edu>
Graduate School (410) 651-6507; <http://www.umes.edu/grad/>
Application <http://www.umes.edu/Admissions/Default.aspx?id=4340>

University of Maryland Center for Environmental Science (UMCES); <http://www.umces.edu/>
Appalachian Laboratory (AL) - (301) 689-7100; <http://www.al.umces.edu>
Chesapeake Biological Laboratory (CBL) (410) 326-4281; <http://www.umces.edu/cbl>
Horn Point Laboratory (HPL) (410) 228-8200; <http://www.umces.edu/hpl>

Institute of Marine and Environmental Technology (IMET) (410) 234-8800;
<http://www.umbi.org/comb/home.php>

Introduction

The Marine-Estuarine-Environmental Sciences (MEES) Program is a graduate program leading to M.S. and Ph.D. degrees. The mission of the MEES Program is to train graduate students in the environmental sciences. There is a clear need for scientists with training in this area, given the multitude of environmental problems faced by society today. The title of the program emphasizes our strengths in marine and estuarine sciences, although the program spans environmental science as a whole, irrespective of habitat. The interests of students in the program are diverse, but generally center on some aspects of the interaction between biological and physical or chemical systems. The analysis of this interaction may range from a study of molecular mechanisms to an assessment of the economics of an environmental impact. To ensure that all students in the program have some understanding of the breadth of information in the field of environmental sciences, each student is required to have course work in a variety of areas.

The MEES Program is multidisciplinary; its faculty consists of members from numerous units within the University System of Maryland (USM). In most cases, students within the MEES Program work in the laboratory of their research advisor in the department or unit to which the advisor belongs. This may be a department of the Baltimore, Baltimore County, College Park, or Eastern Shore campuses; one of the biotechnology centers of the Institute of Marine and Environmental Technology (IMET); or laboratories of the University of Maryland Center for Environmental Science (UMCES) – Horn Point Laboratory, Chesapeake Biological Laboratory, or the Appalachian Laboratory.

Courses taken by MEES students are taught on all campuses of USM and at the research laboratories. In general, basic or fundamental courses are offered on the campuses, whereas more advanced and specialized courses are offered at both the campuses and research laboratories. A course taught anywhere within USM is available to any graduate student registered at any campus through inter-institutional enrollment.

The interests of faculty and students within the MEES program have led to six formally defined *Areas of Specialization (AOS)*, from which a student may choose. The AOSs are: Ecology, Environmental Chemistry, Environmental Molecular Biology and Biotechnology, Environmental Science, Fisheries Science, and Oceanography. Each student will choose an AOS when applying. Both admission and program requirements will depend upon the selected AOS.

Given that students will be admitted to the program **only** if a research advisor can be identified, applicants are urged to contact potential advisors early in the application process so they can determine the possibility of working with him/her. This information can be found at our website: www.mees.umd.edu.

Admission

Applicants will be considered for admission and advising on all campuses by faculty associated with the appropriate Areas of Specialization, based on the applicant's requests. Prospective students may apply through the University of Maryland Baltimore (UMB), Baltimore County

(UMBC), College Park (UMCP) or Eastern Shore (UMES). In general, a student who has identified a specific member of the faculty with whom to work should apply to the campus where that faculty member is affiliated.

Applicants to the MEES Program will be considered at both the M.S. and Ph.D. levels. In the event that an applicant to the Ph.D. program has only a B.A. or B.S. degree, admission may initially be to the M.S. program with the future acceptance to the Ph.D. program contingent upon successful completion of a probationary period and on the recommendation of the student's advisory committee. An Admissions Committee for each Area of Specialization has been established to evaluate the applications of prospective students based on the following criteria.

1. The applicant's research interests and experiences. An essay clearly defining areas of research interest and research objectives (preferably including the AOS of interest) is required.
2. The academic preparation of the applicant must be consistent with stated interests and AOS requirements.
3. Official transcripts of all college-level work must be submitted. The undergraduate GPA must be at least 3.0; although some students with a GPA below 3.0 may be provisionally accepted based on related research or work experience.
4. Graduate Record Examination (GRE) Scores (only the General Test is required).
5. Three letters of recommendation from persons familiar with the applicant.

The Admissions Committee of the appropriate AOS will screen the applicant's credentials for admission. Each AOS has course prerequisites; students missing several of these courses may be offered provisional acceptance. Students missing three or more prerequisites will generally not be admitted and should plan to take some of those courses before applying again. All prerequisite courses must be completed within a student's first year after admission.

No student will be admitted to the Program unless an advisor has been identified. Hence, if prior discussions have taken place between an applicant and a member of the faculty regarding the faculty member's serving as advisor to the student, the fact should be mentioned and a letter from the potential advisor should be in the student's file. The student will be matriculated on the degree-granting campus of their advisor, following formal acceptance of the applicant by the appropriate Graduate School.

Applicants without the prerequisite course work may be provisionally admitted, based on overall academic record and related practical experience. Unless granted an extension by the appropriate AOS committee, such students will be expected to have successfully completed these courses during their first year of study.

Financial Assistance

Each University of Maryland campus has several types of graduate assistantships. Any financial aid available to graduate students on the University of Maryland campuses is available to MEES students on a competitive basis.

Teaching assistantships may also be available through funds provided by academic departments.

Research assistantships are available through contracts and grants to faculty sponsored by outside agencies and through research funds allocated to specific research laboratories. The student's advisor will take particular responsibility to assist in identifying these sources of financial aid for the student.

Students frequently find part-time employment in offices and laboratories in the Baltimore-Washington-Annapolis area and other parts of the state.

General Program Requirements

Committee Formation

Every MEES student must have a faculty advisor upon admittance. This person will be responsible for advising on all aspects of the student's progress through the program.

During the first semester of enrollment in the MEES Program, the student and advisor must form this committee. The committee should meet by the end of the first semester to determine required coursework, and a committee report, along with an initial proposal must be on file with the MEES Office before the end of the second semester. Annual meetings are to be held through the degree program.

A Master's advisory committee with consists of at least three members. A Ph.D. advisory committee must have at least five members.

Preparation of Theses and Dissertations

The student, in consultation with the advisory committee, will designate an area of research specialization and prepare a thesis or dissertation reporting the results of an original investigation in that area. The thesis or dissertation will be prepared according to the rules of the Graduate School. The final oral examination for the MS. or Ph.D. degrees will constitute a defense of the thesis or dissertation.

Master of Science Requirements

The requirements for the M.S. degree in MEES are as follows:

- 1. Course Work**

A minimum of 30 graduate credits with 24 credits of course work (including AOS core requirements and 6 credits of graduate research

- 2. Annual Progress Reports**

All MEES students are required to convene a committee meeting at least once per year and at that meeting provide a progress report summarizing their research and coursework to date, including a transcript.

- 3. Proposal**

A proposal or outline should be written and discussed with the committee. This preliminary proposal should be brief (2-3 pages) but should cover as specifically as possible the student's research interests and course plans.

4. Thesis Defense

An oral defense of the thesis, administered according to Graduate School regulations will take place at the completion of the research project. Once the thesis has been successfully defended, one copy must be supplied to the MEES Office in addition to the requirements of the Graduate School.

5. Time to Degree

MEES full-time M.S. students will be limited to four years in which to graduate. Part-time students will be limited to five years.

Doctor of Philosophy Requirements

The requirements for the Ph.D. degree are as follows:

1. Course Work

The student must complete a minimum of 36 graduate credits, with at least 24 credits of course work (including AOS core requirements) and 12 credits of dissertation research. If a student has completed a M.S. degree, up to 16 credits of appropriate courses can be waived by petition.

2. Annual Reports

All MEES students are required to convene a committee meeting at least once per year and at that meeting provide a progress report summarizing their research and course work to date, including a transcript.

3. Proposal

A proposal or outline should be written and discussed with the committee. This preliminary proposal should be brief (2-3 pages) but should cover as specifically as possible the student's research interests and course plans. Students will later develop a more comprehensive dissertation proposal, which they must defend orally before advancement to candidacy.

4. Doctoral Candidacy

Advancement to Candidacy for the Doctoral Degree requires successful completion of both a comprehensive examination and an oral defense of the dissertation proposal. The comprehensive examination must be passed before the student can defend the dissertation proposal. Students must be advanced to candidacy within six semesters after entering the Ph.D. program.

a. Comprehensive Exam

This examination is intended to determine whether the student demonstrates sufficient evidence of scholastic and intellectual ability in major and related academic areas. Areas of the examination will be chosen by the student's advisor, with approval by the committee, from a general list formulated based upon the AOS. The examination will include a written and oral portion.

b. Dissertation Proposal Defense

The proposal defense is an oral examination on the research proposal administered by the advisory committee. At the successful completion of this defense the student officially applies for Advancement to Candidacy for the Ph.D. degree.

5. Dissertation Seminar and Defense of the Dissertation Research

A candidate for the Ph.D. degree will present a public seminar on the dissertation

research during the academic year in which the degree will be awarded. A committee of graduate faculty conducts the final oral defense of the dissertation. Following successful completion of the final examination, a final copy of the dissertation must be supplied to the MEES Office, in addition to the requirements of the Graduate School.

6. Time to Degree

MEES full-time Ph.D. students will be limited to seven years in which to graduate (three years to candidacy). Part-time Ph.D. students will be limited to nine years in which to graduate (five years to candidacy).

Areas of Specialization

Each student will design his or her curriculum in consultation with their advisory committee, subject to approval by the MEES Program.

Ecology

Ecology is a broad discipline encompassing both terrestrial and aquatic environments. Specific areas of study include behavioral, community, evolutionary, marine, benthic, limnological, systematic, and physiological ecology. Variations and/or combinations of one or more of these subdisciplines are common (e.g., marine benthic community ecology as one area of study or the evolution of terrestrial communities as another). Students successfully completing this Area of Specialization could go on to academic appointments in a variety of departments (e.g., Environmental Sciences, Ecology, Biology, Zoology, Botany, etc.), or work for environmental consulting companies, or government agencies.

Heavy emphasis is placed on the student's unique research goals in this AOS. As such, core course requirements are kept to a minimum. The remainder of a student's course lead is determined by the student and his or her committee, on the basis of the individual's research topic and previous academic experience.

Prerequisites:

A Bachelor's degree in the natural or life sciences, along with:

1. Two semesters of Calculus
2. Two semesters of Introductory Chemistry
3. Two semesters of Organic Chemistry or Biochemistry
4. Two semesters of Physics
5. Two semesters of Introductory Biology
6. One Ecology course and two other Advanced Biology Courses

Core Courses and Other Requirements (M.S. and Ph.D.):

1. Population Biology, including mathematical modeling
2. Ecosystem Ecology and/or Community Ecology
3. One course for one of the other MEES AOSs
4. One course in Statistics/Biostatistics
5. On seminar for each year in the program
6. One course or seminar in Management, Policy or Ethics

7. A specialized field or laboratory course is recommended
 8. Courses in experimental design and analysis and scientific writing are recommended
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Environmental Chemistry

The objective of the Environmental Chemistry Area of Specialization (AOS) is to train research scientists to apply basic chemical principles to the study of the environmental behaviors or natural and anthropogenic chemicals. Environmental chemistry includes interdisciplinary studies of various realms such as geochemistry, transport processes, and toxicology to determine the fate and effects of chemicals in the natural environment. Students graduating from MEES through this AOS will find professional positions in Federal, state and local government agencies (such as EPA, FDA, NIH), private chemical and manufacturing industries, academic institutions, and consulting firms.

As both the Masters and Doctoral programs are research-oriented, emphasis is placed on learning and applying the scientific method, understanding statistical techniques, and developing effective scientific writing skills.

Prerequisites:

A Bachelor's degree in the natural sciences or engineering, along with:

1. Two semesters of Calculus
2. Two semesters of Physics
3. Two semesters of General Chemistry
4. Two semesters of Biology
5. Two semesters of Organic or other Advanced Chemistry (e.g., Biochemistry)

Core Courses and Other Requirements (M.S. and Ph.D.):

1. One fundamental and one advanced course in Environmental Chemistry or Geochemistry
 2. One course in Physical Transport Processes
 3. One course in Aquatic Toxicology/Ecology
 4. One 400 or 600 level course from one of the other MEES AOSs
 5. One course or seminar in Management, Policy, or Ethics
 6. One course in Statistics/Applied Mathematics
 7. One seminar for each year in the program
 8. One or more courses in Physical Chemistry are strongly encouraged
 9. Courses in experimental design and analysis and in scientific writing are recommended
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Environmental Molecular Biology/Biotechnology

Molecular approaches pervade every biological discipline, and each MEES campus boasts distinguished, energetic faculty that emphasize molecular mechanisms of ecological interactions

and dynamics. Expertise includes molecular endocrinology of fish growth, development and reproduction; methods of drug delivery; environmental stressors contributing to fish physiological dysfunction and oncogenesis; mechanisms and stressors of nitrogen fixation; molecular models of marine surface colonization; molecular cues of organism-organism interaction; and invertebrate immunity. Faculty in this area frequently study macromolecular-environmental interactions using recombinant DNA and hybridoma approaches. The Environmental Molecular Biology and Biotechnology AOS encourages interactions between campuses and is synergistic with other AOSs.

Prerequisites:

A Bachelor's degree in the natural sciences, life sciences, or engineering, along with:

1. Four semesters of Biology, including Biochemistry
2. Two semesters of Physics
3. Four semesters of Chemistry
4. Two semesters of Calculus
5. Two semesters of Molecular Biology/Molecular Genetics are recommended

Core Courses and Other Requirements (M.S. and Ph.D.)

1. One course in Molecular Biology/Genetics
2. One course in Cell Biology/Physiology
3. One course in Ecology
4. One course in Advanced Chemistry/Biotechnology
5. One course from one of the other MEES AOSs
6. One course or seminar in Management, Policy, or Ethics
7. One course in Statistics/Biostatistics
8. One seminar for each year in the program
9. Courses in experimental design and analysis and in scientific writing are recommended

***Note: For the M.S. degree, only three of the first four requirements must be fulfilled (5-8 are required for all students).*

Environmental Science

This Area of Specialization provides broad training in the environmental sciences. It is clear that some students do not want to specialize to the extent the other Areas of Specialization require, but would like to gain experience and take courses in a variety of scientific, economic, and social disciplines related to the natural environment. These requirements are also very appropriate for students wishing to specialize in environmental management.

The relevant graduate training will provide advanced courses in four distribution areas:

1. *Biology* – Courses in the biological sciences in which the emphasis is on ecology, especially at the population, community, and ecosystem levels.
2. *Chemistry* – Courses in chemistry as applied to organisms or to the environment with an emphasis on pollution/environmental toxicology courses.
3. *Physical Sciences and Technology* – Courses dealing with the physical world or with

the application of physical principles or technology to biological or environmental problems.

4. *Management, Economics, and Policy* – Courses dealing with the interaction of economic, legal, political, and/or social institutions with the biological, chemical, or physical environment.

Prerequisites:

An Bachelor's degree in the natural sciences or engineering, along with:

1. Two semesters of Calculus
2. Two semesters of Chemistry
3. Two semesters of Physics
4. Two semesters of Biology
5. An Ecology course and other advanced Environmental Science courses are recommended

Core Courses and Other Requirements (M.S. and Ph.D.):

1. One approved course from three of the four distribution areas (biology, chemistry, physical science, management) for M.S. students and one from each of the four distribution areas for Ph.D. students
2. One course in Statistics/Biostatics
3. One seminar for each year in the program
4. One or more courses in computer science or computer applications are strongly recommended
5. Courses in experimental design and analysis and scientific writing are also recommended

Fisheries Science

Fisheries Science is multidisciplinary, drawing expertise from the biological, physical, and social sciences. Fisheries scientists study populations and communities of aquatic resources, their responses to exploitation, and changes in environmental conditions and their management. Research is quantitative and may be either basic or applied. A diversity of faculty talent exists within the University of Maryland to provide graduate students with a strong education in ecology, biology, and management of fish and invertebrate resources.

The multidisciplinary nature of fisheries science requires broad training in areas that may include ecology, oceanography, aquaculture, economics, mathematics, seafood technology, pathology and disease, and management science. Students will select a curriculum, with assistance from their advisors and committees, to best achieve their academic and professional goals. The faculty recognizes that flexible yet rigorous, curriculum choices are important for students in fisheries science.

Graduates may expect to find challenging career opportunities. Most career opportunities in fisheries science are in the government and academic sectors, although in recent years, private

businesses, research firms, and aquaculture businesses offer increasingly diverse career choices.

Prerequisites:

A Bachelor's degree in the natural sciences or other field with a strong quantitative emphasis, along with:

1. Two semesters of Calculus
2. Two semesters of Introductory Chemistry
3. Two semesters of Organic Chemistry, Biochemistry, or Physics
4. Two semesters of Biology
5. Advanced Biology courses, such as Ecology and Ichthyology, are recommended

Core Courses and Other Requirements (M.S. and Ph.D.):

All students in Fisheries Science must complete at least three of the five different core courses.

1. *Fisheries Science and Management* – covers the basic principles of aquatic productivity, fish/invertebrate population biology, harvest and conservation of resources, assessing yield potentials, and fishery management practices and economics.
2. *Fisheries Ecology* – covers the biological processes that affect productivity, abundance, and distribution of fish and invertebrate resources. Include life history theory, predator-prey relationships, bioenergetics, trophic ecology, and zoogeography.
3. *Aquaculture* – covers the theory and practices of modern aquaculture of fishes and invertebrates. Includes coverage on water quality, production systems, extensive and intensive approaches, culture genetics, fish disease, and management.
4. *Quantitative Fishery Science* – covers the basic principles of population dynamics.
5. *Graduate Level Course in Oceanography (physical, chemical, or biological) or Limnology* – covers major and minor elements, composition of seawater, seawater ionic structure and interactions, nutrient distributions, biogeochemical cycles, and biology of marine organisms.

In addition, the following core courses are required:

6. One course from one of the other MEES AOSs
7. One course or seminar in Management, Policy, Ethics, or Philosophy
8. One course in Statistics/Biostatistics
9. One seminar for each year in the program
10. Courses in experimental design and analysis and scientific writing are recommended

Oceanography

The current expertise in oceanography in the University System of Maryland lies in the subfields of Biological and Physical Oceanography. The expertise in Biological Oceanography includes water column nutrient cycling and trophic dynamics (comprising the entire pelagic food web and fishes), benthic ecology, and theoretical ecosystem analysis. Physical and biological oceanographers work closely together to understand the dynamics of estuarine, coastal, and ocean systems.

Fundamental courses in the four major subfields of oceanography are required to provide interdisciplinary breadth, but a degree in the Oceanography AOS emphasizes the student's independent research. Students graduating from the Oceanography AOS can expect to find jobs in universities, oceanographic laboratories, government agencies, and consulting firms.

Physical Oceanography Prerequisites:

A Bachelor's degree in a physical science, along with:

1. Two semesters of Calculus
2. Two semesters of Physics
3. One or two additional advanced math courses
4. One or two additional advanced physical science courses
5. Two semesters of Introductory Biology and/or Chemistry are highly recommended

Core Courses and Other Requirements (M.S. and Ph.D.):

1. One 3-credit course in Physical Oceanography
2. One 3-credit course in Biological Oceanography
3. One 3-credit course in Chemical Oceanography
4. Two 3-credit courses in Oceanography or related fields including
 - a. One course in rotating fluid dynamics
 - b. One course in non-rotating fluid dynamics
5. One course in Statistics/Biostatics
6. One course or seminar in Management, Scientific Philosophy, or Ethics
7. One seminar for each year in the program
8. Courses in experimental design/analysis and scientific writing are strongly recommended

Biological Oceanography Prerequisites:

A Bachelor's degree in the natural or life sciences, along with:

1. Two semesters of Calculus
2. Two semesters of Introductory Chemistry
3. Two semesters of Organic Chemistry or Biochemistry
4. Two semesters of Physics
5. Two semesters of Introductory Biology

Core Courses and Other Requirements (M.S. and Ph.D.):

1. One 3-credit course in Physical Oceanography
2. One 3-credit course in Biological Oceanography
3. One 3-credit course in Chemical Oceanography
4. Two 3-credit courses in Oceanography or related fields
5. One course in Statistics/Biostatistics
6. One course or seminar in Management, Scientific Philosophy, or Ethics
7. One seminar for each year in the program
8. Courses in experimental design/analysis and scientific writing are strongly recommended